ROTARY TRANSFORMERS.

CONSTRUCTED BY THE WESTINGHOUSE ELECTRIC COMPANY, PITTSBURG.

(*For Description, see Page 6.*)

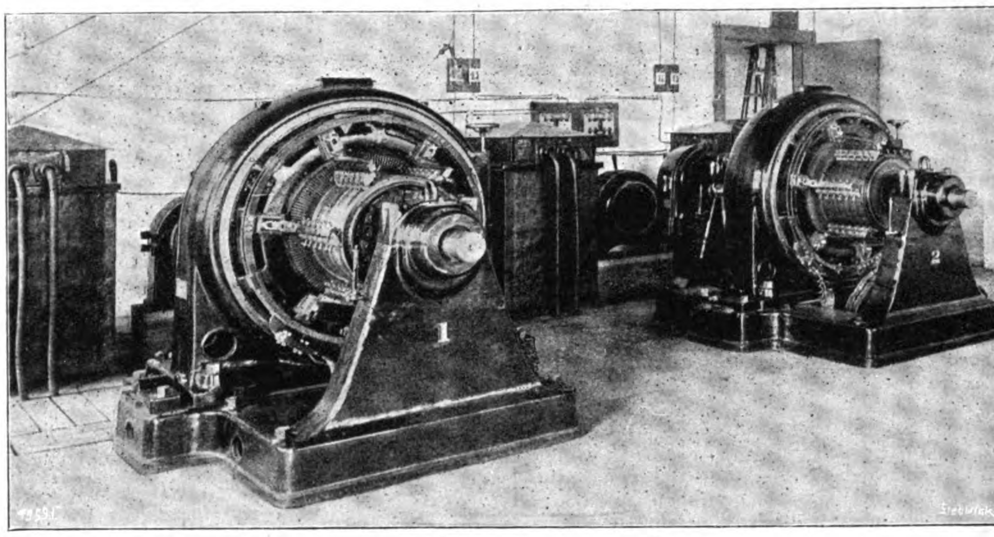
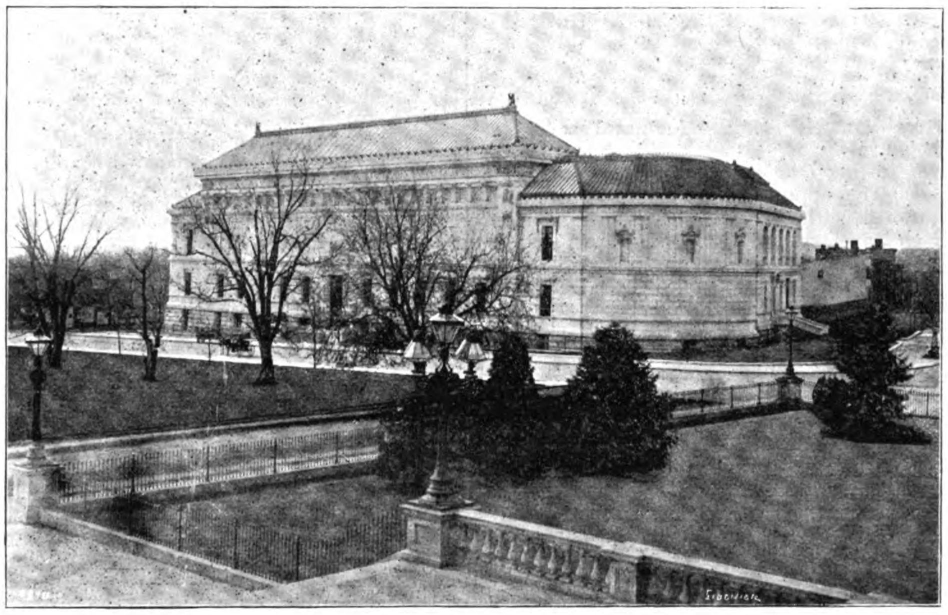


FIG. 40.

the Maria Teresa, and Professor Aldrich of the equipment and work of the Vulcan. At the April meeting an illustrated paper was presented by Mr. Arthur L. Rice on the history of the compression and liquefaction of gases, with special reference to the liquefaction of air, supplemented by those experiments that have been so generally made public in this connection.

The committee that has this movement in charge consists of B. C. Ball, Arthur L. Rice, Percy Allan, F. E. Frothingham, and the secretary of the society as advisory members.

These meetings are to be continued next winter, being held on the first Tuesday evening of each month (except December) at the Society's house in New York. The



THE CORCORAN ART GALLERY, WASHINGTON. (*See Page 7.*)

subjects for next winter's meetings, which have been already selected, are "The Gas Engine," "Bearing Metal Alloys," "Cast-Iron Piping *v.* Steel," and "Mechanical Stokers." Complete reports of the Transactions at these meetings are made and filed in the Society's library.

The first paper was then offered. It was entitled

STANDARDS FOR DIRECT-CONNECTED GENERATING SETS,

by J. B. Stanwood. After showing the great value, from an industrial standpoint, resulting from the extended applications of standards, which not only made production more rapid but cheaper, the author pointed out the confusion and delay resulting from their absence, and then proceeded to set forth the prominent factors in this plan. He said:

What are the features that need standardisation? First, for the use of the outside engineer there is a need for a standard series of capacities and speeds; and, second, those parts of the engine and generator which have to be connected or fastened together should be standardised for each different size to facilitate the assembling of the combined machine or set.

1. *a*, Relative to a standard series of capacities and speeds, the different capacities or sizes should be selected to satisfy the usual demands of the market. The number of different sizes should not be too large, in order that the cost of production may not be enhanced by too great a variety of both generators and engines.

In this connection there might be a standard method of determining the capacity of a generator, which would designate, with a given load or percentage of overload, a given time limit within which a permissible increase of temperature of the field coils, armature, and commutator can occur.

(*b*) Relative to speeds, there should be at least three classes of speed, for each size of capacity of generator, corresponding in the main to the three classes of engines now on the market. These are known respectively as slow, medium, and high-speed engines. By arranging the generator speed in this manner, most of the conditions arising in practice could be met. There would be slow speed for factory, manufacturing, or street-railway service, which would be expensive, but durable and easily tended. A medium speed could be used for lighting plants or conditions where lower first cost and a more limited space exist, but which will require closer attention, and will probably be less durable. Lastly, the high-speed "set" would be required for limited space, low first cost, but it will require close attention, and will probably be subject to heavier repairs.

Perhaps a series of generators could be arranged so that, by a modification in windings only, a given size for a standard slow speed could be used for larger standard sizes, at standard medium and high speeds.

2. As to the standardisation of the dimensions of those parts of the engine and dynamo which are connected together, there are: (*a*) The shaft diameter and armature bore, which should both be expressed in thousandths of an inch; (*b*) the length of shaft outside of the engine, and the location thereon of the outboard bearing, should be given in inches and feet; (*c*) the distance from centre of armature to sub-base, in inches; and (*d*) the length and width of generator base, and the size and location thereon of the bolts which attach it to the sub-base, are probably all that are required.

Such a system would materially reduce the complication of construction and erection. A smaller number of engines with their sub-bases and generators would be required. These, in the marketable sizes, could be carried in stock ready for any combination, thereby permitting manufacturers to avail themselves of multiple production, so great a factor in reducing costs, improving quality, and facilitating delivery.

An American system of standards well introduced abroad and at home might give to us a large share of the electrical and engine business of the world.

In this connection, it seems to me that our Society and the American Institute of Electrical Engineers are the proper authorities to undertake such an investigation as will, by their recommendation, bring about such a result.

To initiate a movement for this purpose, I do move that the Council be requested to communicate with the American Institute of Electrical Engineers, to ascertain if that institute will agree to appoint a committee to co-operate with a similar committee to be appointed by the American Society of Mechanical Engineers, to determine upon and recommend a standard series of capacities, speeds, and necessary dimensions for electrical generators for direct connection to steam engines.

And, furthermore, if a favourable response be received, then the President be requested, with the concurrence of the Council, to appoint a committee of the proper size to co-operate with the committee to be appointed by the American Institute of Electrical Engineers for the purpose herewith set forth.

The author's views seemed to strike all favourably, and the motion was carried. It might be stated here, that standardisation in bridge construction may perhaps explain why an American firm has recently obtained two large contracts in England, not only offering the work in one case for nearly half the price bid by English firms, but cutting down the time of delivery to a third. A careful study of their methods would result in a smaller amount of unfounded assertions by the defeated bidders, implying unfair methods not only on the part of the winners, but also on the part of those giving out the contracts.

(*To be continued.*)

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LX.

NAVAL MOUNTINGS FOR QUICK-FIRING GUNS.

THE construction of naval mountings for quick-firing guns is almost as complex a problem as that of breech mechanism; and the complete solution of the question, as illustrated by the most modern types, has been gradual, though always steadily advancing. The conditions to be dealt with are very varied, as they differ with the calibres that range from the 37 and 47-millimetre (1.456 in. and 1.850 in.) guns, to those of medium and large calibres up to the 24-centimetre (9.449 in.). In this article we propose to give a general history of Schneider-Canet mountings for this class of ordnance.

Messrs. Schneider and Canet took a leading part in this work from the beginning, now more than twelve years ago, and they have since then transformed and improved their first types, until those of 1898 embody the successive improvements which have resulted from theoretical investigations and almost daily experiments in the testing ground.

The general characteristics, taken as a basis for the first designs of these mountings, and which, although largely modified, grow more marked in the successive types, are the following:

(*a*) Automatic recoil and return.

(*b*) Use of progressive-acting brakes and recuperators, which absorb all shocks, so that the various parts of the gun and mounting, as well as the firing platform, have only to withstand the minimum amount of strains consistent with the firing conditions.

(*c*) Reduction in the power required for the

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various manœuvres; and grouping together, within easy reach of the gunner, the devices for laying and training handwheels.

(*d*) Reduction to a minimum of weight and bulk, resulting in greater facility for inspection, dismounting, and maintenance.

In order to give a means of comparison, and an illustration of the progress achieved, we have selected some of the earliest types for illustration and description.

Mounting with Brake Cylinder as Gun Housing (Fig. 563, page 12).—In this type the brake cylinder forms the housing which surrounds and supports the gun, the latter being fitted with a ring that acts as a plunger or piston; a spring recuperator compressed by the action of the brake completes the system. The type is illustrated by Fig. 563, page 12, which shows a 10-centimetre (3.937 in.) mounting of this type, the principal data of which are as follow:

Weight of gun	1980 kilog.	(4364 lb)
,, mounting ...	1900 ,,	(4188 ,,)
,, projectile ...	13 ,,	(29 ,,)
,, service charge (smokeless powder) ...	3.5 ,,	(7.7 ,,)
Muzzle velocity in service...	740 m.	(2428 ft.)

This may be considered a gun of medium power. The various parts and the gunners can be protected by a shield of suitable shape and dimensions, that vary according to whether the gun is for service on board ship or for coast defence. It should be mentioned that, by means of a special device, the breech can be opened and closed automatically during the running out of the gun.

The mounting consists of the three following main parts: the gun carriage, the traversing platform, and the bolster or fixed support. For naval mountings this is circular, and is bolted to the deck of the ship; for coast defence it is either fixed to masonry-work or on a wrought-iron base. Its upper surface forms a roller path. The traversing platform rests on the bolster through the interposition of rollers, and consists of two parallel brackets strongly stayed together. The gun-carriage proper is formed of a cylindrical housing, carried by trunnions which rest in the trunnion plates of the traversing platform, the housing forming a closed cylinder, in which the gun moves to-and-fro during recoil and running out. A ring fitted round the latter and provided with openings forms the brake piston. The recuperating cylinder is placed below the housing and is in one piece with it, communication between the two being maintained by a pipe and valve. An air, or a spring, compressor can be used indifferently. During recoil the liquid which fills the space between the jacket and the gun, passes from the rear to the front of the brake piston. The diameter of the gun being larger in the front than in the rear of this piston, the liquid displaced is forced through the connecting pipe, lifts the valve, and enters the recuperator, where, acting on a piston, it compresses the air or springs. When the recoil is finished, the liquid is forced back into the jacket through a narrow passage, and runs out the gun.

For elevating the gun, a shaft with a hand-wheel is provided, mounted on a bracket fitted to the left side of the carriage; this works a pinion through a set of toothed gearing which engages a toothed sector fixed to the jacket, and the centre of which corresponds with the axis of the trunnion. For training, the lateral motion of the system can be effected either by direct action or with the intermediary of transmission gearing. In the first case, the gunner acts on a jointed lever on the left side of the mounting, and by working it to the right or to the left he causes the mounting to turn round on its rollers; previously, however, he slightly presses down the lever, in order to disengage a bar which serves to fix the system in the firing position. In the second case, the lever is replaced by a hand-wheel, which works a pinion through a set of gearing that engages a circular rack on the bolster. In this type of mounting, the lateral sights are fixed to the housing and are not affected by the recoil; the gunner can, therefore, constantly follow the aim during the whole of the service operations, including firing, recoil, and running out.

Figs. 564, 565, and 566, page 13, illustrate a modification of this type of mounting for a 65-millimetre (2.559-in.) 50-calibre quick-firing gun; the slide and bolster are, however, of a particular shape, and there is a special system for elevating the gun.

The base of the mounting has the form of a truncated cone, bolted on the deck; the top forms the circular path for the slide, while in the base is the pivot in which the steel pivoting screw rests that supports the slide, which is guided by a friction ring.

The slide is of cast steel, with two brackets joined at the bottom by a circular plate, and carefully stayed. It is continued downwards by an inverted cone, terminated by a wrought-steel bearing which rests on the rounded head of the pivoting screw; brass friction rings are fitted on all the parts that undergo friction. Side openings cut in the walls of the bolster, and usually closed, enable inspection of the pivot.

The gun is trained by the shoulder on the butt rest, which is fixed rigidly to the slide; part of the length is screwed and is provided with a box-nut, to which is fitted the working hand-wheel; a hollow cylinder surrounds the butt rod, and slides on it governed by the box-nut; it is joined to the gun-housing by a bar which ends above the left trunnion. The whole of this mechanism, under the action of the hand-wheel, causes the gun-housing to turn round on the trunnions, thus giving the required elevation. The system is completed by a sight bracket fixed to the housing, and by a jointed bar which unites the head of the sight to the axis on which the longitudinal bar acts that unites the hand-wheel to the gun-housing.

The gunners and the various parts of the mechanism, can be protected by a shield, the shape and dimensions of which vary according to requirements.

Mounting with Horizontal Slides (Fig. 567).—This type is fitted with fixed horizontal slides; the tangent scale recoils with the gun horizontally, and sighting the gun requires the co-operation of two gunners. These arrangements are not completely in accord with the general conditions of the programme already given, and according to which quick-firing Schneider-Canet guns are usually mounted. They have been reproduced in a small number of guns only. In this type of carriage, elevation and training is effected exclusively by electricity, the motor being controlled by one lever. The present description applies to 15-centimetre (5.905-in.) guns, shown in Fig. 567, page 12:

Weight of gun	6300 kilogs.	(13,885 lb.)
,, mounting ...	4650 ,,	(10,248 ,,)
,, projectile ...	40 ,,	(88 ,,)
,, service charge (smokeless powder) ...	10.5 ,,	(23 ,,)
Muzzle velocity in service...	740 m.	(2428 ft)

A suitable shield is made for naval and coast-defence guns.

The mounting consists of the three main parts, as usual. The upper face of the traversing platform is made with two horizontal bearing surfaces on which travel the horizontal slides. These are provided with cylindrical rollers, to facilitate the displacement of the cradle during the recoil and running out of the gun. The cradle contains the lateral brake cylinders, and also the recuperator placed below and in the centre line of the system. The brakes have central counter-rods, and carry the trunnion-plates in which are placed the gun trunnions. The piston-rods are fitted in the front of the travelling platform. The recuperator cylinder is provided with lugs in front, to which are fastened the spring bars. A piston, the rod of which is fixed to the front of the traversing platform, moves in this cylinder during recoil, the cylinder being closed at the opposite end by a movable bottom, on which are bolted the bars that run in the centre of the set of springs. When the gun is fired, the carriage proper runs on the rollers, which are placed slightly above the top surface of the horizontal slides, and the brake cylinders act in the usual way to absorb part of the recoil energy.

The mounting is provided with two sets of gear for elevating and for training the gun, which can be worked by electricity or by hand. For elevating by hand, the device comprises a hand-wheel placed at the rear part of the housing, which works through differential gearing, a pinion that engages a rack fitted to the gun. For training, a hand-wheel is placed in the middle of the left cheek, which works through a set of toothed wheels, a pinion that gears in the circular rack placed inside the traversing platform.

Two small electric motors are provided for working the elevating and training mechanism; but, as working by hand and by electricity are not required at the same time, a lever and clutch are provided that throw one or other in or out of gear. The electric motors are driven by a battery of accumulators. The commutators are arranged in such a way that the gunner, by acting on the lever in the direction he wishes to give to the gun, obtains exactly the position required. The rapidity of the motion is proportional to the angle of displacement of the lever from its original position, the gun being fixed immediately it is suitably laid.

H.M.SS. "HERMES" AND "HIGHFLYER."

We give on page 16 an illustration of the machinery of the second-class cruisers which the Fairfield Shipbuilding and Engineering Company, Limited, Glasgow, have lately completed for the British Navy — the Hermes, which completed her trials on June 13, and the Highflyer which ran her official trials between June 20 and 30. Both ships are identical, and their smart appearance will be seen from the engraving of the Hermes on page 5. The principal dimensions are: Length between perpendiculars, 350 ft.; breadth extreme, 54 ft.; displacement, 5600 tons. There is a cellular bottom extending the full length of the engine and boiler spaces, and before and abaft these the watertight flats of the magazines, &c., continue the double bottom right to the stem and stern. Under the protective deck, the side compartments for the full length of the boiler space are utilised for stowing coal. The hull is subdivided by longitudinal and transverse bulkheads into numerous watertight compartments as usual, the number of watertight doors having been reduced to a minimum, and all being worked from the main deck as well as from below. The sternpost, struts, and stem are of phosphor-bronze. The stem is of the usual ram form, and the structure behind is especially strong and efficiently connected to the general framework of the vessel with a view to the contingency of ramming—the rudder, also of phosphor-bronze, is of the balanced type and controlled by Harfield's compensating gear below the protective deck. The vessel being intended for foreign service and long cruises at sea, in which the maintenance of a uniform speed becomes essential, she has been completely covered to above the load water-line with teak of a minimum thickness of 3½ in., and coppered. To secure steadiness of gun platform, so necessary in a vessel intended for war purposes, bilge keels extending for about half the vessel's length amidships have been fitted.

The protection of the vessel consists of a curved deck extending from stem to stern, ranging from 3 in. to 1½ in. in thickness, covering the whole of the propelling and steering machinery, boilers, magazines, &c. The reserve bunkers are on the protective deck over the machinery space, and whilst affording a water-line belt of coal protection they, being subdivided into watertight compartments, give additional security in the event of damage. An armoured conning-tower of Harveyised steel is placed forward, fitted up with the usual means of navigating the vessel and directing operations while in action, the whole of the connections for which are protected by a steel tube extending to the protective deck. The steel for this tower has been supplied by Messrs. William Beardmore and Co., Parkhead. Three searchlights are operated from these bridges, and the vessel throughout is fitted with a complete installation of electric light. Her armament consists of eleven 6-in., eight 12-pounder quick-firing guns, and a number of smaller machine guns. The guns are all protected by extra-thick shields. Two submerged torpedo tubes are fitted forward, capable of working the latest pattern torpedoes.

The propelling machinery consists of two sets of triple-expansion engines, fitted in two separate engine-rooms, each set having four inverted cylinders and four cranks. The high-pressure cylinders are 26 in. in diameter, the intermediate-pressure cylinders 42 in. in diameter, and each of the four low-pressure cylinders, 48 in. in diameter, all adapted for a stroke of 2 ft. 6 in. The cylinders are all separate and independent castings, each fitted with a cast-iron barrel or liner and steam jacketed. Each of the high-pressure and intermediate pressure cylinders is fitted with piston valves, and each of the low-pressure with flat slide valves, all worked by the usual double eccentric and link motion valve gear. The reversing engines are of the all-round type, capable of being reversed, with worm and wheel gear; all the levers being fitted with a slot and adjusting screw to allow of the expansion of steam in the cylinders being altered. The back columns are of cast iron, fitted with separate guide faces, and the front columns are of forged steel, the engines being arranged with the starting platform amidships. The condensers are of brass and placed at the wings, the steam being condensed outside the tubes. There are two centrifugal pumps of gun-metal, each worked by an independent engine one in each engine-room, and arranged with a cross-connection, so that either or both condensers can be supplied with cooling water from either pump,

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The feed bilge and hotwell engines are all independent and separate from the main engines. Steam is supplied by a special range of auxiliary pipes. Feed-water filters are fitted to prevent any impurities reaching the boilers. The crank, thrust, and propeller shafting is of forged steel and hollow. The crankpins are fitted with centrifugal lubricating apparatus. The propellers are of gun-metal, each propeller having three adjustable blades.

Steam is supplied by 18 Belleville water-tube boilers of the latest type fitted with economisers, and adapted for a working pressure of 300 lb. The boilers are arranged in three boiler-rooms, and there are three funnels. Fans and engines are fitted in the stokeholds to insure the necessary supply of air, air pumping engines being also fitted to deliver air direct into the furnaces and combustion chambers.

The vessel is also fitted with the usual auxiliary machinery, viz., a complete distilling plant to supply fresh water to the boilers, and also for drinking purposes; two sets of engines and dynamos for producing the necessary current for electric lighting; one double-cylinder engine with the necessary gear for steering purposes; two complete sets of air-compressing engines and pumps, with the air reservoirs, for charging torpedoes; and one refrigerating machine of the cold-air type, with the necessary cold chamber for ships' provisions. As we explained in connection with the earlier trials of the Hermes, the exhaust steam from all of the auxiliary engines in the machinery room, including the steering engines, can be utilised for evaporation or other uses.

With the Hermes' trials we dealt at some length on page 745 of our last volume. Since then, however, the vessel has made two runs, one at low power, because on the former occasion the conditions did not admit of reliable results being realised; and, as will be seen from the Table of results appended, the coal consumption was greatly reduced, being 1.78 lb. The second supplementary trial was run at 9000 indicated horse-power, with the exhaust steam from the auxiliary machinery passing into the low-pressure receiver of the propelling engines, an arrangement which gave satisfaction.

Mean Results of Additional Trials of H.M.S. "Hermes." (Built and Engined by the Fairfield Shipbuilding and Engineering Company, Limited, Glasgow).

—	Second 30 Hours' 2000 I.H.-P. Coal Consumption Trial.		Eight Hours' Trial at 9000 I.H.-P., with Auxiliary Machinery Exhaust Steam Passing to the Low-Pressure Receivers of Main Engines.	
Date of Trial	June 9 & 10, 1899		June 13, 1899	
Mean steam in boilers .. lb.	196		270	
,, ,, at engines.. ,,	126		247	
	starbd.	port	starbd.	port
,, cut-off in high-pressure cylinder .. .. per cent.	35	32.7	56	56
Mean vacuum .. .. in.	26.0	27.0	25.1	25.2
,, revolutions per minute..	111.2	110.6	174.4	176.8
Mean pressure in cylinders { High .. lb.	40.2	35.0	105.0	96.6
Intermediate ,,	16.1	15.9	31.2	31.7
Low forward ,,	6.86	6.21	23.0	21.8
Low aft .. ,,	5.78	5.47	19.5	19.6
Indicated horse-power { High	360	312	1470	1374
Intermediate ..	377	362	1143	1176
Low forward ..	209	189	1099	1058
Low aft.. ..	176	166	934	949
Gross total indicated horse-power	2151		9203	
Coal per indicated horse-power per hour .. .. lb.	1.78		1.52	
Speed per hour .. .. knots	13.4		20.0	

The Highflyer trials gave even more satisfactory results, the coal consumption being unprecedentedly low on the full-power run, when the boiler pressure was maintained at 292 lb. and at the engines the mean was 228 lb. The links were set to cut off at 74 per cent. of the stroke, and the starboard engine running at 187.6 revolutions made 5262 horse-power. The port engine ran at 186.5 revolutions. It will be noticed from the Table that the power got from the high and intermediate cylinders is almost equal, while the powers of the low-pressure cylinders also closely approximate each other. The variation is practically within the limits of error. This same remark holds good as regards the other trials, the low pressure cylinders each giving about 66 per cent. of the power indicated in each of the high and intermediate. This arrangement gave most satisfactory results as regards engine balancing, there being practically no vibration. The collective power on this trial was 10,344 horse-power. The speed of the ship was 20.1 knots, which more than meets the expectations of the design. On the 30 hours' trial at continuous sea speed, the steam pressure was 260 lb., and at the engines it was reduced to 223 lb. The cut-off was arranged at 56 per cent. of the stroke, and at 169.7 revolutions the starboard engine gave 3828 horse-power, while the port engine recorded 3816 for 168.1 revolutions. The collective power was thus 7644 indi-

Mean Results of Trials of H.M.S. "Highflyer" (Built and Engined by the Fairfield Shipbuilding and Engineering Company, Limited, Glasgow).

—	Contractors' 30 Hours' 2000 I.H.-P. Coal Consumption Trial.		Contractors' 30 Hours' 7500 I.H.-P. Coal Consumption Trial.		Contractors' 8 Hours' Full-Power Trial at 10,000 I.H.-P.	
Date of trial	June 20 and 21, 1899		June 22 and 23, 1899		June 27, 1899	
Mean steam in boilers lb.	214		260		292	
,, ,, at engines ,,	125		223		228	
,, cut-off in high-pressure cylinders ..	34 per cent.		56 per cent.		74 per cent.	
	Star.	Port	Star.	Port	Star.	Port
Mean vacuum .. in.	26.5	26.0	25.4	26.1	25.6	25.4
,, revolutions ..	110.1	110.4	169.7	168.1	187.6	186.5
Indicated horse-power { High	346	320	1313	1265	1610	1523
Intermediate	341	360	1087	1157	1515	1513
Low forward	202	191	724	719	1067	1040
Low aft ..	190	185	704	675	1070	1006
Gross total indicated horse-power	2135		7644		10,344	
Coal per indicated horse-power per hour lb.	1.62		1.49		1.407	
Speed per hour .. knots	12.5		19.4		20.1	

cated, while the speed of the ship was 19.4 knots. The addition, therefore, of 2700 indicated horse-power to the power, equal to 34 per cent., barely added three-quarters of a mile to the distance run in each hour. This 19¼ knots speed was got for an expenditure of 5 tons of coal per hour, which, in view of the displacement, 5600 tons, is a very satisfactory result, proclaiming not only a high mechanical efficiency, but a beautiful form of ship and great propulsive efficiency. On the low-power trial it was preferred to work the boilers at a high-pressure, reducing it greatly at the engines and cut-off steam in the cylinders at a comparatively late period of the stroke, rather than with a high initial pressure and an early cut-off. The steam pressure was, at the boilers, 214 lb., and at the engines, 125 lb.; this latter enabling the simple auxiliary engines to be worked at a better economy. Sir John Durston, K.C.B., the engineer-in-chief, was present at the trials, with Mr. J. Smith, inspector of machinery, Mr. Ellis and Mr. Gregory for the Devonport Dockyard, and Mr. Frost for the steam reserve. Mr. Alexander Gracie, the engineer manager at Fairfield, as well as Sir John Durston, is to be congratulated on the results in both ships.

AMERICAN LOCOMOTIVES FOR THE MIDLAND RAILWAY.

MUCH interest has naturally been manifested in order given to American firms for goods locomotives for the Midland Railway, and hence we are glad to be able to publish with our present issue a two-page plate, on which are reproduced drawings of the engines constructed for the Midland line by Messrs. Burnham, Williams, and Co., of the Baldwin Locomotive Works, Philadelphia. The number of engines ordered from the Baldwin Works was thirty, and of these ten have already been received at Derby. They were shipped within ten weeks of the drawings being approved by Mr. S. W. Johnson, the locomotive superintendent of the Midland Railway. Of the engines received, one has been put to work, and the remainder are in course of erection.

In giving the order for these engines Mr. Johnson stipulated that the fireboxes, firebox stays, and tubes should be of copper, that the engine and tender wheels should have steel centres, and should, with the tyres, be of the Midland pattern; that the injectors, steam sanding and brake apparatus, and the water gauges should be also of Midland patterns, and that the wheels of the pony truck should be wrought iron with steel tyres. In other respects the makers were left free to adopt their regular practice, subject, however, to their detailed drawings being approved by Mr. Johnson. The necessities imposed by the English loading gauge had, of course, also to be satisfied.

The result of these conditions is shown by our engravings, from which it will be seen that the engines are of the six-wheel coupled type with outside cylinders and a pony truck at the leading end. The makers have retained the American bar-frames stayed at the leading end to the sides of the smokebox and at the rear end to the back of the firebox casing by diagonal braces, as shown in Figs. 1 and 4. The springs of the coupled axles are arranged above the frames and those of the driving and trailing axles are coupled by compensating beams. A series of compensating levers also connects the front ends of the springs of the leading coupled axle with the pony truck, as shown in Figs. 1 and 2. The same views also show the construction of the pony truck itself and the arrangement of its springs, which are helical. It will be noticed that the springs and compensating beams all transmit pressure through knife-edge bearings—as is usual in American practice—there being no pin connections. The guides for the axle-boxes of the coupled axles are all fitted with adjusting wedges.

The arrangement of the cylinders and the mode of fixing them is shown in Figs. 1 and 2, and will be seen to be in accordance with ordinary American practice. The cylinders are 18 in. in diameter with 24 in. stroke. The slide valves, which are of the balanced type, are placed above the cylinders and are driven through rocking shafts, as shown. The chief dimensions of the valve gear and the sizes of crosshead slides, crankpin bearings, &c., are given in our engravings.

The boiler is marked by no very special features. It is of the flush-topped type with a barrel 4 ft. 8 in. in diameter inside the largest ring, and its centre is 7 ft. 2⅝ in. above rail level. The connection between dome and boiler barrel is made by a thick flanged ring, as shown in Fig. 1. The use of the bar frames has, of course, reduced the width of the lower part of the firebox casing, the grate being thus long and narrow. The firebox is, as we have already stated, of copper, and the crown is supported by transverse girder stays and numerous sling stays, as shown in Figs. 1 and 4.

The design and general construction of the cab, side foot-plates, and other general details are so clearly shown by our engravings that further description will be unnecessary. The engines are accompanied by tenders, each mounted on two four-wheeled trucks. The chief dimensions of the engines and tenders are as follow:

Cylinders:	
Diameter	1 ft. 6 in.
Stroke	2 ,, 0 ,,
Length of ports	1 ,, 4 ,,
Width of steam ports...	0 ,, 1¼ ,,
,, exhaust ports	0 ,, 2⅜ ,,
From centre of cylinder to valve face	1 ,, 3¼ ,,
Wheels and Axles:	
Diameter of coupled wheels... ...	5 ,, 0 ,,
,, pony truck wheels ...	2 ,, 9 ,,
Wheelbase of coupled wheels ...	14 ,, 9 ,,
Total wheelbase	22 ,, 2 ,,
Diameter of bearings of coupled axles	0 ,, 7 ,,
Length of bearings of coupled axles	0 ,, 8 ,,
Diameter of bearings of pony truck axle	0 ,, 5 ,,
Length of bearings of pony truck axle	0 ,, 10 ,,
Boiler:	
Diameter of barrel (mean)	4 ,, 8 ,,
Thickness of plates (steel)	0 ,, 0⅝ ,,
Length of inside firebox	6 ,, 0 ,,
Width of inside firebox at bottom ...	2 ,, 9¼ ,,
Width of inside firebox at centre line of boiler	4 ,, 0½ ,,
Thickness of tubeplate (copper), upper part	0 ,, 0¾ ,,
Thickness of tubeplate (copper), lower part	0 ,, 0½ ,,
Thickness of side and crown plates	0 ,, 0½ ,,
Length of tubes	10 ,, 5¾ ,,
Diameter of tubes	0 ,, 1¾ ,,
Number	263
Heating and Grate Surface:	
Firebox surface...	125.3 sq. ft.
Tube ,, ...	1247.1 ,,
Total	1372.4 ,,
Firegrate area	16.6 ,,
Working pressure	180 lb. per sq. in.
Tender:	
Diameter of tender wheels	3 ft. 0 in.
,, axle bearings	0 ,, 4½ ,,
Length of ,, ...	0 ,, 8 ,,
Capacity of tank	3000 gallons
Weights:	
Weight on coupled wheels	83,100 lb.
,, pony truck wheels ...	17,150 ,,
Total	100,250 ,,
Total weight of engine and tender...	179,550 ,,

WORKINGTON DOCK.—A new deep-water dock at Workington is proposed to be built by a syndicate, at the head of which are Messrs. Steer, Lawford, and Co., London. The Workington Town Council will subscribe 150,000*l*. The dock is to be built on the north side of the town, and the syndicate will buy out Lord Lonsdale's present dock and harbour. These terms have been approved by the Town Council and ratepayers.

BRADFORD SEWAGE.—On Friday a Select Committee of the House of Commons further considered a Bill for the confirmation of a provisional order granted by the Local Government Board giving the Town Council of Bradford powers to compulsorily acquire 529 acres of the Esholt estate, the property of the Misses Stansfield, for the purpose of sewage works. The Misses Stansfield, it will be remembered, opposed the scheme on the ground that it was unnecessary in the public interest to take their land and deprive them of their home. They refused to enter into the question of purchase by agreement, and submitted an alternative proposal to the Committee by which the Council might establish a sewage farm on land adjacent to the estate at Baildon. Counsel on both sides having been heard, the Committee decided that the preamble of the Bill had not been proved.

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MOUNTINGS FOR 10-CENTIMETRE AND 15-CENTIMETRE GUNS.

(*For Description, see Page 9.*)

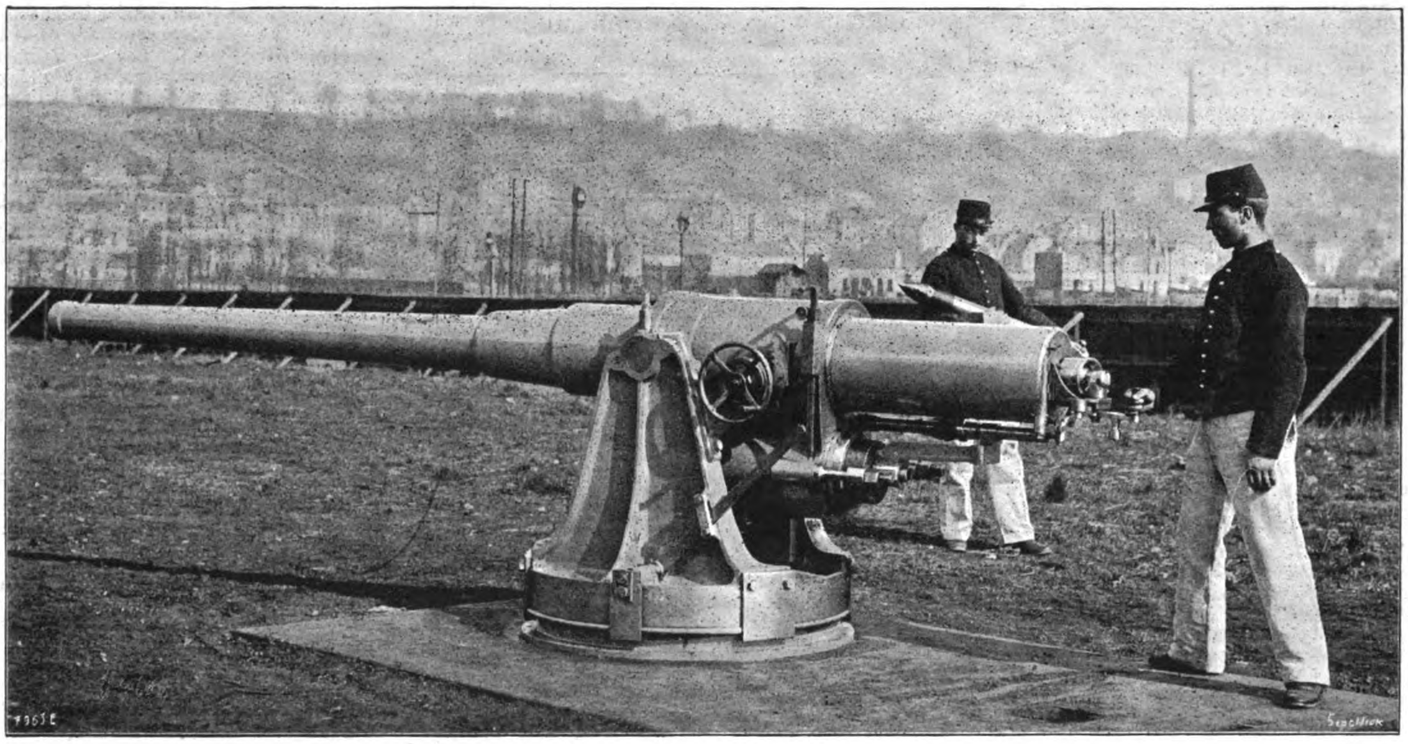

FIG. 563. MOUNTING FOR 10-CENTIMETRE GUN, WITH HOUSING USED AS BRAKE CYLINDER.

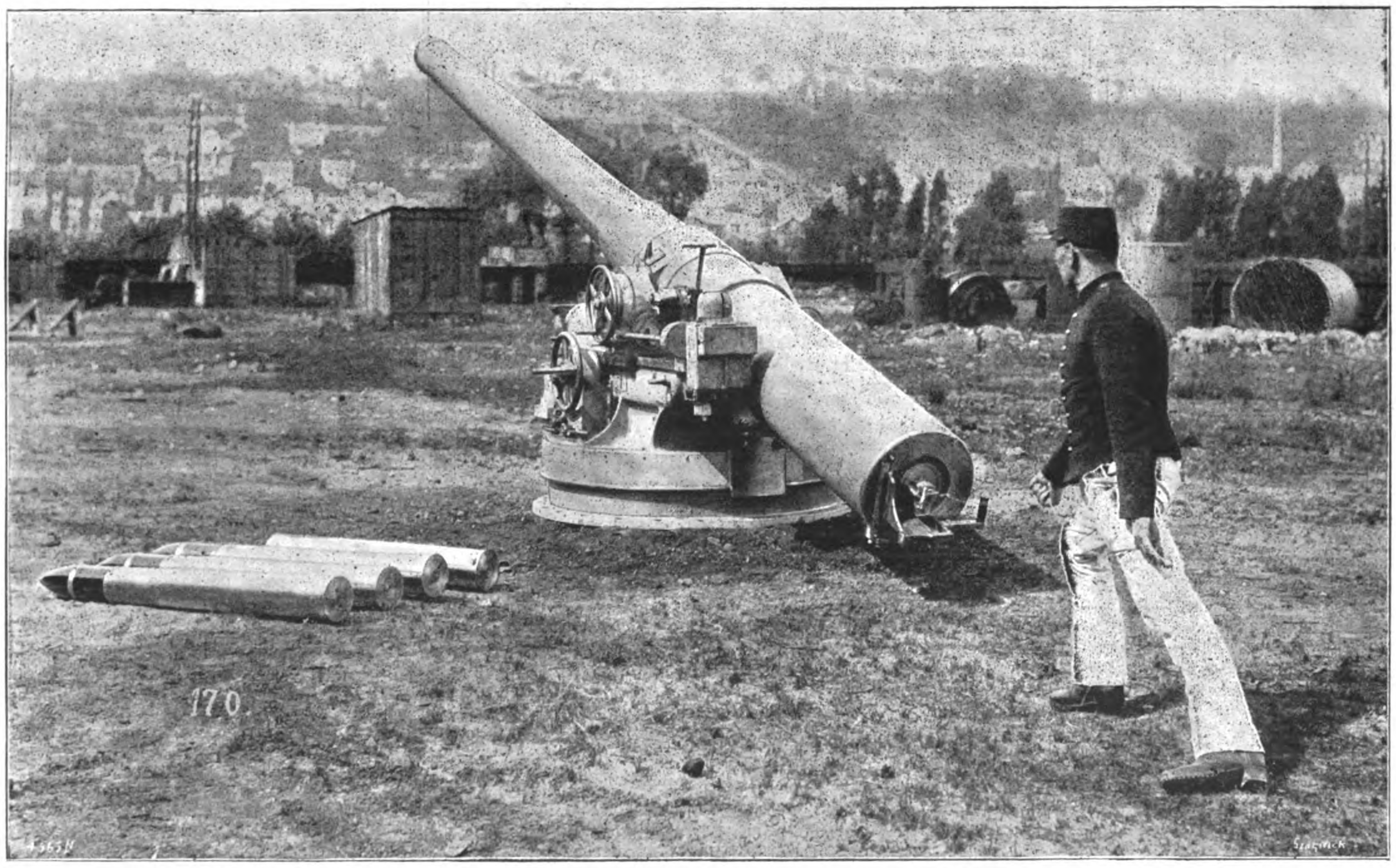

FIG. 567. MOUNTING FOR 15-CENTIMETRE GUN, WITH HORIZONTAL SLIDE.

NOTES FROM THE UNITED STATES.

PHILADELPHIA, June 28.

THE steel market has touched the highest range of prices yet known. Quotations for steel billets are given at 33 dols. and 34 dols. at mill, which means 36.50 dols. at tide water. No steel is to be had at these or any other figures. Open-hearth steel billets are selling at 40 dols. at mill, and the enormous demand continues. Mills have six to seven months' work ahead, and business is piling in without any sign of cessation. All kinds of manufactured iron continues to advance. Bessemer pig has taken another leap, and is quoted at 19 dols. It might as well be any other price as there is none to be had, all iron being sold up to the end of the year and into 1900. Consumers are everywhere running in a hand-to-mouth way, being in danger of enforced suspension from absence of material. At present there is a rush of orders for 1900 delivery. The question will soon hinge on the supply of ore. Extraordinary efforts are now being made to very greatly increase the ore production for 1900, and at this time it is impossible to say how much the increase will be. The present prices of iron and steel represent the largest margins ever realised. There is a strong probability that these margins will increase month by month until the climax is reached, when a more or less disastrous

MOUNTING AND TRAINING GEAR FOR 65-MILLIMETRE 50-CALIBRE GUN.

(*For Description, see Page* 9.)

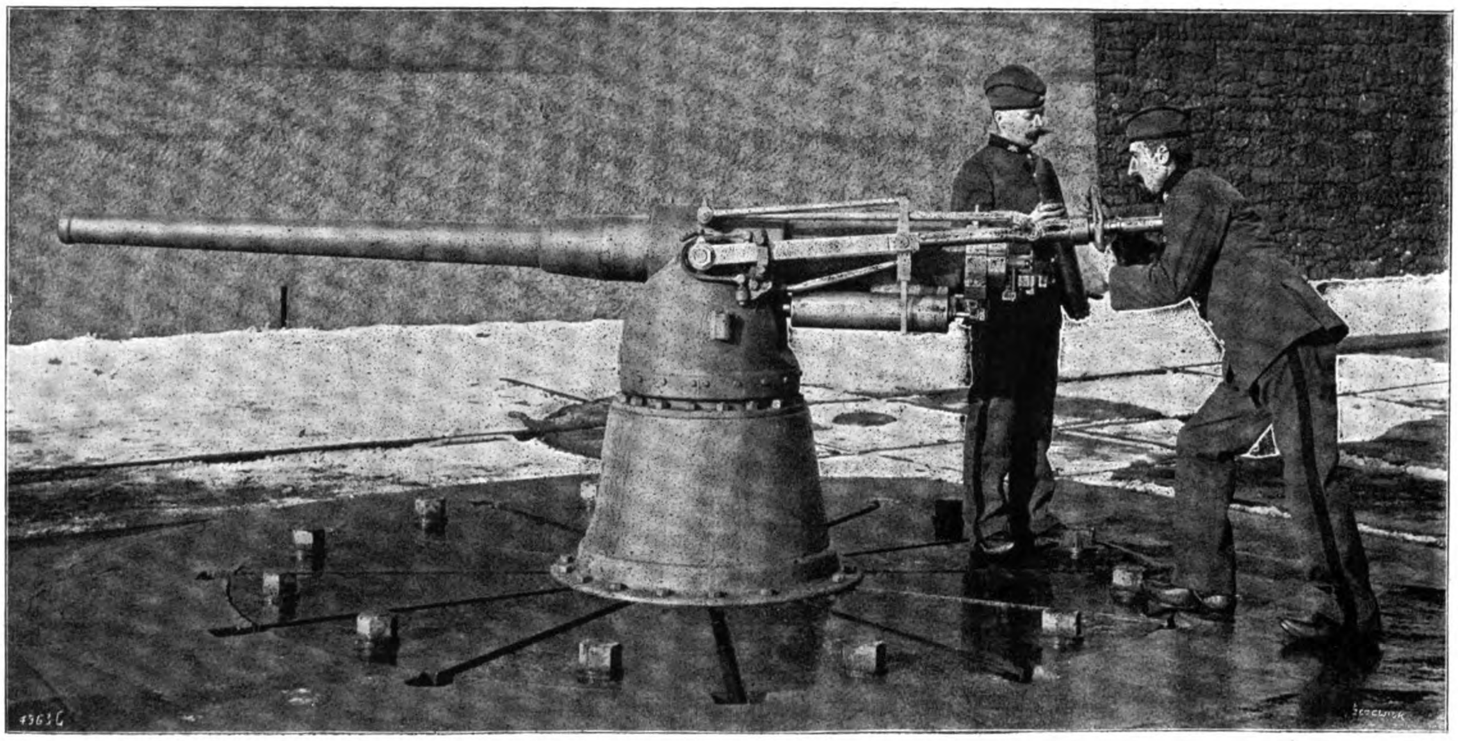

FIG. 564.

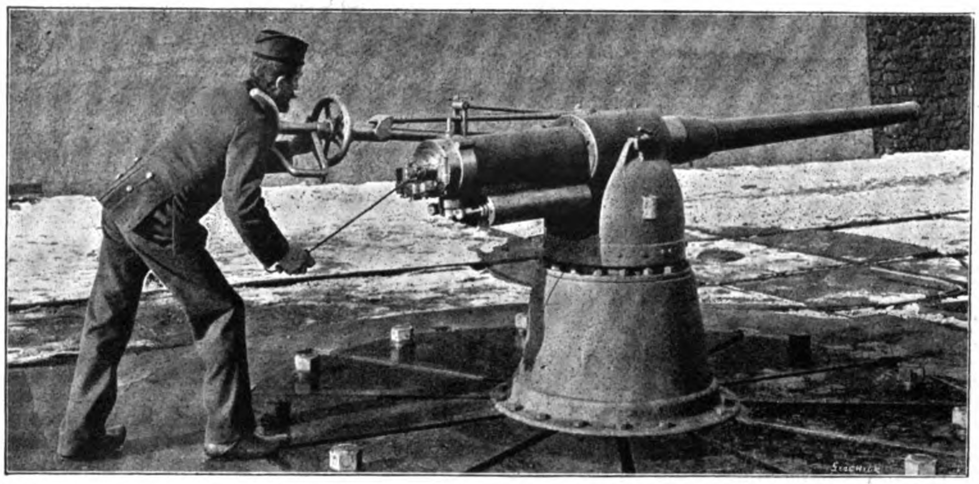

FIG. 565

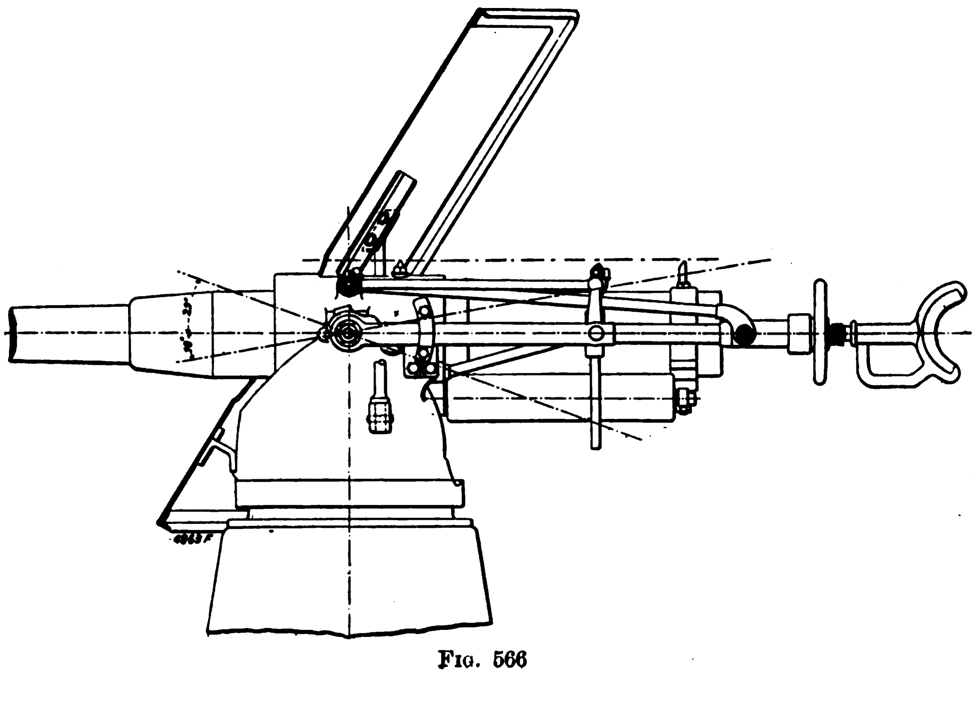

FIG. 566

tumbling of prices will take place, as has been the case in all previous eras of expansion and contraction. Reports received at Pittsburg from all parts of the country state that iron and steel products in all markets have been cleared up to the last pound. All the warehouses are barren of stocks. All prospects point to an increasing consumption during the remainder of the year. Mills are overrun with business, and finished material of all kinds are advancing. Blast-furnace production has passed the 260,000 per week mark. Steel rail production is at maximum for the present. A very heavy demand for girder rails for tramways is in sight. Japanese requirements for 12,000 tons standard sections are before us. Large orders for shipbuilding material will be placed in a few days. The shipyards have two years' work in sight, and within the coming six months three new yards will be under way. The activity in mining industries is phenominal. The Alaska and British American mines are attracting a great deal of labour and capital. Copper and zinc developments are keeping the excitement in that direction at fever heat. The consumption of both minerals is steadily increasing, and new properties have been bought up during the past few days at prices that appear on the surface to be fabulous. The production of anthracite and bituminous coal and coke is increasing steadily, though for coal there is scarcely any improvement in prices. Coke is advancing, and a number of new and large coke-producing properties will be in operation in a few months.

NOTES FROM THE NORTH.

GLASGOW, Wednesday.

Glasgow Pig-Iron Market.—The forenoon market was in an excited state last Thursday, and about 35,000 tons of pig iron changed hands, and at further sharp advances, the quotations being higher than at any time since 1880. Scotch warrrants closed at 70s. 7d. per ton buyers. Cleveland and hematite iron also advanced considerably. There were also some sharp movements in the afternoon, and finally the morning improvement was more than lost. The turnover was about 20,000 tons, and the settlement quotations were: Scotch, 69s. 3d.; Cleveland, 68s.; Cumberland and Middlesbrough hematite iron, 74s. 4½d. and 72s. 9d. per ton. A moderate amount of business was done on Friday forenoon, and prices, while firm, were of a much less excited character than for the two previous days. There was a turnover of about 20,000 tons, and advances of 4½d. to 7½d. per ton were recorded. In the afternoon the market was irregular, opening firm, going flat, and rallying again, but closing from 2d. to 6d. per ton down from the forenoon finish. The sales were again some 20,000 tons, and the settlement quotations were 69s. 4½d., 68s. 6d., 74s. 3d., and 72s. 9d. per ton. Business was less active on Monday forenoon, and owing to the trade advices from America timid operators were inclined to hold off. Only some 10,000 tons were included in the afternoon operations. The different

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trate in Fig. 33, on page 460, a circular milling machine.

The Small Tool Grinding Department is, as we have already stated, illustrated by Fig. 36, on page 460. The machines here are mostly Messrs. Brown and Sharpe's manufacture. The same care is exercised in this room for carrying away dust, as in the other grinding shop already mentioned, there being exhaust ducts throughout, and hoods covering the parts being operated upon. Dry grinding is used on nearly all the surface work, and wet grinding for cylindrical work. A magnetic chuck is found most serviceable for thin parts, as it has the advantage of fixing the work immediately, and holds it firmly without distortion. In this way flat pieces are ground for height gauges, or measuring strips, down to 0.85 millimetres thick. They are brought nearly to truth, being tested by micrometer gauges, and are afterwards lapped absolutely true to size, after which the parts are demagnetised. There are special machines for grinding holes and for face grinding. There are also special surface grinders and snap-gauge grinders.

Gauges, Jigs, and Fixtures.—In the small tool factory there are departments for special jigs and fixtures which may be required in the manufacture of any particular kind of work or article that a manufacturer may have to produce. At the time of our visit a complete set of gauges had just been completed for an English firm, and these we had an opportunity of testing. Of the limits allowed we have already given examples in describing our illustrations. The snap gauges are of one standard, the distinction between running and driving fits being made in the holes, the tolerance being $\frac{2}{1000}$ in. A set of arbors had also been manufactured to go with the gauges. We tried a plug gauge into a standard ring, the diameter being $\frac{7}{8}$ in. This gave a good fit, the ring not dropping off by its own weight, though it would turn easily. The standard plug was then put in the ring, and so long as it was kept turning it could be withdrawn, but if allowed to stop it set fast. This, of course, is a well-known phenomenon. With a $1\frac{3}{8}$ in. arbor 8 in. long, having a taper on it of 1000th of an inch long, it would be quite easy to detect the variations in diameter by means of a snap gauge, even in the hands of the clumsiest workman. This illustrates the value of accurate gauges as a means of producing the closest work with the aid of unskilled labour. Naturally, with ordinary callipers, such close measurements cannot be made. The arbors for turning are themselves turned and ground with great accuracy. The limit gauges, already described, are, however, now used for turning, as well as grinding, and the greater accuracy thus obtained by the use of these snap gauges leaves the grinding machine less to do; and, moreover, as a uniform amount of metal has to be removed, the grinder knows when the machine will finish the job, and can, therefore, work more rapidly and intelligently. Another advantage is obtained in the case of parts that have to be case hardened, for when the piece is accurately made at first there is less to grind away, and the hard skin therefore remains of a uniform thickness. Such matters as these seem almost unnecessary refinements; but when we learn from Messrs. Loewe that it has been found by experience that 30 per cent. is saved on the cost of labour for turning when the system is properly carried out, it puts the matter in an entirely new light. As a matter of practice, there are plenty of turners who work as close to accuracy as within the difference in the ends of the plug gauge already referred to. The one-eighth of $\frac{1}{1000}$ in. variation is easily felt when parts are fitted together. But they have to be fitted together, and this involves time and labour, in addition to which the advantage of interchangeability is lost. With the snap gauges and plug gauges for holes, the work need not be removed from the machine for testing, and when finished, any part can be substituted for another similar part. Another order that was in hand at the time of our visit involved the fitting up of a large Continental locomotive factory with sets of complete gauges of the nature described, as well as the supply of a large number of small tools. There were several sets of thread gauges, such as those illustrated in Figs. 30, 31, and 32, already referred to; these being found exceedingly valuable for maintaining accuracy. On one end is a cylindrical hardened and ground plug; this gauges the hole and forms the smallest diameter between the thread when the hole is tapped. The drilled hole is made somewhat larger as the tap squeezes the metal up, the difference being about $\frac{1}{10}$ millimetre. On the other end is the thread gauge for holes. For testing outside threads the gauge is slotted through the hole and a dowel pin with adjustable screws for pressing in or opening out the slot is used. It may be said that the gauges for the International Standard Thread Commission on the Metric System were worked out here. An accurate angle of 60 deg. was first obtained by forming a triangle with sides exactly equal. The operation was a very tedious one, and took a long time to perform; but the standard piece having been obtained it constituted a former or "copy" from which smaller parts could be ground accurately, and these pieces could then be used as cutters for work. To carry out the operations it was necessary that instruments of extreme precision should be used, and with these the department is most adequately equipped.

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXVIII.

Schneider-Canet Naval Turrets.

This is an important branch of the Schneider-Canet system of armament, both as regards the improvements carried out in successive turrets built, and the large number, for all calibres of guns, that have been supplied to the French and various foreign Governments. The Schneider-Canet system was the first to embody balanced turrets with a central tube, and constructed to work either by electricity or by hand. The present section of this series of articles is therefore of special interest and we shall classify it, in order to facilitate the description of the various types, under the three following heads:

I. Hydraulic, non-balanced turrets, for loading in all positions.

II. Hydraulic, balanced turrets, with central tube, for loading in all positions.

III. Electrically working turrets.

I. Hydraulic, Non-Balanced Turrets, for Loading in all Positions.

As a type of this the Schneider-Canet turrets for 138.6-millimetre (5.456-in.) guns may be taken.

The turret consists of a platform with a conical wrought-steel socket, the gun mounting, a hoist with loading platform, a means for the discharge of empty cartridge-cases, and the mechanisms for lateral training and elevation of the gun. One side of the turret space is set aside for delivery of ammunition to the gun and the discharge of empty cartridge-cases, the other side being reserved for operating the breech-block, and the elevating and training mechanism. Ammunition from the magazines is placed in the hoist on the orlop deck.

The platform consists of two longitudinal and six transverse beams built up of plates and angles, and strongly fitted together with wrought-steel flooring plates; it carries the gun and its mounting with the interposition of a cast-steel bearing, in the sides of which the trunnions are formed. Angles fitted to the ends of the beams round the flooring plates, serve to fix the armour and backing to the platform. The turret is 1.800 metres (5 ft. $10\frac{7}{8}$ in.) high to the springing of the top plates. The conical socket consists of two 12-millimetre (.472-in.) steel plates lap-jointed together; the top enters a steel casting which connects the socket with the platform, and the lower part is closed by another steel casting which forms the pivot support. This pivot is of forged steel; it turns on a bush of hard gun-metal placed inside a gun-metal step bearing, which is bolted to a cast-steel foundation plate. The rotation of the step bearing allows the height of the turret to vary by a few centimetres. The pivot, the step bearing, and the foundation plate are recessed in the centre to receive the pipe that contains the water under pressure. The turret is guided in a cast-steel ring fixed to a guide plate, the joint between the socket and the platform being lined with a gun-metal friction ring which turns inside the cast-steel ring.

The gun mounting is arranged with limited recoil and automatic return; it consists of a trunnion carriage, two recoil slides, and a spring recuperator. The centres of the carriage trunnions and those of the recoil slides are in the same plane, the spring recuperator being placed underneath the carriage. The carriage is of cast steel, in two similar parts, connected vertically in front and at the rear. On the sides are the trunnions on which it is carried and the slides for the slide-blocks. The jointed parts in front and in the rear, form two jackets which serve as guides for the gun. These jackets are placed as far apart as possible, and form very satisfactory guides. They are lined with gun-metal, as also are the lateral slides, in order to reduce friction during recoil and return. The slide-blocks are rectangular, and are placed symmetrically; they contain the brake cylinders; two half rings welded to the blocks unite them together in a vertical plane. These half rings are made with projections which fit in grooves cut in the gun, thus causing the slide-blocks to follow all the motions of the gun. Recoil is absorbed by the two recoil cylinders. The piston-rods in front of the carriage pass through the cylinders from one end to the other, the volume in the brake therefore remaining constant. Grooves of varying sections are cut inside the cylinders to allow the liquid to flow from one side to the pistons to the other; they are calculated in such a way as to offer a practically constant resistance on the whole length of recoil, namely, 250 millimetres (9.842 in.). The recuperator consists of two sets of spiral springs, symmetrical with the gun; the springs bear on the rear end of two rods, the front ends being fixed to the front of the mounting. The springs are compressed during recoil, through a forged steel crosspiece fixed to the half rings of the slide-block. When the recoil is spent, the reaction of the springs runs out the slide-blocks and the gun. The spring can be easily and quickly replaced. Return to firing position is controlled by the brake during the greater part of the travel and afterwards by an hydraulic buffer.

The gun is supplied with ammunition by means of an hydraulic hoist and a loading platform. The hoist consists of a tube with a lateral opening, which serves as a guide for the ammunition, and of an endless chain, fitted at intervals with cleats or brackets that carry the cartridges. By working the chain, ammunition is delivered from the magazine on a lower deck to the gun, as it is required. The chain is operated by the plunger piston of a double-acting hydraulic cylinder. To this end, the head of the plunger piston is provided with two jointed levers, bearing alternately on the spindles of the rising side and of the descending side of the chain, so that the chain always turns in the same direction round the pulleys whichever way the plunger piston acts. A spring cleat at the bottom of the hydraulic cylinder engages the chain automatically, and holds it fast when the motion of the plunger piston changes its direction. The loading table can be turned round, and is fitted with concentric compartments, in which the cartridges are placed as they are removed from the magazines; it rests on a set of rollers that bears on a cast-iron baseplate. Each compartment of the loading table is brought automatically opposite the hoist, and the gunner has only to slide the cartridge on its bottom to place it on the hoist. The automatic working of the loading platform is insured by gearing driven by the lower pulley of the endless chain, the various parts being so arranged that the hoisting of a charge corresponds with the shifting of the loading platform from one compartment to the next. On reaching the top, one end of the cartridge engages in a guide, and is prevented from falling when it leaves the hoist tube. The cartridges are placed by hand into the gun. The opening for discharging the empty cartridge-cases is cut in the rear of the turret in its vertical wall; it is closed by a cover and a double bolt.

The elevation of the gun, which ranges from −10 deg. to +15 deg., is obtained by causing the carriage to oscillate in the mounting by means of a double-acting hydraulic cylinder, the plunger rod of which is jointed to the underside of the carriage. This hydraulic cylinder is fitted to the mounting frame, its distribution valve being worked by the gunner from the turret. The gun is trained by means of two hydraulic cylinders, placed under the armoured deck, each working a plate-chain, one end of which is fixed to the body of the hydraulic cylinder, and the other end passing over a drum fixed to the turret socket. The lateral training mechanism is arranged so as to work the turret when the ship has a list of 5 deg., and to hold it fast under an angle of 15 deg. The delivery and exhaust of water under pressure take place through a valve at the bottom of the cylinders; this valve is loaded at 10 kilogrammes (142 lb. per square inch), in order to keep the chain taut and to fix the turret should the pipes leak or burst. The distribution gear of the lateral training cylinders is placed on the orlop

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SECTIONS OF GUN TURRETS.

Fig. 632.

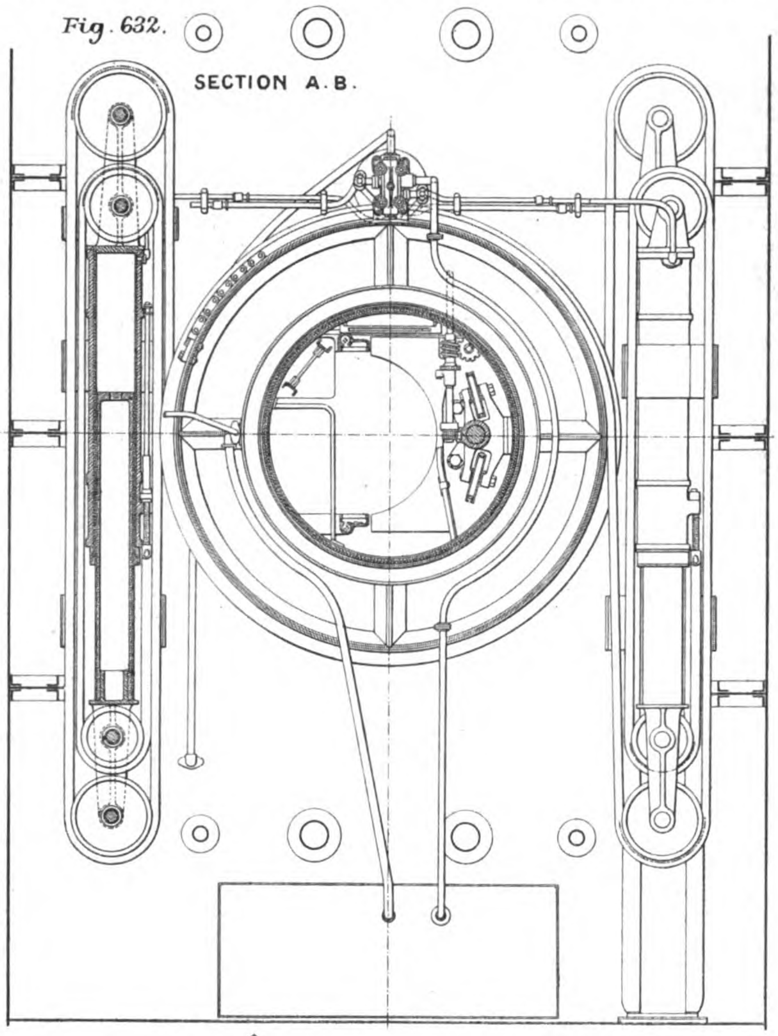
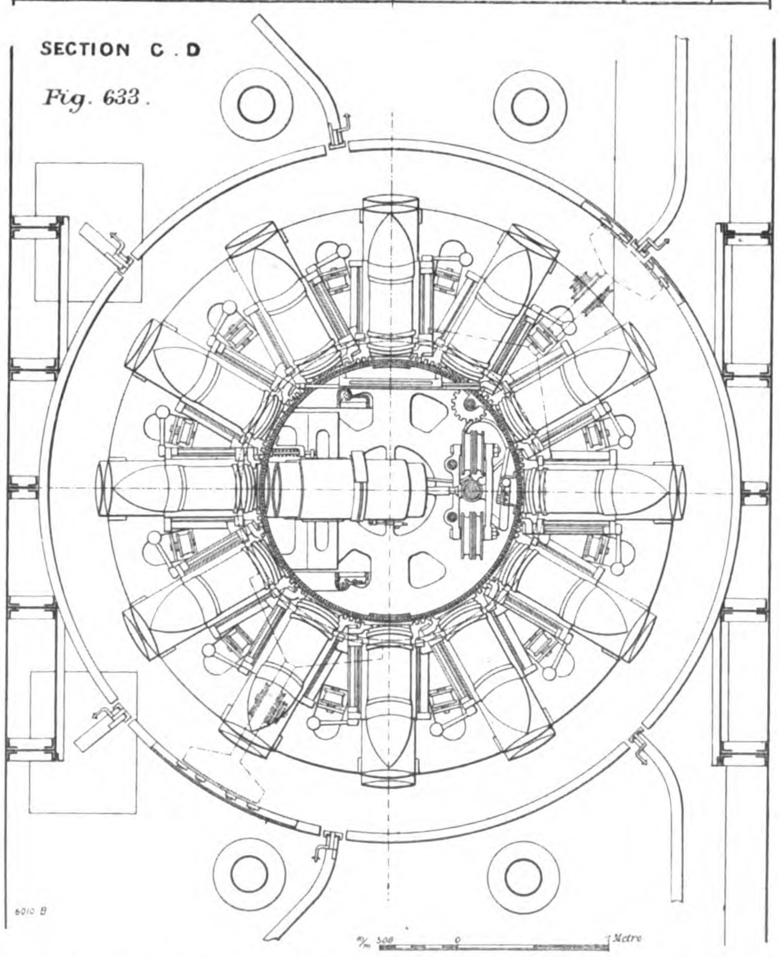


Fig. 633.



deck, in the cylinder space; but it is worked from the firing platform by means of a geared transmission, placed in the turret; while in the pit, on a level with the distributor, are a wheel and an endless screw working a gun-metal disc to fix the system; this disc is made with two concentric grooves connected by an incline, and in which a roller travels fitted to the distribution valve-rod. The difference between the radius of the concentric parts of the groove corresponds with the travel of the distribution valve. When the turret is not in service, the roller is in the middle of the incline, and by turning the disc one way or the other, the valve becomes displaced and causes one cylinder to be supplied with water under pressure, and the other ready for exhaust. The turret is thus caused to turn, drawing the disc round with it; when the latter has resumed its former position, the valve closes and the turret stops. By this arrangement the turret is always under the gunner's control; the valve ports are calculated so as to insure the required precision in the training of the gun. Six men are required for operating the turret and serving the gun.

Schneider - Canet Turrets for 305 - *Millimetre* (12-*In.*) *Guns.* — The principal parts of these turrets are the mounting, training, and elevation mechanisms, loading apparatus, distributors, and safety devices, provided for the various operations. The gun is held on the carriage by means of cramps, rings, and pins. The centre of gravity of the gun being in front of the bearing base, the carriage rests in front on a trunnion block, while in the rear it throws a vertical strain on the clamps. The sides of the mounting serve as slides for the carriage; they are joined in front by a stay, and in the rear by the cylinder for working the gun. This is in one piece with the mounting, the double-acting piston-rod being fixed to the lower rear end of the carriage. During recoil, the liquid driven from the rear passes to the front through loaded valves and pipes. In order to cause the recoil cylinders to take up the largest possible portion of the recoil, the valves are only loaded to about 32 kilogrammes (455 lb. per square inch), a sufficient pressure to keep the gun run out at all angles. When water under a pressure of 80 kilogrammes (1138 lb. per square inch) is introduced in the rear of the cylinder for running out the gun, the valves are exposed to an extra hydraulic pressure which keeps them closed until the instant that firing takes place. As soon as recoil commences this surcharge is removed. The recoil cylinders are cast on the sides of the carriage; during recoil, the liquid passes from the rear to the front through vents in the pistons. The pistons are provided with counter-rods in front.

The revolving platform, built of steel plates, carries the mounting and the gun, as well as the protective armour; it is bolted to the top part of the socket. The latter transmits the whole weight of the movable turret to the ship's framings; on the top is a gun-metal ring which slides inside the circular guide, and ends at its lower part with the hydraulic pivot. This can travel vertically over 40 millimetres (1.575 in.) in a step bearing, the travel being regulated by an automatic valve mounted on the pivot, the rod of which is joined to the step bearing in such a way that the admission of water under pressure underneath the pivot is closed by the turret itself when it reaches the firing position, and opened if the turret has a tendency to get lowered. Special latch-bolts on the platform lock the turret when it is not in service; these bolts are set under the action of springs, and are pushed back when the water under pressure acts underneath the plunger pistons. A safety device prevents setting the bolt-valve for water admission, and the turret cannot be freed for lateral training, if the pivot valve has not been adjusted previously for admission. A finger joined to the pivot valve prevents it being set for exhaust, if the latch-bolts are not home in their catches. The hydraulic cylinders for elevation are placed on the lower part of the platform; they each contain a double-acting piston, the top part of the rod forming a sheath in which is a connecting-rod jointed at one end to the mounting frame, and to the piston at the other end. The connecting-rod heads are provided with spherical bushes which allow a certain lateral motion of the mounting frame. Single-acting horizontal hydraulic cylinders, placed transversely on he orlop deck, two in front and two in the rear, regulate the lateral training by means of plate chains and pulleys. The plungers are guided by slides fixed at one end to the cylinders and at the other end to the sides of the ship. Handwheels for lateral training are placed in the turret; they are turned in the same direction as the turret. Ammunition is supplied to the gun by a special hoist, suitably arranged and provided with devices for insuring safe working. This type of turret, as fitted on the French ironclad Charles Martel, is illustrated by Fig. 631 of our two-page plate, and by Figs. 632 and 633.

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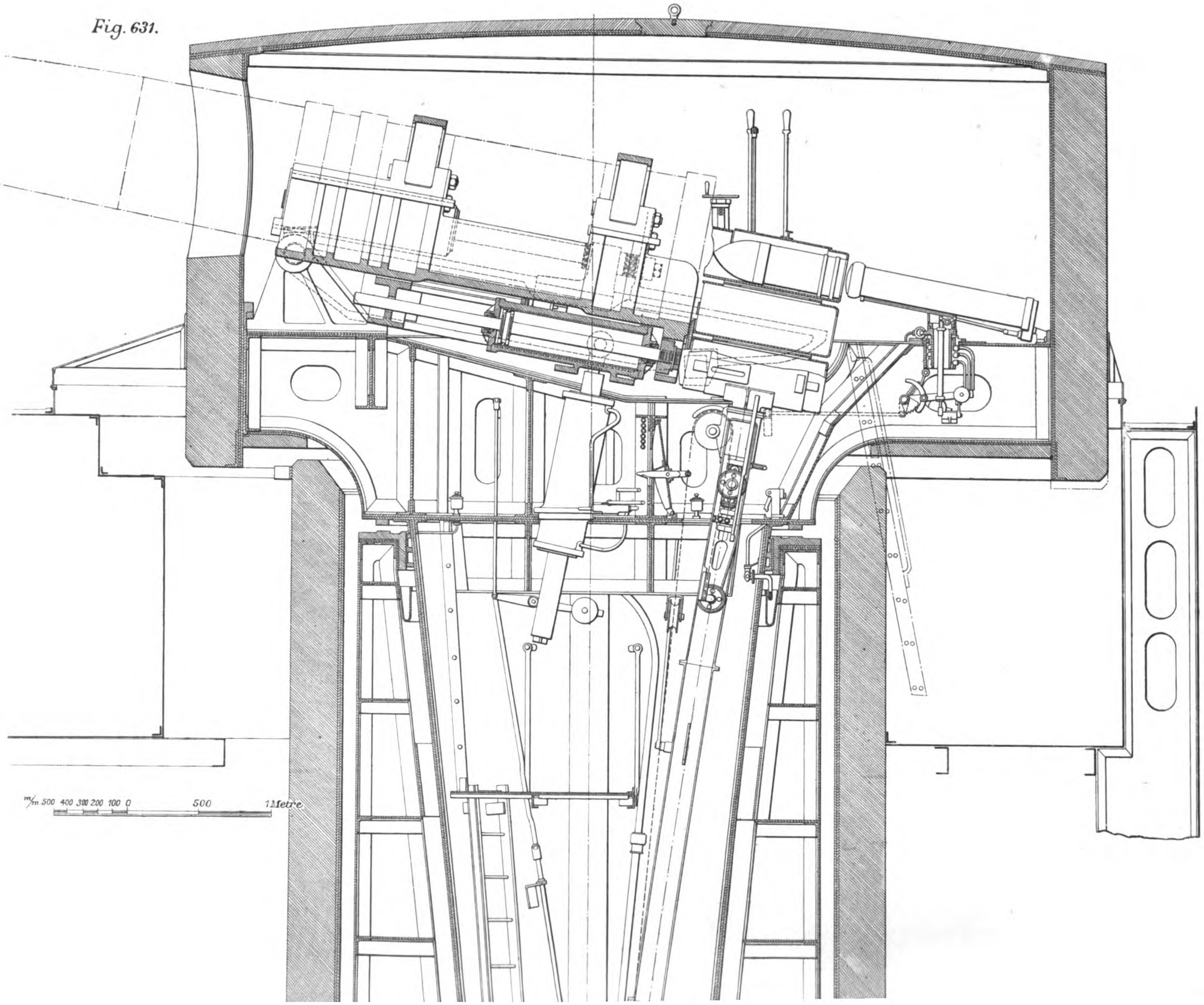
TURRET, GUN MOUNTING, AND AMMUNITION HOIST ON THE FRENCH IRONCLAD "CHARLES MARTEL."

CONSTRUCTED BY MESSRS. SCHNEIDER AND CO., CREUSOT.

(*For Description, see Page 455.*)

Fig. 631.



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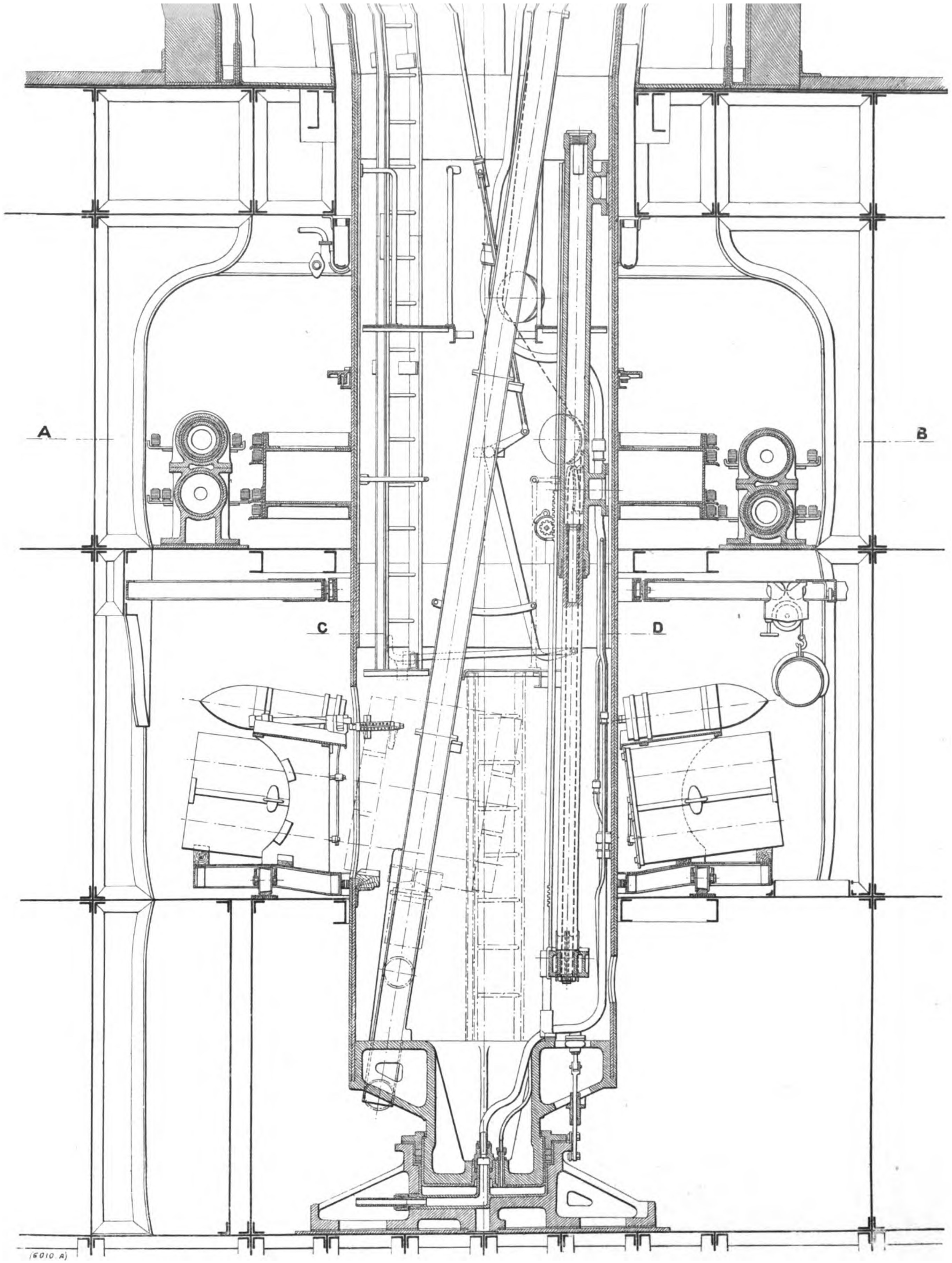

Tailby & Price Eng.rs

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TWENTY-FOUR PANEL SWITCHBOARD, PITTSBURG ELECTRIC TRACTION SYSTEM.

CONSTRUCTED BY THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, PITTSBURG.

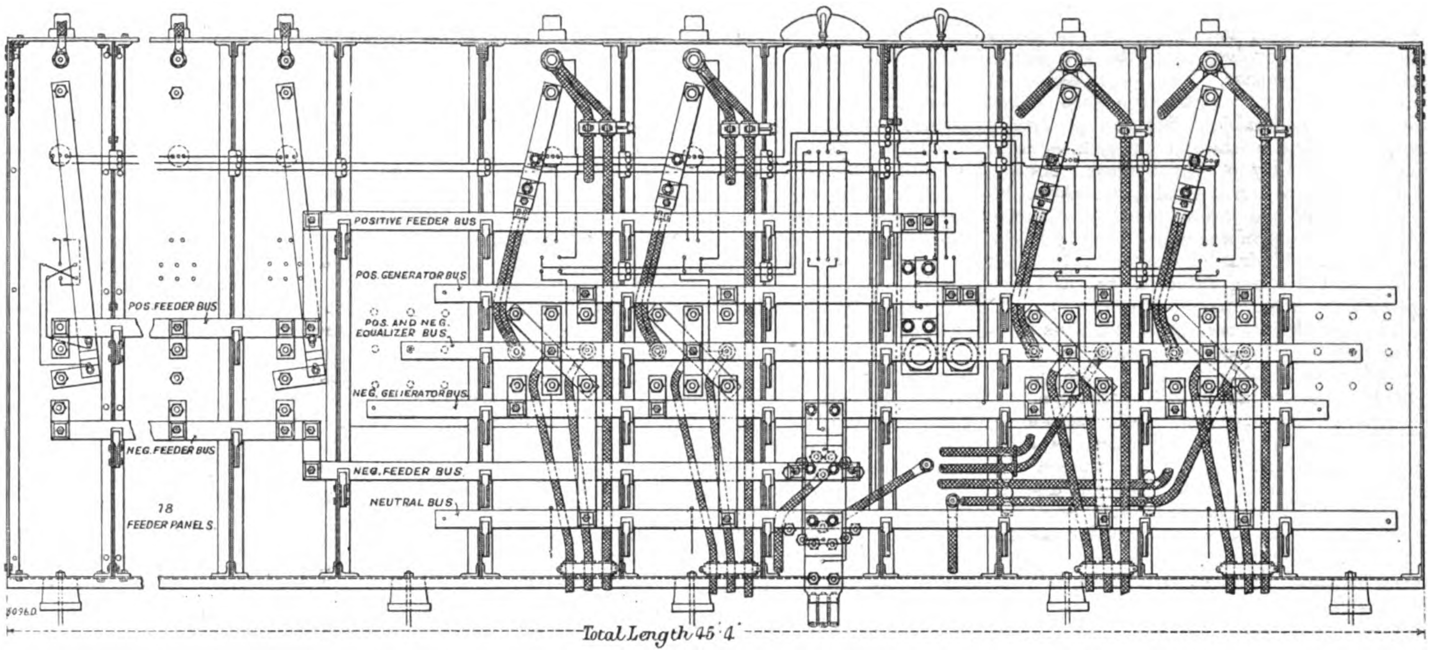

FIG. 3.

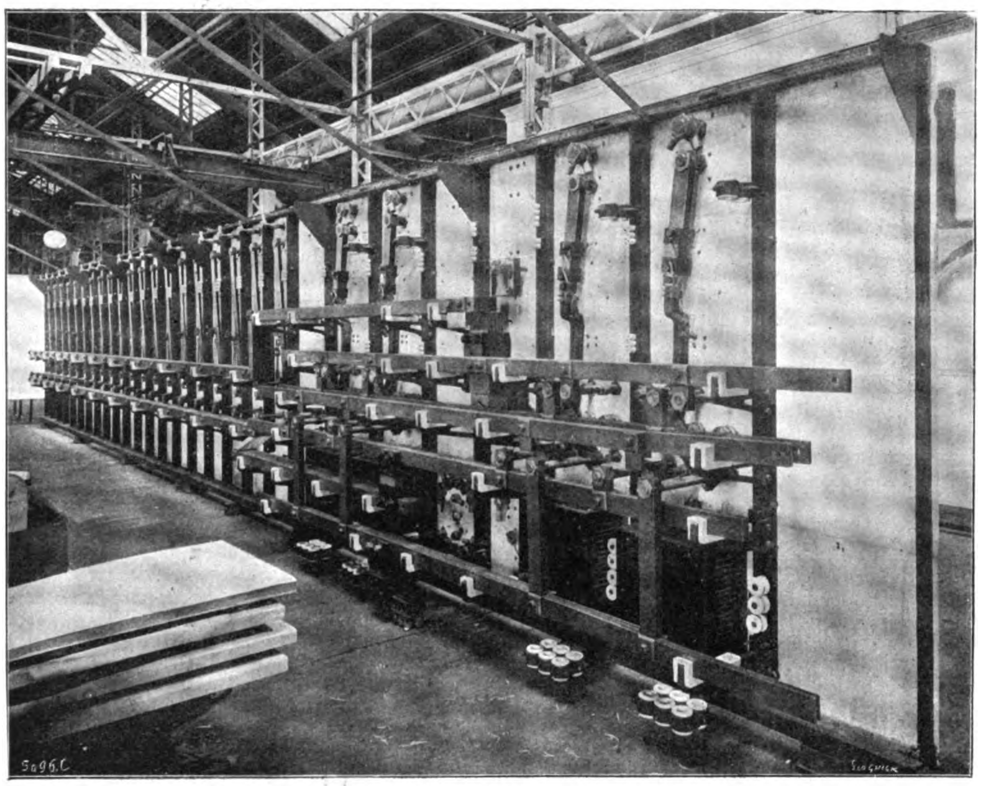

FIG. 4.

circuit when the engineers desired to put a temporary overload on the feeder for burning out a short-circuiting wire, or for any other purpose. Westinghouse "brush" type circuit-breakers are used, and are placed at the top of the board. This type of breaker is one of the latest Westinghouse productions. The switches are made entirely of copper, are of the "washer" type, and are all double-throw, as noted. The large capacity of this board, together with its complicated set of connections, made it difficult to place the necessary copper conductors on the rear; the diagram, Fig. 3 of the back of the board shows the construction which was used.

In order to get the necessary cables to the instrument studs on the switchboard, the rheostats were placed separately, being connected to their face-plates by conductors carried in a hose. The bus-bars are of bare copper, made up of individual bars of 3 in. by $\frac{1}{8}$ in. section, with $\frac{1}{8}$ in. space between for ventilation. The positive, negative, and neutral bus-bars each consist of twenty-three of these bars, and each total bus-bar is of sufficient carrying capacity for six 500-kilowatt generators operated on the same side of the three-wire system.

As the bus-bars are laminated and tapered, the maximum carrying capacity, with the least amount of copper is obtained. The connections between the generators and switchboard consist of two rubber-covered cables in parallel for positive, negative, and equaliser. The cables are supported by special porcelain insulators to the I-beams forming the ceiling of the 10-ft. basement and the floor of the engine-room. The switchboard itself rests on large wooden blocks, which are carried on 10-in. I-beams, which in turn rest on brick piers built up from the basement floor. The latter is of concrete.

The boiler-room contains five batteries of boilers of 400 horse-power each. A special iron chimney is provided for each battery, and each boiler is equipped with mechanical stokers. The freight cars carrying the coal are run on a trestle into the boiler-room, and discharge their loads into a large iron bin of thirty car-loads capacity in front of the boilers. In front of this bin is a track on which runs a coal conveyor, or elevator, consisting of an endless chain or buckets, driven by an electric motor. These buckets can be filled at any point along the bin, and raise the coal to a height where it can be shot down into the hoppers above the mechanical stoker with which each boiler is equipped. The ashes are discharged from the boilers into hoppers located in the basement, and are taken out by a small car, drawn by a cable operated by an electric motor situated outside the boiler-room proper. A feed-water heater completes the equipment of the boiler-room.

The company is using the overflow from the condensers for feed water, and although there is naturally a slight admixture in it of oil from the cylinders, no trouble has been experienced with scales in the boiler tubes. The advantage of using this overflow is, of course, that water of a temperature of from 95 deg. to 100 deg. is available. Exhaust steam from the auxiliaries supply the heater, and the feed water is forced into the boilers at a temperature of 212 deg.

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT. — No. LXIX.

SCHNEIDER-CANET NAVAL TURRETS (*continued*).

Turrets for 274.4-*Millimetre* (10.790-*In.*) *Guns.*—The illustrated description of the turrets for 305-millimetre (12-in.) guns, given in our last issue, applies to those for 274.4-millimetre (10.790-in.) guns, especially as regards the method of working. The differences in their construction are wholly in points of detail. These three types of turrets have been supplied to the French Navy, for the armament of the Charles Martel and Massena.

II. HYDRAULIC BALANCED TURRETS WITH CENTRAL TUBE FOR LOADING IN ALL POSITIONS.

In the earlier days of turret-protected guns, a large number of ship turrets of various systems presented two disadvantages which, in certain cases, rendered their working a rather delicate matter, and prevented the guns being fired at their maximum power. The ammunition was, as a rule, delivered into the turret, through an opening on the circumference of the platform, corresponding with a single fixed passage leading either direct to the magazine or to an intermediate staging. To supply the gun with ammunition during firing, it was therefore necessary to bring the opening in the

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movable platform, over the mouth of the ammunition passage, which involved an extra manœuvre of varied duration. Besides this, the centre of gravity of the whole of the movable system was not on the vertical axis of rotation of the turret; it was, indeed, in not a few instances, far from it. Therefore a slight inclination of the platform caused a tendency to revolve, owing to the eccentricity of the movable mass. This effect varied, of course, with the extent to which the ship rolled. The result was a considerable difficulty in producing lateral displacements for training the gun, or even a temporary immobility of the system. As the deck of a ship at sea is in a state of constant oscillation, the working of the various mechanisms gave more or less trouble, producing uncertainty in the firing manœuvres. Hydraulic brakes were then little known and seldom resorted to, and the mountings which were placed in the turrets were much longer than those now used, thus leading to the use of protective armour of large diameter and considerable weight. The consequences of the earlier mode of construction and working such turrets may be briefly stated as follow: Firing was comparatively slow, as after each round the turret had to be turned for a new supply of ammunition. Effects due to the eccentricity of the system either produced sudden movements, or, offering considerable resistance, deranged the operations of training the gun or even stopped them at times; in extreme cases the transmissions became totally disorganised. The working gear had consequently to be strengthened owing to these various strains, and the medium power of the engines had to be increased above that actually required, in order to counteract the tendency to revolve, due to the oscillations of the platform. The armour had also to be made of dimensions and weight excessive in proportion to the offensive power of the gun it protected. It is easy to see, therefore, that under such conditions the working of the various parts was difficult, requiring a trained and cool-headed *personnel*; indeed, under the best conditions the power of the guns could only be utilised to a limited extent. At the same time, turrets did not play the important part in the armament of ships which they do now, owing to the great improvements that have been introduced.

Schneider-Canet Barbette-Turret for 27-Centimetre (10.630-*In.*) *Gun.*—This type of turret has been supplied to the Greek Admiralty for the armament of the cruisers Psara, Hydra, and Spetzia. It is illustrated in Fig. 634, page 488. Each turret was delivered complete, with gun mounting and frame, revolving and training mechanism, hoist, &c.

The trunnions of the gun rest in the trunnion-plates cast with the carriage; this consists mainly of the two recoil cylinders, with slides and clamps. Inside are two compensating cylinders joined to the recoil cylinders by pipes. The mounting consists of two cheeks, the top surfaces of which form the slide-paths. Rollers facilitate the travel of the carriage.

On the front cross stay are butts corresponding with the buffers on the carriage. The recoil piston-rods are fixed to the rear end of the slides; those of the compensating cylinders, to the front stay of the carriage. When the gun is fired the liquid which is compressed in the front of the recoil cylinders flows to the rear, whence it is driven into the compensating cylinders, the dimensions of which are carefully calculated. When the recoil is complete the intermediate valves fall back on their seats and the mounting remains run in, until communication is re-established by hand, through a vent made in the thickness of the valve-chest, when it runs out again by gravity. The whole of the system comprising the gun, the mounting and its frame, is fitted to a bolster, which rests on the platform, with the interposition of a series of coned rollers. The bolster supports the tube for the passage of ammunition, as well as the movable shell of the turret. A circular casing of armour fitted to the deck, and a space which surrounds the central tube, complete the protective part of the installation. Elevation is given by a crank which gears the pinion that works a toothed sector fitted to the left cheek of the carriage. The mechanism is completed by a set of holding-back toothed wheels, worked by the crank and which set in motion the small pinion of the elevating mechanism. Lateral training is obtained either by hand or by power, by means of a pinion which engages in the circular rack fixed on the upper deck. This pinion is set in motion either by a set of gearing worked by a pinion keyed on a horizontal shaft which goes through the cheeks of the mounting and carries the working cranks, or by a steam motor which actuates an endless screw with a helicoidal wheel, carrying a regulating device of the type provided for the elevating mechanism. The hoist is made with three compartments; it is guided by rollers which travel inside the central tube, and there are two chains mounted on drums, that are turned by hand or power. In the former case, the drums are operated by means of cranks, plate-chains, and gearing; when a motor is used, the transmission consists of an endless screw with helicoidal wheel and gearing keyed on the endless screwshaft, that work the toothed wheel of the drum. When the top staging is reached, the half-cartridges are removed by hand, the projectile being raised to the height of the breech by a winch fixed to the roof of the inner shell of the turret.

Closed Turret for 274.4-Millimetre (10.790-*In.*) *Gun.*—Turrets of this type (see Figs. 635 and 639, page 489) have been built for the French armoured gunboats Achéron, Styx, Phlégéton, and Cocyte. They consist of the mounting with its slide, the turret, the training mechanism, and the ammunition hoist. In order to obtain the necessary elevation, the gun is mounted on a carriage which travels on a slide, turning around horizontal trunnions in brackets carried by the movable platform. The carriage is provided with buffers and is guided in its slides by lateral clumps; the gun is held in the carriage by grooves and pins. The slide consists of beams stayed together, and between them are placed the two recoil cylinders. An intermediate stay, which rests on the piston-rod of the training press, carries the mechanism that regulates the recoil as well as the running out and in of the gun. The hydraulic brake consists of two lateral cylinders bolted to the slide, the piston-rods of which have a constant diameter on their whole length and extend on both sides of the piston. There is in connection with these cylinders an intermediate distribution chest, fitted with a loaded valve, and to which are brought the conduits that are connected with the pipes extending to the front and rear of the recoil cylinders. A regulating rod completes the system, which works as follows: When the gun is fired, it draws back with it the carriage and piston-rods, which are fixed to its rear cross-beam, the liquid flowing to the front end of the cylinder after lifting the valve of the distribution chest. The rapidity in flow of the liquid is governed by the regulating rod, which is controlled by a suitable sliding link placed under the carriage; this maintains a practically uniform pressure in the recoil cylinders during the whole period of recoil. When the recoil ceases, the valve falls on its seat and interrupts all communication between the front and the rear of the cylinders, the gun remaining run in. To run it out ready for firing, the water under pressure is directed to the rear of the pistons, the front part of the cylinders being exhausted.

The carriage and slide rest on the movable platform of the turret, in the centre of which is the opening of the tube for the passage of ammunition. The platform is provided with the drum round which the chains pass that operate the lateral training. To the platform is also attached the armour-plating of the turret, with its roofing, and an armoured hood for protecting the gunner. The central tube is surrounded by a casing that rests on the deck and supports the fixed protective armour. Between the platform and the supporting framework is placed the series of truncated conical rollers, on which the turret revolves under the action of the turning drum and chain.

The hydraulic cylinder for elevating the gun is double-acting. The piston-rod extends on both sides, and is made with spherical joints. The breech-end of the gun is raised or lowered, according to whether the lower part of the cylinder is in communication with the inlet or outlet of water under pressure. A bolt worked by a lever is provided with the object of fixing the gun in its loading position. For lateral training two sets of hydraulic gear are arranged horizontally on the lower part of the system. The working chains rise first vertically, pass round transmission pulleys, and then round the drum fixed underneath the platform, and referred to above; they then return to the hydraulic cylinders. The motion is obtained by placing one or other of these cylinders in communication with the accumulator. The valve distribution chest is within easy reach of the gunner. A set of fixed and loose toothed wheels produces more or less rotation one way or the other, or an instantaneous stoppage of the system. A special brake holds the turret fast at the position chosen for firing.

Ammunition is raised from the magazines to the breech by means of an hydraulic hoist provided with three stagings that can hold a projectile and two half-cartridges. The ammunition tray, mounted on a roller truck, rests on a plate which is raised by means of a telescopic apparatus; it is guided by two shoes, which move in the slides carried by the tube. On reaching the upper end of the travel, the rollers of the truck engage in a part of the slides that are turned over at an angle, and bring the ammunition tray into the required position for loading or unloading. A latch-bolt allows of the apparatus being held fast at both extreme positions. The projectiles and cartridges are brought to the lower staging in a truck carried on a line fixed to the deck beams.

THE BRITISH ASSOCIATION.

(*Continued from page* 450.)

THE THEORY OF ELECTROLYTIC SOLUTION PRESSURE.

DR. R. A. LEHFELDT had prepared this paper in the hope of raising a discussion, for which unfortunately was no time; this is to be regretted, as a discussion would have been interesting. If he is right, Nernst's theory of solution pressure, which many chemists of the modern school accept, cannot be maintained. When a metal is immersed in an electrolyte, a minute amount of it goes into solution in the ionic form, giving a positive charge to the liquid; or ions from the solution are deposited in the metallic form, giving the metal a positive charge, according as the osmotic pressure of the ions in solution falls short of, or exceeds, an amount known as the electrolytic solution pressure. It has been supposed that the amount of metal, deposited or dissolved, is too small to be measured. Calculating the tensions exerted by electric charges electrostatically, however, Dr. Lehfeldt finds that in the case of zinc, the amount of metal dissolved would amount to some centigrammes per square centimetre of surface immersed. That amount could certainly be measured. Some time ago, Dr. Lehfeldt warned against drawing certain inferences from unreliable determinations of electromotive forces. Accepting Luther's observations, he had calculated what is evidently a wild absurdity, namely, that 80 litres of water should not contain more than one molecule of free hydrogen. Here is a similar example.

SOME NOVEL THERMO-ELECTRIC PHENOMENA.

Professor W. F. Barrett read this paper, which concerns the conductivity of certain alloys, a subject which he, in conjunction with Mr. W. Brown, also brought before Section G* in another form, and to which we have referred in our account of the Royal Society Conversazione. Together with Mr. R. A. Hadfield, he has studied the thermo-electric properties of many alloys. All aluminium alloys have a high resistance. An addition of nickel to iron does not increase the resistance very much; but nickel and manganese together have a very strong effect. The most interesting alloy found, has the following composition: Fe 68 8 per cent.; Ni, 25 per cent.; Mn, 5 per cent.; C, 1.2 per cent. Its resistance is about 4.5 times as high as that of German silver, and its temperature coefficient is only 0.085. The electromotive force rises slowly up to 300 deg. Cent., and then keeps steady up to 500 deg.; after that it begins to fall, but the change in the electromotive force between 500 deg. and 1100 deg. is only 4 per cent. of the total. This steady electromotive force is very remarkable. With iron strips, the alloy gives fine thermo-couples. Professor Barrett exhibited many curves to show the thermo-electric properties of this and other alloys. One feature may be said to be common to most of them. The electromotive curves for rising and falling temperatures are not the same, although they almost coincide for the steady part of the special alloy mentioned. With platinum alloys, the cooling curve is considerably below the heating curve. Further, a second heating does not give the same values as the first. All this is not in the least surprising. We know, as Professor Trouton demonstrated some years ago,

* See page 388 *ante*.

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that an electromotive force is generated in a closed iron ring if it is heated by a shifting flame. We further know that all iron—except, perhaps, the very purest—has recalescence points which can, no doubt, be traced in the phenomena spoken of. And, finally, it seems manifest that oxidation will strongly affect these phenomena, so that we can hardly expect identical values for series of tests. Professor Barrett, of course, mentioned the recalescence which he was one of the first to investigate; but he did not speak of oxidation.

Electrical Standards.

In the absence of Professors Ayrton and Jones, who had intended to bring communications before the Section, Principal Glazebrook, F.R.S., had only a formal report to read, one statement of which was received with acclamation. Professor Glazebrook will enter upon his new duties as chief of the National Physical Laboratory with the new year, and the electrical standards will remain in his custody. Professor Poynting had, in his address, congratulated the Section on the excellent selection made. The papers on thermometry, to which we proceed, form part of the Committee Report.

Discussion on Platinum Thermometry.

Papers for this discussion had been prepared by Professor Callendar, Dr. Chappuis, and Dr. Harker. Professor H. L. Callendar, F.R.S., introduced the discussion with "Proposals for a Standard Scale of Temperature based on the Platinum Resistance Thermometer." He proposes the platinum thermometer as a practical standard, as he had done before the Royal Society in 1886, considering that gas thermometers, the theoretical standards, have given discordant results at high temperatures. Impurities can easily be detected in platinum. He would select a particular sample of platinum wire as the material for standard thermometers. The temperature on the platinum scale is defined by the formula $pt = 100 (R - R^0) / (R^1 - R^0)$ where R, R^0, R^1 are the resistances at temperatures pt, R^0 (melting point of ice) and 100 deg. Cent. That is to say, if R be the resistance of the platinum at any temperature T^0, this temperature will be pt on the platinum scale as defined by this equation, the symbol pt having been introduced by Professor Callendar. The scale of temperature t would be deduced from the standard platinum scale by means of the parabolic formula $t - pt = d\ (t/100 - 1)\ t/100$, which has proved a very close approximation to the true or thermo-dynamic scale, and this scale should be called the British Association Scale of Temperature, the value of the d in this formula to be determined by reference to the boiling point of sulphur, as described by Callender and Griffiths, namely, 445.53 deg. Cent. under a pressure of 760 millimetres, reduced to 0 deg. Cent. and latitude 45 deg. This value might have to be modified, but before the expansion of glass and porcelain, and the relations between various gas thermometers, were more accurately known, nothing could be gained by changing it. In supporting these proposals, Professor Callendar first referred at length to the widely differing melting points of silver, and boiling points of zinc, which we find in text-books. Those discrepancies are, however, as Mr. Glazebrook pointed out, not by any means all to be ascribed to the defects of the respective gas thermometers. Professor Callendar further emphasised the dangers from leakage in all gas thermometers, and the unreliability of thermo-couples, otherwise suitable, at low temperatures. We subjoin a Table of a few constants on the new British Association Scale:

Melting Points.	
Tin	231.9
Bismuth	269.2
Cadmium	320.7
Lead	327.7
Zinc	419.0
Boiling Points.	
Aniline	184.1
Naphthalene	218.0
Mercury	356.7

Comparison of Glass and Platinum Thermometers.

Both Dr. P. Chappuis, of the Bureau International des Poids et Mesures, at Sèvres, and Dr. J. A. Harker spoke on this, their joint work. A new resistance box and several platinum thermometers had been constructed for the Kew Observatory, and after being tested they were sent to Sèvres in 1897. In its design, the resistance box was very similar to Mr. Griffiths' box which we described a few years ago; but the plugs were replaced by a special form of contact maker, and the platinum silver coils, by manganine coils. This latter point is noteworthy, because some electricians have given manganine a bad name. The comparisons were divided in several groups. The first group covers the range—23 deg. Cent. to 80 deg., and consists of a large number of comparisons made between each platinum thermometer and the primary mercury standards of the Bureau whose relation to the normal hydrogen scale had previously been studied by Chappuis. The latter had charge of the gas thermometer comparisons. Above 80 deg. the mercury thermometers were replaced by a gas thermometer. This was originally filled with hydrogen, but there is apparently a slow reducing action of the hydrogen on the hot glass, so that nitrogen was substituted which remains indifferent up to full red heat, at any rate. Between 80 deg. and 200 deg. the measurements were made in an oil bath filled with various oils. This oil bath was arranged by Chappuis in a very clever way for different pressures; and the boiling point could further be raised by admitting air into the oil. Temperatures above 200 deg. were produced in a mixture of the nitrates of potassium and sodium, fused in an iron crucible. In this bath the two principal thermometers were compared with a gas thermometer, first up to 460 deg., fitted with a glass tube, then, as the glass began to soften, with a porcelain tube, protected by a very thin steel tube, up to 890 deg. The dilatation of this china thermometer had been determined by Fizean's method. The expansion of porcelain is, however, a very difficult problem; the porcelain comes from the Berlin manufactory. Over 200 comparisons were made, each comprising from ten to twenty readings.

There remains one dubious point. Callendar and Griffiths have made their determinations with air thermometers at constant pressure; Chappuis works at constant volume. In the case of hydrogen, both methods give identical results; in the case of nitrogen, there are slight differences; for carbonic acid, the differences are quite noticeable. The mean of the determinations by Chappuis of the boiling point of sulphur, which, it will be remembered, Callendar proposes as one of the fixed points, is 445.27 deg.; Callendar and Griffiths found 444.53 deg. The discrepancy would almost disappear if Regnault's expansion coefficient of the air is corrected as Chappuis has suggested. If this value 445.27 deg. be adopted, then the parabolic formula of Callendar is confirmed in a very remarkable way, the maximum difference not amounting to more than 0.1 deg. for the highest temperatures.

With regard to the sulphur boiling point, Mr. Griffiths explained that his value 444.53 represents the temperature which a body assumes in a sulphur vapour atmosphere. Mercury thermometers were little use. In the platinum thermometer there were only three points to be determined; a resistance box had to be standardised, it was true, but one box would do for many thermometers. Professor Carey Foster maintained that the gas thermometer must remain the ultimate standard, as there is no theoretical connection between the resistance and temperature of a platinum wire. Mr. Burstall mentioned that he had been able to record very high temperatures by compressing and igniting mixtures of gases, and suspending a fine platinum wire, 0.0015 in. thick, in the mixture. His apparatus measures pressure and temperature simultaneously. The temperature was not altered by more than 15 deg. or 20 deg. at temperatures of 1500 deg. Cent., when thick wires were applied.

Principal Glazebrook was doubtful about the adoption of a platinum standard. In any case the suggestion to draw wires from a particular block of platinum could not be recommended. We must have a definition of the kind of material which would permit of reproducing standards all over the globe. He inquired whether platinum might still further be purified, or whether gold, which we know in a still higher state of purity, would not be preferable. Dr. Chree, of Kew, stated that he had tested Griffiths' instruments for four years. The results have not been published yet. The platinum thermometers have their advantages, but also their faults and tricks, and these faults did not manifest themselves in any way to attract attention. Mr. Griffiths had had trouble, too, but was generally able to cure them. As regards the boiling point of sulphur, the relation between vapour pressure and temperature was not known. Professor Threlfall had recommended platinum thermometers when describing his gravity balance, to which we shall refer lower down; they would answer for commercial purposes too, but he did not regard them as ultimate standards. Mr. Shaw drew attention to thermopiles, which are being more and more perfected in Germany. The attitude of the Section was hesitating, and considering the high accuracy and agreement already attained, a decision can all the less be taken at present, as Professor Callendar had not proposed the platinum thermometer as an ultimate standard, though the question has occupied the British Association for several years already.

The Expansion of Porcelain.

This paper, by Mr. T. G. Bedford, was read by Mr. C. F. Green, of Cambridge. The expansion of the porcelain tube in which the gas of a gas thermometer is contained, is a more important matter for delicate measurements than the nature of the gas. But the expansion of porcelain has, owing to the difficulty of the problem, been studied very little, and if we adopt the average coefficients of Deville and Troost, high temperature values are unreliable by 30 deg. and even 50 deg. The experiments were conducted on Callendar's method. Two fine marks were made, 91.3 centimetres apart, on a tube of Bayeux porcelain, heated in a gas furnace, and then slowly cooled. During cooling the variations in the length were determined with the help of a pair of reading microscopes, mounted on stone blocks. The temperatures were deduced from the resistance of a platinum wire, running axially through the tube, supported on a plate of mica. The temperature ranged from 0 to 800 deg. Cent. The results up to 600 deg. are fairly well represented by a formula; beyond that temperature the data are more erratic, the influence of the 6 centimetres of non-heated tube at both ends coming in more strongly, among other reasons.

Variation of the Specific Heat of Water.

Although Professor Callendar and Mr. H. T. Barnes, of McGill College, Toronto, styled their paper a "Preliminary Note," it is really an elaborate communication, preliminary in so far as the final results cannot yet be communicated. The work, of which a first account was given at the Toronto meeting, has been delayed by Mr. Callendar's removal to London—he is now Quain Professor at University College—and has since May been done by Mr. Barnes alone. There are sufficient means at disposal, but it is exceedingly delicate work. The steady flow method has been adopted. Water flows through a narrow tube, 1 or 2 millimetres in diameter, and is heated in its passage by a bare platinum wire, through which a current passes. The temperature of the water is determined by means of platinum thermometers, whose glass bulbs are surrounded by thick copper tubes. The whole is provided with a vacuum jacket, and again with a copper jacket, in which water circulates. The paper discussed the previous determinations by Regnault, Jamin and Amaury, Bartoli and Stracciati, Rowland, Griffiths, Schuster and Gannon, Dieterici, Reynolds and Moorby, and demonstrates incidentally the importance of very exact thermometric measurements; Rowland's corrected and uncorrected curves deviate a good deal from one another, for instance. The authors do not lay great stress on their absolute values. But their researches bring out several important points. The temperature of minimum specific heat seems to be 40 deg. Cent. (not 29 deg., Rowland), and the specific heat increases rapidly as the freezing point is approached, a fact predicted, but not observed by Rowland. That point will be investigated, of course, although Professor Callendar did not assent to Mr. Shaw's view that all tables of specific heat were of little value, as long as we are uncertain about the values near the freezing point. Mr. Griffiths was not satisfied that the polarisation of the naked wire would be minimal, and he also inquired whether there was not a difference in water pressure at the inflow and outflow; he thought it would be possible to maintain a flow at − 4 deg. Cent.

Heat of Combination of Alloys.

The work of this Committee has been done by by Dr. Alex. Galt, of Glasgow; the report was read by Dr. O. Lodge. Briefly, the method is the follow-

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BARBETTE TURRET AND MOUNTING FOR 27-CENTIMETRE GUN.

CONSTRUCTED BY MESSRS. SCHNEIDER AND CO., CREUSOT.

(*For Description, see Page* 485.)

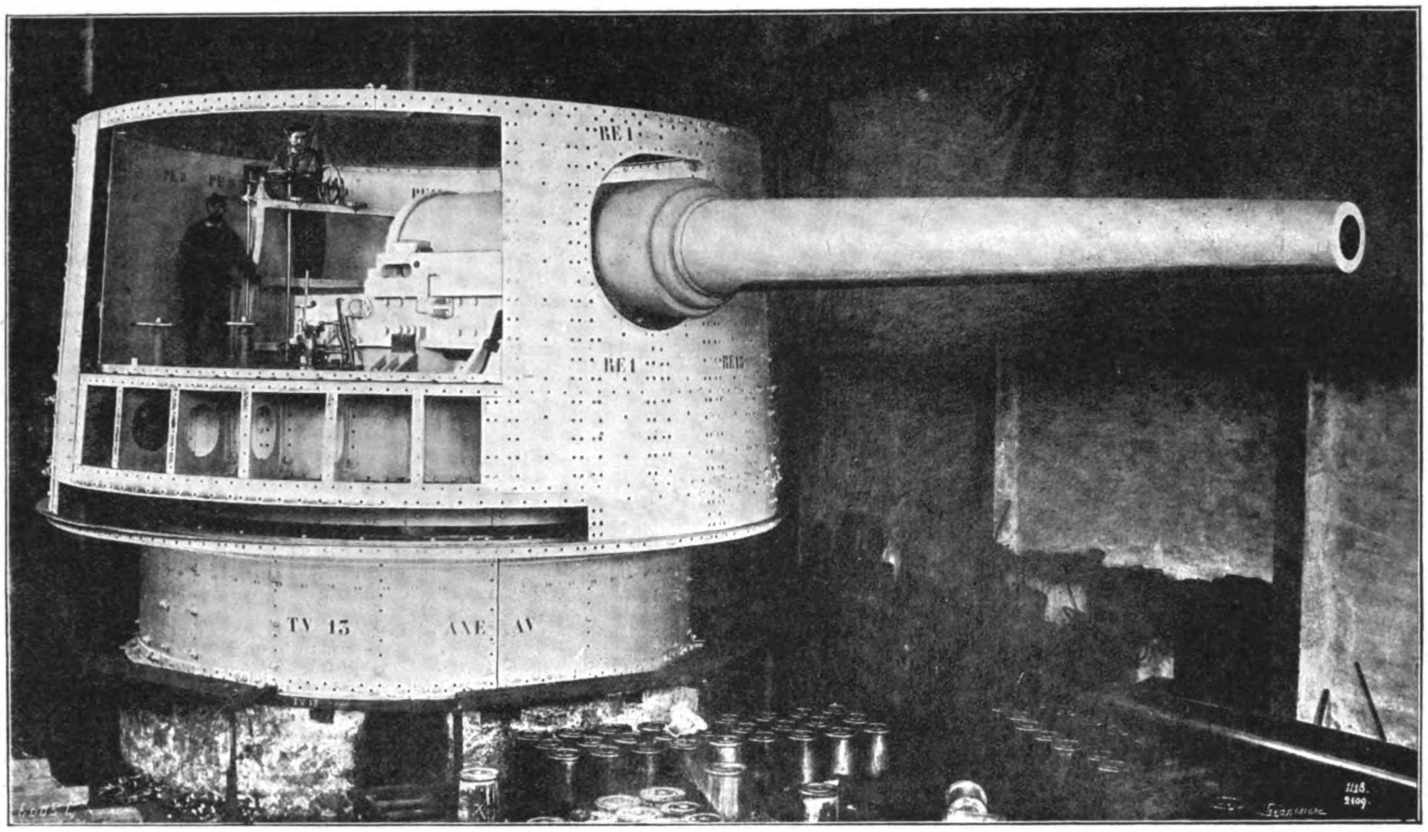

Fig. 634.

ing. Fine filings of the metals, copper and zinc, are separately dissolved in nitric acid, and the heats of solution measured; then mixtures in definite proportions are dissolved; finally, alloys of the same proportions. The compositions varied between 5 and 91 per cent. of copper. If the alloys represent definite compounds, then a different heat value should be observed, for mixture and alloy, and the difference would indicate the heat of combination of the metals. Starting from zinc, the heat of combinations on adding increasing amounts of copper is at first negative, the maximum being reached at 16 per cent. of copper. The negative difference then gradually changes into a positive one, the maximum with 38 per cent. of copper corresponding approximately to the formula $Cu_2 Zn_3$. It then decreases again, and vanishes for alloys containing more than 90 per cent. of copper. The formation of the alloy with 24 per cent. of copper seems to take place without evolution of heat. The experiments appear to have been conducted with great care, as they were repeated until concordant results were obtained. But we cannot help agreeing with Professor Vernon Harcourt's objection, although it found no support in the Section, that the solution of two metals in an acid, and in nitric acid above all, is fraught with so many complications, owing to electrolytic effects, and the generation and absorption of gases, that the reliability of the method must be questioned.

Solar Radiation.

This Committee reported that the new apparatus, designed for determining solar radiation, had only just been received, and that they hoped to have a real report next year. It was by no means the first time that this hope has been expressed.

Sun Spots and Temperature.

Dr. van Rijckevorsel, of Rotterdam, briefly exposed his views on a connection between sun spots, temperature, and meteorological phenomena in general. Taking the mean daily temperatures and plotting out yearly curves for the last 35 years, he obtains curves and ripples with perhaps 20 or 30 secondary maxima. These secondary ripples are similar for all Europe; but he had only scanty material from the southern hemisphere. Barometer, rainfall, wind force, the magnetic elements also yield similar curves. Hence we may assume a cosmic origin for these variations. When the sun spot maxima are plotted, we come again to similar secondary curves, but the maxima are two or three days in advance of the others. If we take Mercury years of 88 days, instead of Earth years of 365 days, the coincidence of the secondary maxima is still very striking; and the same appears to apply to Venus. This, we believe, is to be understood that the 1st, 89th, and 177th days would be counted as first days, the 2nd, 90th, &c., as second days. The author granted, however, that his curves had to be smoothed down. Professor G. H. Darwin inquired whether the author hoped to be able to give a formula for sun spots with different terms, depending on the different planets. Professor van Rijckevorsel replied that his answer would be, Yes, if he had the records of 10,000 years; but that was the direction in which his researches were bent.

Seismology.

In the generally regretted absence of Professor J. Milne, F.R.S., Mr. G. J. Symons said a few words on the bulky report he had undertaken to present. Twenty-three stations are now fitted with identical instruments, thanks to the British Association, the Foreign Office, and other Governments. The co-operation of foreign observatories renders it desirable that a central seismological laboratory should be established, at which earth movements could be recorded and analysed in relation to the corresponding registers received from abroad. Professor Milne's own station at Shide, Isle of Wight, is still located in some dark and damp stables, which have ruined some photographs and are responsible for other mischief. In spite of these difficulties, Professor Milne has recorded, during the past year, 103 earthquakes. Over 70 per cent. of these records are repeated in the registers of Kew; from 58 to 65 per cent. are common to Nicolaiev, Potsdam, and Trieste; and 56 per cent. to Victoria in British Columbia. From the time at which these disturbances reached the various observatories, it has been possible to locate the centres from which they had originated. In many instances these were shown to be suboceanic, and while they give evidence of geological activity in ocean beds, they promise to indicate localities which it would be unwise to cross with cables.

A curious feature exhibited in a collection of seismograms referring to the same earthquake, is that the large waves may be less in amplitude at a station near their origin, than they are at stations more remote. For instance, an earthquake, originating in Japan, crossing beneath the Pacific to Victoria, B.C., may yield a smaller diagram at that place than the one obtained at double the distance in the Isle of Wight. In this latter case the large waves swept over the free surfaces of two Continents. The inference is that oceans exert a damping influence upon indulations of their beds. This possibly explains why seismograms from Mauritius are small. The large waves which appear to be surface waves travel with a practically constant velocity. The preliminary tremors, however, although they outrace the larger waves at a constant rate near to an origin, have an average velocity practically proportionate to the square root of the average depth of the chord, joining the earthquake centre and the distant station. Taking the observation as the foundation for the assumption that the square of the speed is a linear function of the depth, Dr. C. G. Knott arrives at the result that the square of the speed increases 0.9 per cent. per mile of descent. Assuming that the waves are compressional, and that the density of the earth increases uniformly towards the centre, then the coefficient of its elasticity increases at a rate of nearly 1.2 per cent. per mile of descent.

One of the last sections of the report refers to what Mr. Milne provisionally calls earthquake echoes. As an earthquake dies, it does so by a rythmical succession of similar movements which are more suggestive of surgings following reflections than of a spasmodic settlement of disjointed strata. The first of these surgings often appears about five minutes after the chief shock, and this, but on a

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BARBETTE TURRET AND MOUNTING FOR 27-CENTIMETRE GUN.

CONSTRUCTED BY MESSRS. SCHNEIDER AND CO., CREUSOT.

(*For Description, see Page* 485.)

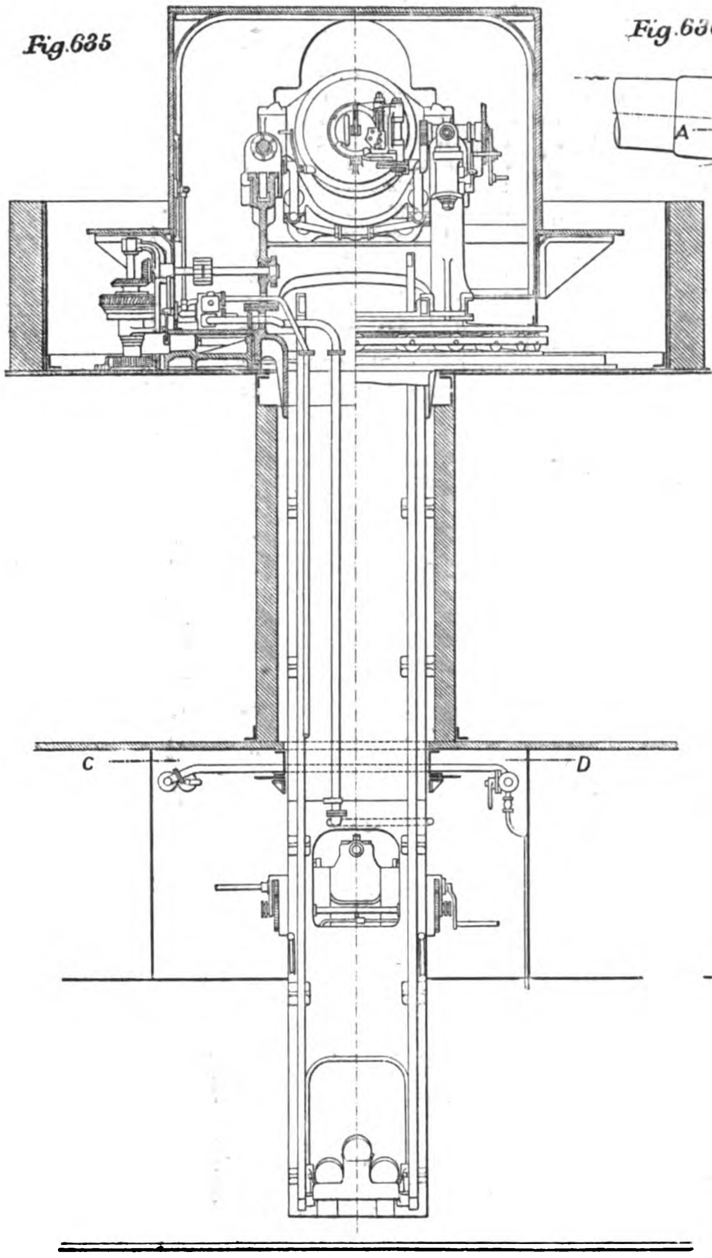


Fig. 635

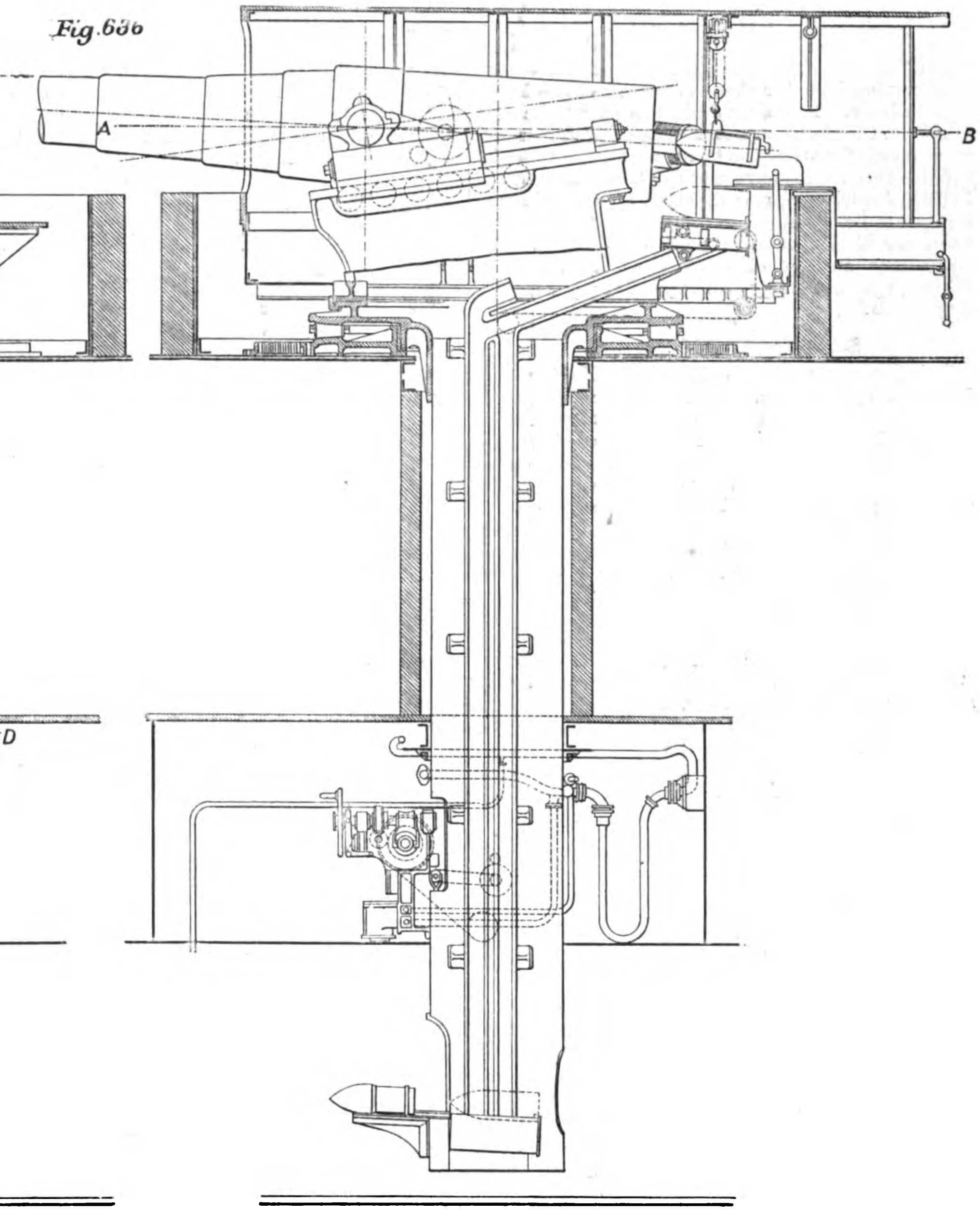


Fig. 636

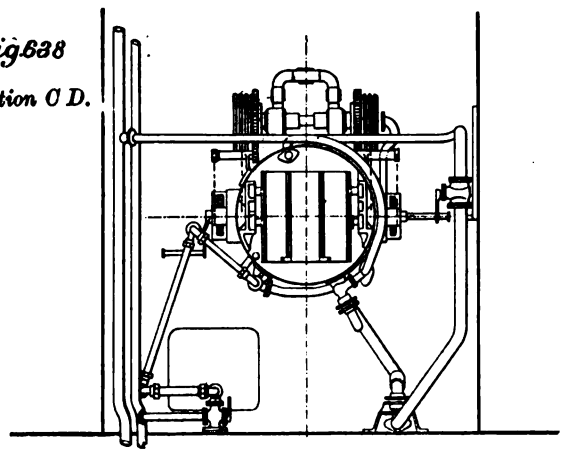


Fig. 638
Section C D.

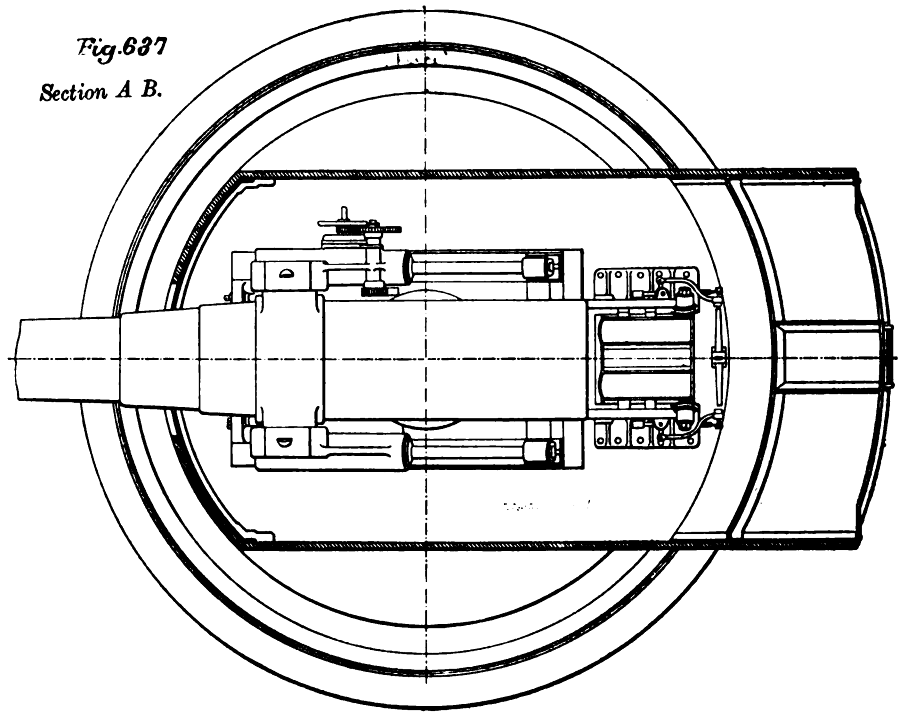


Fig. 637
Section A B.

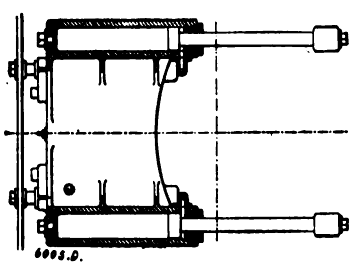


Fig. 639

papers. The subject is certainly one which appeals to an extremely wide circle, and a satisfactory answer to the query does not become any easier as time goes on. Probably for most lads it is wisest to follow rather those lines of life in which they have most prospect of commanding influence than those consonant with their particular tastes and aptitudes unless the latter are exceptionally marked. The principal drawback to this policy is to be found in the natural and healthy desire of most youths to steer their own course, and, if prevented, they may—if unsuccessful in after years—feel that the fault lies entirely with their parents or guardians. A reliable work, giving particulars as to the present position and prospects, and mode of entrance into the various businesses or professions is therefore calculated to fill a marked want; and so far as we are in a position to judge, this need is well met by the authors of "Professions for Boys, and How to Enter Them." The volume is divided into three sections, the first of which deals with home professions, ranging from the Army and Navy, to engineering, medicine, the stage, and commerce. In the second section, Indian professions are dealt with; and in the third miscellaneous professions, such as the consular service, the Royal Irish Constabulary, the various colonial police forces, and farming, tea planting, and mining abroad.

We are best qualified to criticise the section on engineering, and we are, on the whole, quite prepared to endorse the advice given. The different courses open to the embryo engineer are fully dealt with, the best plan, where funds permit, being, it is stated, for the youth to take a course at a good technical college before entering works or offices. Some engineers of prominence, we know, consider that the college course should follow the practical, but our experience leads us to in most instances disagree with them, though lack of funds or other circumstances may render it necessary in particular cases. The authors are, however, somewhat optimistic in estimating the pay to be expected by a lad of 20 to 21, which they place at 100*l.* to 120*l.* If these figures were halved, they would, we think, be considerably nearer the mark.

One of the most valuable features of the book are the estimates given of the cost of starting a lad in the different callings dealt with. The Army is apparently the most expensive, in view of the fact that until a certain rank is attained, the pay needs to be supplemented by a substantial sum per annum.

BOOKS RECEIVED.

A Handbook of Gold Milling. By HENRY LOUIS, M.A. Second Edition. London: Macmillan and Co., Limited; New York: The Macmillan Company.

Festschrift zur 40 Haupt-Versammlung des Vereins Deutscher Ingenieure in Nürnberg vom 11 zu 15 Juni, 1899. Herausgeben von FRANKISCH-OBERPFALZISCHEN, Bezirks-Verein Deutscher-Ingenieure. Nürnberg: E. Nister.

A Dissected Model of a Direct-Current Dynamo for the Use of General Readers and Students. By ARNOLD PHILIP, Assoc. R.S.M. London: George Philip and Son. [Price 4s. 6d. net.]

Terminal Index for Use with McNeill's Code. By BEDFORD MCNEILL, Assoc. M. Inst. C.E. London: Whitehead, Morris, and Co., Limited. [Price 7s. 6d.]

Elementary Practical Mathematics. By FRANK CASTLE, M.I.M.E. London: Macmillan and Co., Limited; New York: The Macmillan Company. [Price 3s. 6d.]

Magnetism and Electricity for Beginners. By H. E. HADLEY, B.Sc. (Lond.). London: Macmillan and Co., Limited; New York: The Macmillan Company. [Price 2s. 6d.]

Notes on the Construction of Cranes and Lifting Machinery. By EDWARD C. R. MARKS. New and enlarged edition. Manchester: The Technical Publishing Company, Limited. [Price 3s. 6d. net.]

Problems on Machine Design. By CHARLES H. TRINES, M.A. Second edition. Manchester: The Technical Publishing Company, Limited. [Price 4s. 6d. net.]

Machines Marines. Cours de Machines a Vapeur Professé a l'Ecole d'Application du Genie Maritime. Par L. E. BERTIN. Paris: E. Bernard et Cie. [Price 30 francs.]

Elements of Precise Surveying and Geodesy. By MANSFIELD MERRIMAN. New York: John Wiley and Sons; London: Chapman and Hall, Limited. [Price 2.30 dols.]

Heat and Heat Engines. By FREDERICK REMSEN HUTTON, E.M., Ph.D. New York: John Wiley and Sons; London: Chapman and Hall, Limited. [Price 21s.]

Transactions of the Liverpool Engineering Society. Vol. XX. Edited by R. C. F. ANNETT, Assoc. Inst. C.E., Honorary Secretary. Liverpool: Published by the Society.

Over-Pressure. By S. DE BRATH and F. BEATTY. London: George Philip and Son. [Price 3s. 6d.]

The Department of Havana, and Military Governorship of Havana. Annual report for fiscal year ended June 30, 1899. By WILLIAM LUDLOW, Brigadier-General, U.S.V., Havana.

Theorie der Parabolischen Brückengewölbe. Von HEINRICH HAASE. Regensburg: Kommissionsverlag der Nationalen Verlagsanstalt.

The Design and Construction of Dams, including Masonry, Earth, Rock-Fill, and Timber Structures, also the Principal Types of Moveable Dams. By EDWARD WEYMANN, M. Am. Soc. C.E. Fourth edition, revised and enlarged. New York: John Wiley and Sons; London: Chapman and Hall, Limited. [Price 5 dols.]

The Slide Rule: its Principles and its Application. By JOHN W. NASMITH. Manchester: J. Nasmith; London: John Heywood.

Regelung der Motoren Elektrischer Bahnen. Von Dr. GUSTAV RASCH. Berlin: Julius Springer. [Price 3 marks.]

Notes et Formules de l'Ingénieur du Constructeur-Mechanicien du Métallurgiste et de l'Electricien. Par un Comité d'Ingénieurs, sous la direction de CH. VIGREUX et CH. MILANDRE. Twelfth edition. Paris: E. Barnard et Cie. [Price 12 francs.]

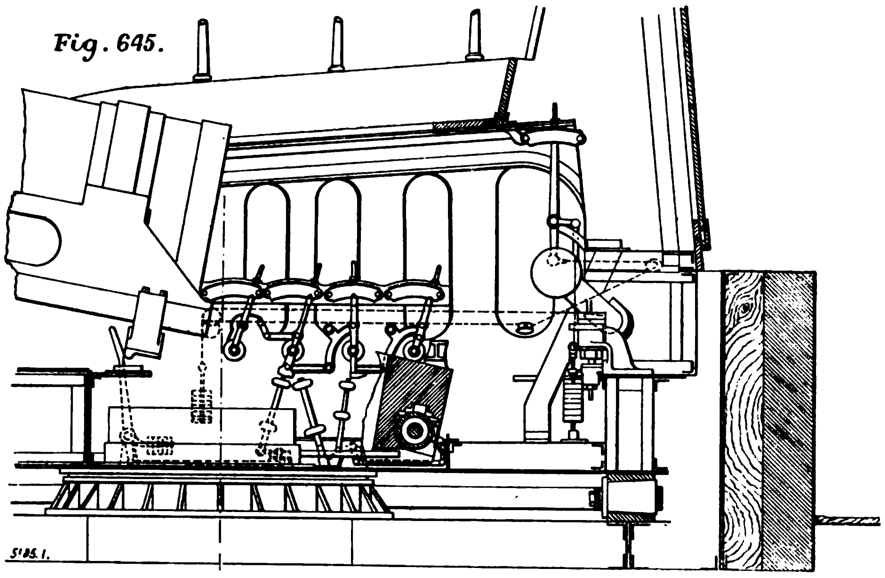
MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXX.

SCHNEIDER-CANET NAVAL TURRETS—(*continued*).

Barbette Turret for 32-Centimetre (12.598-*In.*) *Gun.*—Turrets of this type have been built, among other ships, for the Pelayo, of the Spanish Navy. The gun is held by tongues and grooves in a carriage which travels on a slide formed of two beams pivoting round horizontal trunnions attached forward to the floor of the platform; between the beams are the recoil cylinders and the intermediate compensator, the system being completed by clamps and buffers. The recoil piston-rods are fitted to two lugs in the front of the carriage; in the rear is the intermediate piston-rod. The intermediate piston is made with a series of small vents, and the recoil cylinders are provided with reglets of varied section, calculated to maintain a practically constant effort during the period of recoil. When the gun is fired, the carriage in recoiling moves the piston-rods in the cylinders; this causes the liquid to flow through the rectangular vents, and to lift the valves until it reaches the intermediate cylinder. When the recoil is complete, the valves fall back on their seats, and the gun remains run in. To run it out for firing anew, water under pressure is delivered through a special pipe to another cylinder, and the front of the intermediate cylinder is connected with the exhaust. In conducting operations inversely, the gun would be run in.

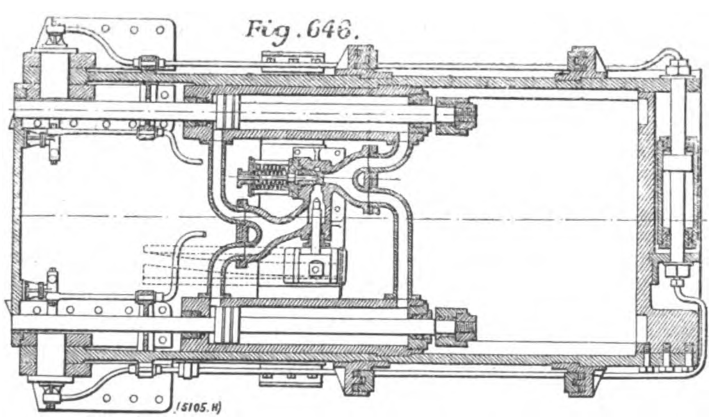
The gun, carriage, and mounting rest on the movable platform, which consists of two beams joined by a circular built-up girder. The framing of the turret is stiffened by radiating stays. A staging of plates and angles in front carries the hydraulic cylinder for elevating the gun. The whole of the platform rests, with the interposition of a series of rollers, on a ring bolted to the deck. The central ammunition tube is provided at the top with a ring, which insures the accurate guiding of the system. Below the armoured deck is fixed a lateral training circular piece, which surmounts the guiding socket fixed to the frame that carries the hydraulic cylinders. Inside the tube are the guides, hydraulic cylinders, and gear, for the working of the hoist. The gun is elevated by means of an hydraulic cylinder, the piston-rod of which, acting on the underside of the carriage, causes the latter to oscillate round its trunnions. Lateral training is obtained by connected hydraulic cylinders, placed underneath the armoured deck; the piston-heads carrying each a pulley round which passes a plate-chain that surrounds the rack fixed to the tube. The two ends of the chain being fixed to the hydraulic cylinders, it is sufficient, in order to train the gun, to put one of these cylinders in connection with the accumulator and the other with the exhaust. The distribution valves are worked by a small hand-wheel within easy reach of the gunner. For loading, the gun has to be elevated to its maximum angle. Ammunition is raised by means of a drum carrier with three compartments; the working is controlled by the hydraulic cylinders and gear; an hydraulic automatic brake controls the delivery from the hoist at the top staging. The carrier is mounted on a roller truck, which by travelling in the slides is brought to the rear of the breech; it is free to turn round its axle, so as to place successively each one of its compartments opposite the bore. To the rear is the telescopic rammer,

Fig. 645.



PLATFORM WITH STARTING AND CONTROLLING MECHANISM.

Fig. 646.



HYDRAULIC BRAKE FOR 340-MILLIMETRE GUN.

with the help of which each part forming the charge is driven home. Manœuvres on the lower staging are carried on with the help of hydraulic cranes and tackle, made to travel on a circular line fitted to the deck-beams. Illustrations of this turret, ammunition hoist, and mounting, will be published in an early issue.

Barbette Turret for 340-*Millimetre* (13.386-*In.*) *Gun.*—Turrets of this type (which is illustrated by Figs. 640 to 644 of our two-page plate, and by Figs. 645 and 646) have been built for the French battleship Marceau; they comprise the carriage and its slide, the turret, the elevating and lateral training mechanisms, and the hoist. The gun is invariably joined to the movable carriage, which constitutes the mounting proper, by a tongued and grooved ring which surrounds the breech-end. The carriage rests on shoes forming clamps on the slide-paths of the main beams of the mounting, which consists of two vertical parallel cheeks, strongly stayed together. Recoil is governed by two hydraulic cylinders, which act at the same time as controllers in running out the gun, which can be effected at all angles by introducing water under pressure to the rear of the recoil pistons. The whole of the system rests on the movable platform, to which is fitted a vertical tube formed of plates, as illustrated by Figs. 640, and 641; ammunition is supplied through this tube. It extends down to the magazines placed under the armoured deck, and is guided at both ends; as will be seen from Figs. 641 and 644, it is used to rotate the turret, through the hydraulic cylinders and chain on a lower deck. The distribution chest for water under pressure is placed at the level of the lower staging. The mounting and all its mechanism are completely protected by the fixed armour, and also by a light structure which turns with the platform. In the rear is the gunner's stage, surmounted by a shield.

For elevating the gun, the slide pivots rounds its trunnions in front, the trunnion plates being fixed to the movable platform; the latter rests, with the interposition of a ring of rollers, on the fixed circular path bolted to the upper deck. Elevation is obtained by means of an hydraulic cylinder, the piston of which, placed under the slide, causes the whole of the mounting to rise or fall; a valve-chest with a lever, within easy reach of the gunner, is suitably arranged for obtaining the required actions. The lateral training mechanism consists of a toothed ring fixed on the tube (see Fig. 643) and surrounded on half its circumference by a plate-chain. Pulleys are mounted on the ends of the piston-rods of the two hydraulic parallel cylinders, and around these pulleys the chain passes. When one of the cylinders is opened to the pressure, the other is free to the exhaust; so that when one ram is protruded, the other is withdrawn to an equal amount. Lateral training, therefore, is obtained by putting one or the other of the two cylinders in connection with the accumulator, according to the direction of rotation required. The valves are worked by a handwheel controlled by the gunner; a special mechanism operated by the same handwheel causes a continuous revolution more or less quick, one way or the other; the rotating movement stops when the handwheel is released.

For loading, the gun is elevated to its highest angle. In this position its centre line corresponds to that of an hydraulic rammer, with a telescopic ram carried on the turret platform; this rammer serves to drive home the projectile and the two half-cartridges. The charge-holder is of the same form as that already described; it has three tubes mounted on an axle, placed, when in position for loading, at the same angle as the gun; a partial rotation through 120 deg. brings the projectile and the two half-cartridges successively opposite the breech; an automatic latch-bolt fixes the barrel in the required positions. The charge-holder is worked by two hydraulic pistons, the cylinders of which are placed vertically in the tube, near the guiding slides. The two plate-chains are fixed at one end to the head of the piston-rods, and at the other to the plate which supports the charge-holder. The plate is also guided by two slide shoes which travel in the slides fitted to the tube. The charge-holder is mounted on a truck which renders it movable in its support, and which is fitted with two rollers that travel in vertical slides; these are made to branch off at their top part. This arrangement forces the truck to travel first vertically, and when it nears the breech, to slide back so as to take up a suitable position for the loading of the gun. At the lower staging, the operations follow each other thus: Cranes raise the projectiles and half-cartridges to the height of the lower deck, from where they are taken by a set of tackle that travels on a circular line made concentric with the ammunition tube. The tackle discharges in a cradle fitted to the lower part of the tube; the charges have then only to be slid in their compartments in the barrel. The gun can be loaded, whatever be the position of the firing platform.

THE DESIGN OF ROTARY CONVERTERS.*

By H. F. Parshall, M. Inst. C.E., and H. M. Hobart, S.B.

(*Continued from page* 450.)

Six-Phase Rotary Converter.

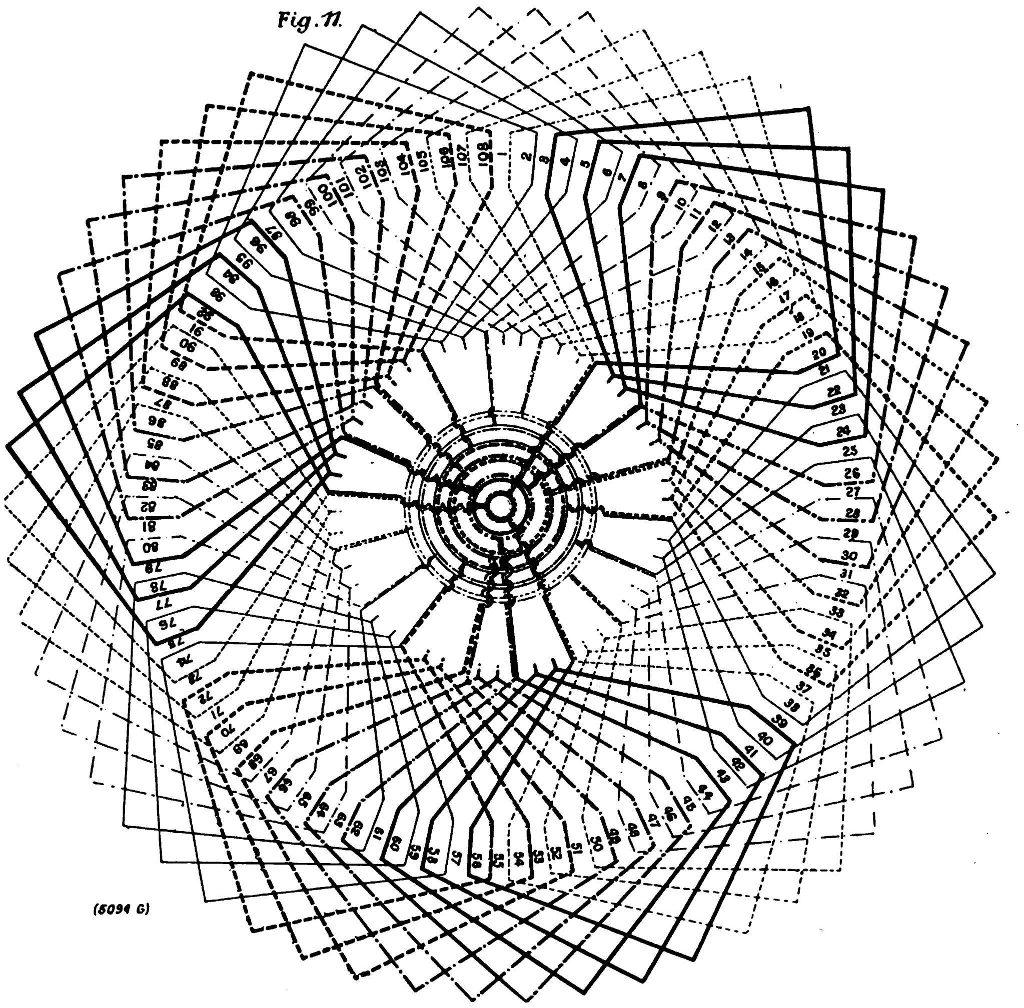
This disadvantage is mainly overcome in the so-called six-phase rotary converter, in which—as will appear later—the conductors of any one phase are distributed over only one-third of the entire periphery, as a result of which an almost simultaneous linkage of all the turns of one phase, with the entire magnetic flux, is obtained. The resultant output of such a machine, for a given heating of the armature conductors, increases, as stated in Table I. on page 391 *ante*, in the ratio of 1.38 to 1.98, *i.e.*, by 44 per cent. beyond that of an ordinary three-phase machine. As a matter of fact, this so-called six-phase is only a special case of three-phase arrangement. This distinction will be subsequently made clear.

Figs. 11, 12, and 13 (pages 517 and 518) are the same winding diagrams as for Figs. 8, 9, and 10 (pages 448, 449, and 450 *ante*), but with the connections made for so-called "six-phase" with six collector rings. This requires in each case subdividing the winding up into just twice as many sections as for the case of three-phase windings. A study of these windings will show that with these connections with six sections (where before there were three) the first and fourth, second and fifth, and third and sixth, taken in pairs, give a distribution of the conductors suitable for a three-phase winding, each of the above pairs constituting a phase. Furthermore, each portion of the periphery is now occupied exclusively by conductors belonging to one phase, *i.e.*, the first and fourth groups, the second and fifth, or the third and sixth, and in this way is distinguished from the previously described three-phase windings in which the phases overlapped.

The diagram (see Fig. 14, page 519) represents the difference.

Interconnection of Static Transformers and Rotary Converters.

For three-phase rotary converters, the transformers should preferably be connected in "delta," as this permits the system to be operated with two transformers in case the third has to be cut out of circuit temporarily for repairs.



Winding for a Six-Phase Rotary Converter. Six-Circuit Single Winding with 108 Conductors, Six Poles, Pitch, Front 19, Back 17.

A satisfactory method of connection is given in Fig. 15.

For six-phase rotary converters either of two arrangements will be satisfactory. One may be denoted as the "double delta" connection, and the other as the "diametrical" connection. Let the winding be represented by a circle (Fig. 16), and let the six equidistant points on the circumference represent collector rings, then the secondaries of the transformers may be connected up to the collector rings in a "double delta," as in the first diagram, or across diametrical pairs of points as in the second diagram. In the first case it is necessary that each of the three transformers have two independent secondary coils, as A and A^1, B and B^1, C and C^1, whereas in the second case there is need for but one secondary coil per transformer. The two diagrams (Fig. 17) make this clear.

In the first case, the ratio of collector ring to commutator voltage is the same as for a three-phase rotary converter, it simply consisting of two

* For previous articles see issues of September 29, page 389, and October 13, page 450.

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BARBETTE TURRET, AMMUNITION HOIST, AND MOUNTING FOR

CONSTRUCTED BY MESSRS

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Fig. 640.

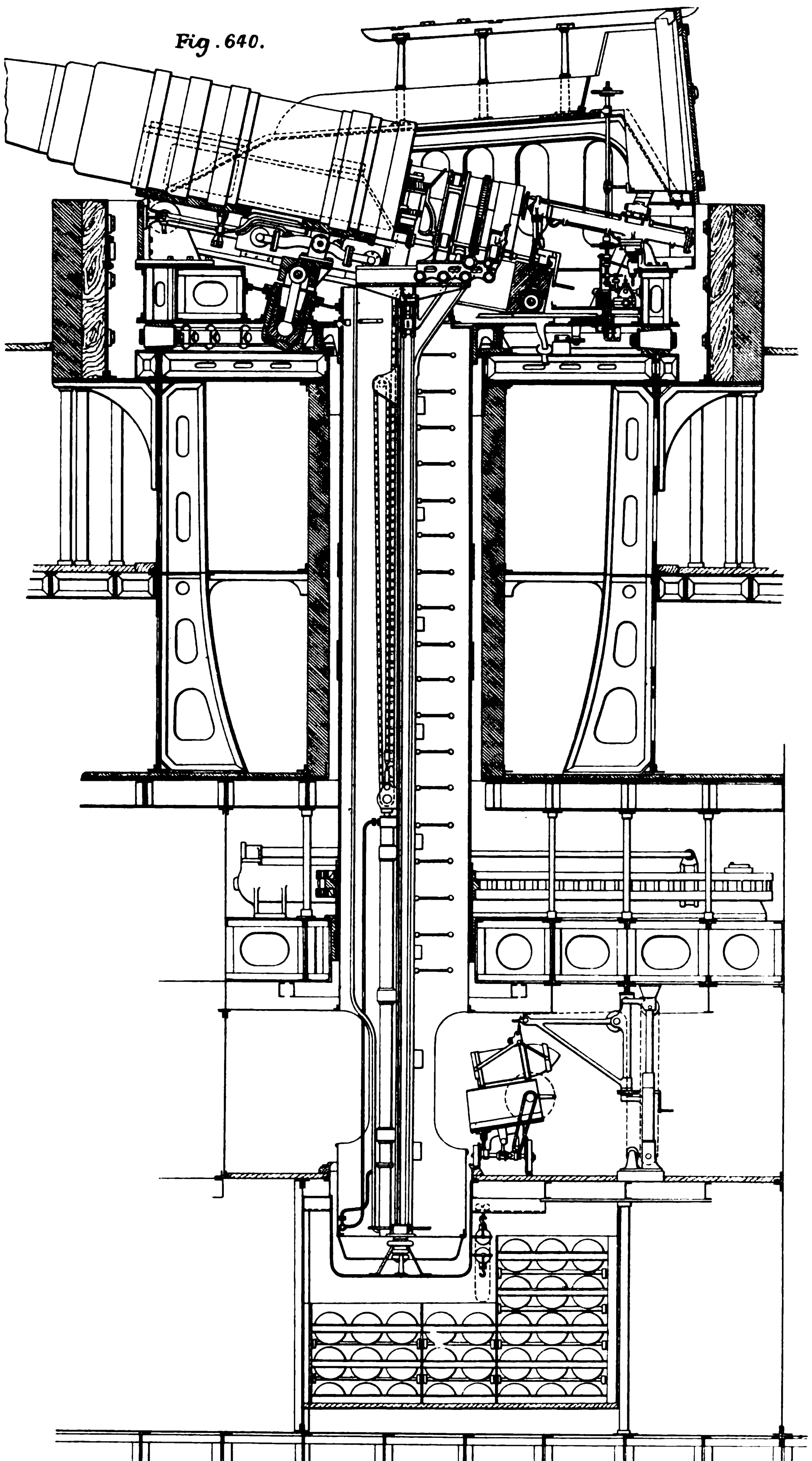
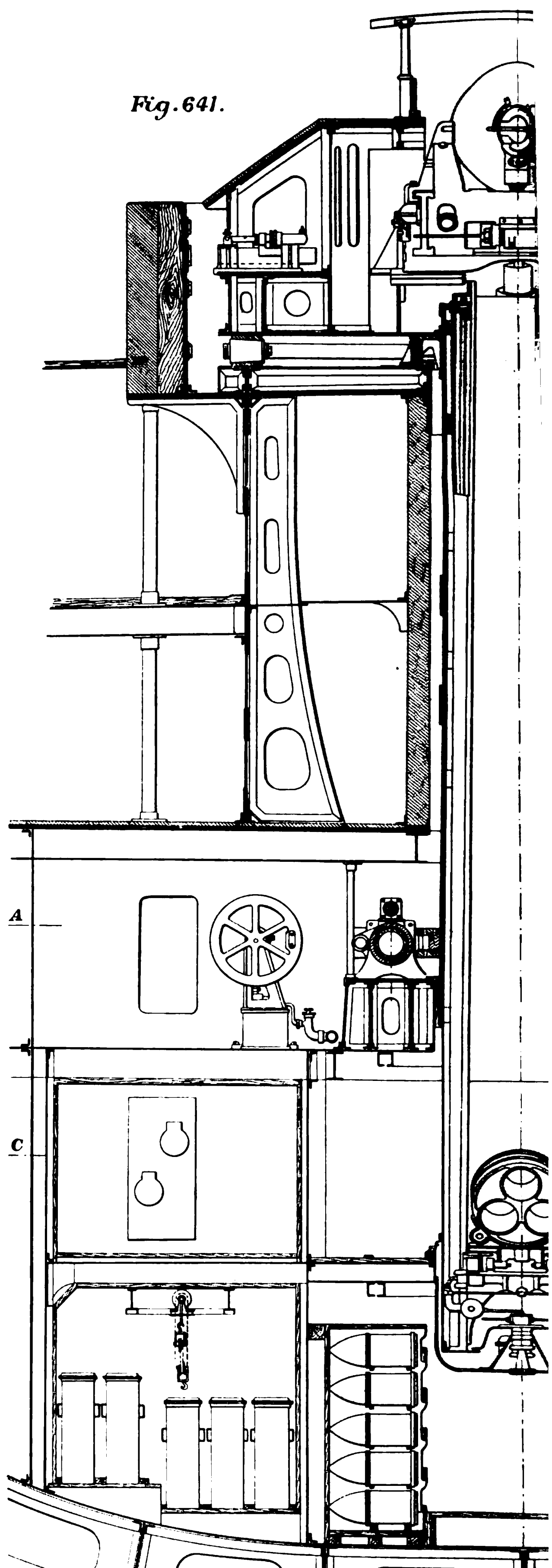


Fig. 641.



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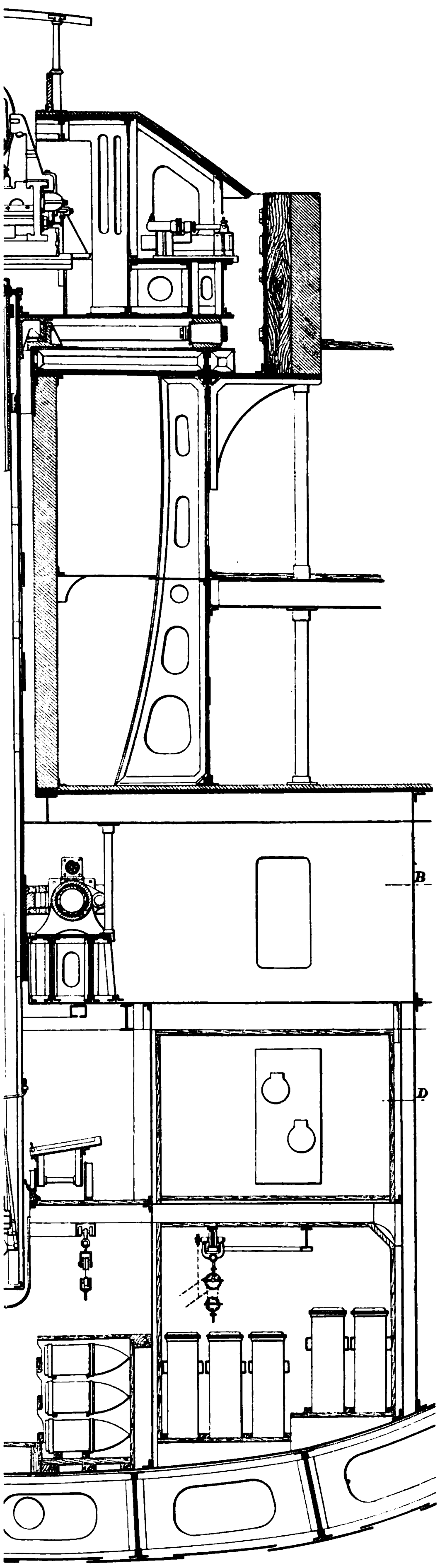
0-MILL. (13.386-IN.) GUN FOR THE FRENCH IRONCLAD "MARCEAU."

INEIDER AND CO., CREUSOT.

see *Page* 516)



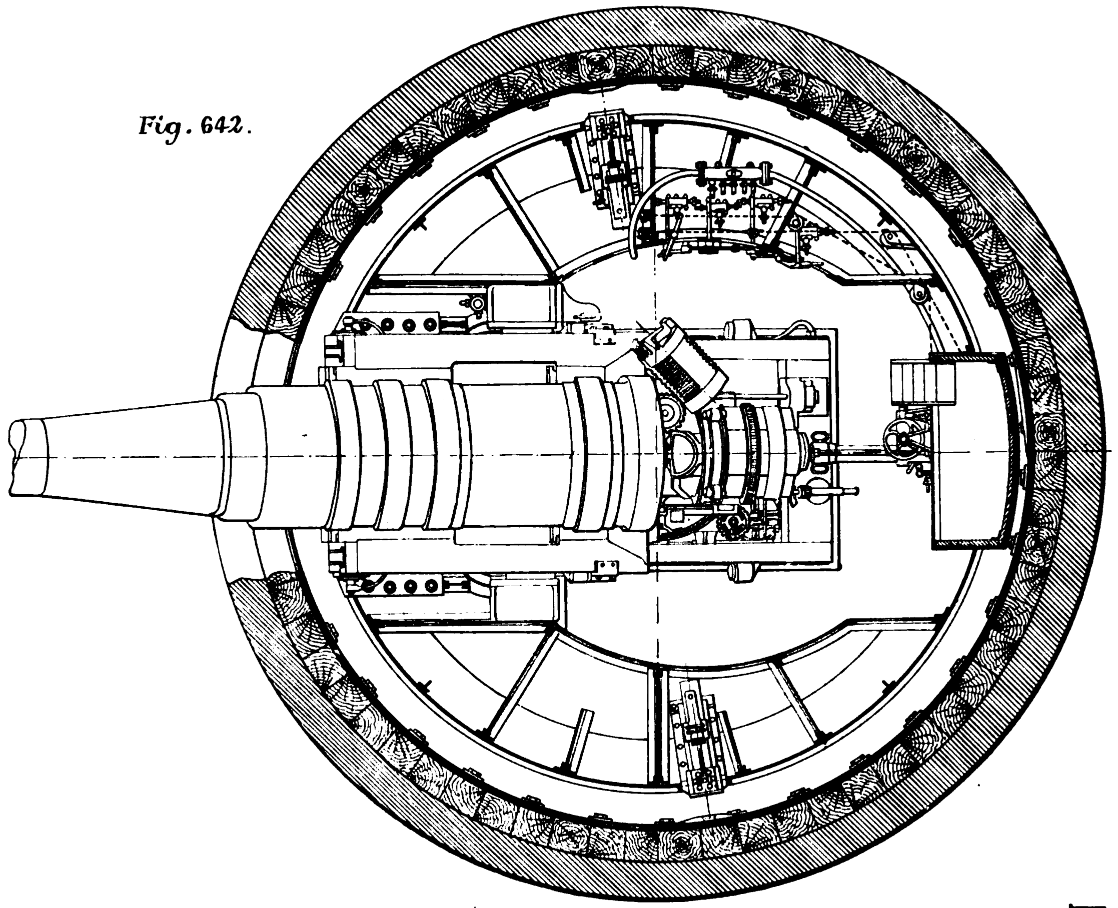


Fig. 642.

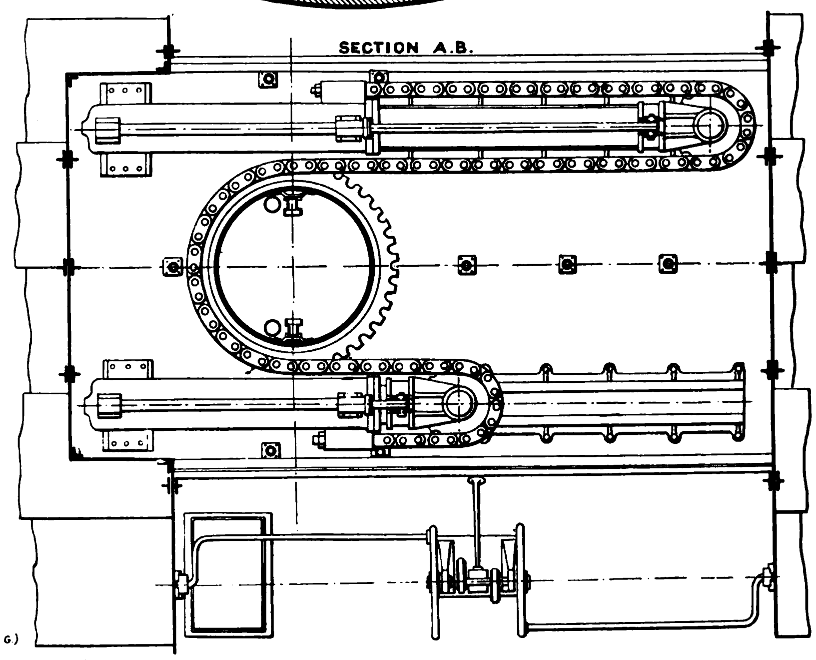


Fig. 643.

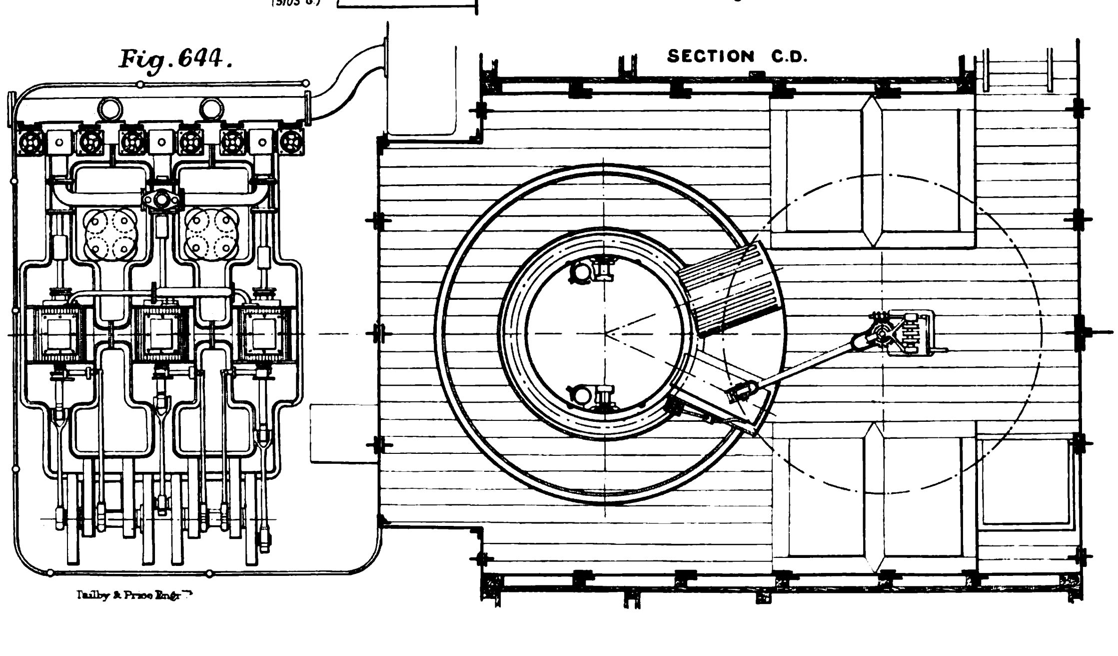


Fig. 644.

SCHNEIDER-CANET ELECTRICALLY WORKED TURRET FOR TWO 12-CENT. GUNS

Fig. 652. Section A.B.

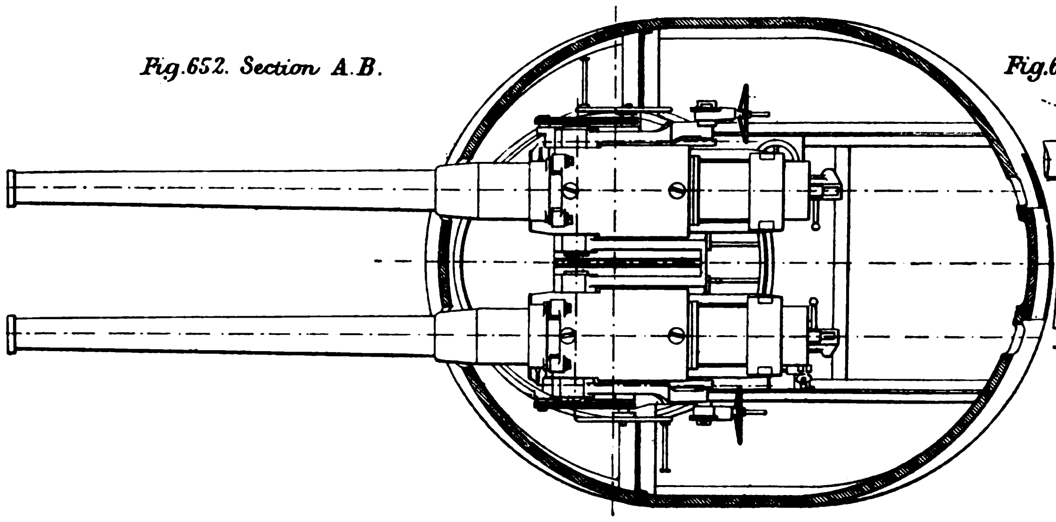


Fig. 653.

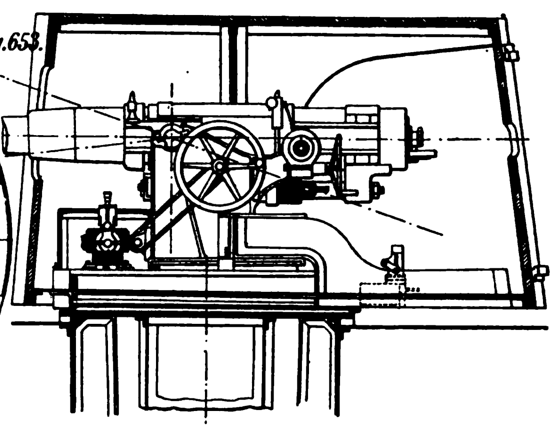


Fig. 654. Section C.D.

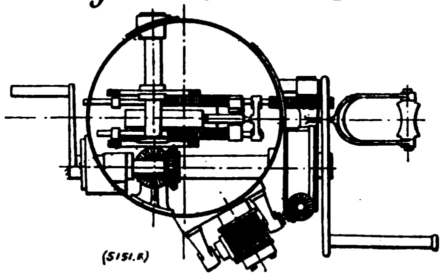
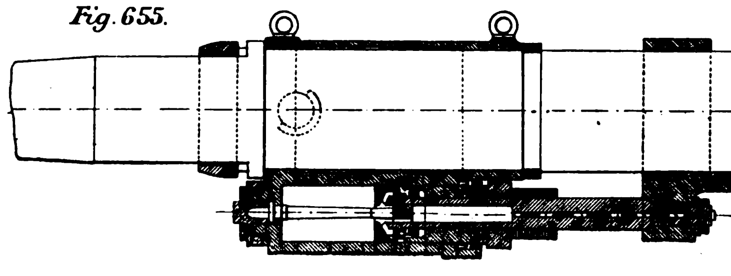


Fig. 655.



cuttings before it, and so keeps the chuck constantly clear. Fig. 11, page 655, illustrates a machine of the same type, fitted with a magazine carrying handwheels 5 in. in diameter, of the ordinary type. These are machined by five tools in the turret, the operations including turning the rim, facing and boring the bosses.

There seem, therefore, practically to be no limitations to the utilisation of the turret machines for operations on castings. It is not merely the saving of time which they effect over the ordinary operations of chucking and turning, though that is very great. It is the absolute uniformity in every piece turned out which will commend itself to engineers. There are no misfits; there is no such thing as "fudging" and "faking" to make parts fit, as in hand-operated lathes, if the tools and machines are kept up to their proper standard. The human element is almost knocked out. But since results depend so much on the manufacture and maintenance of accurate tools, and on sound and exact methods of measurement, the value—and, in fact, the absolute necessity—of the tool-room becomes apparent.

For the first time, we think, in the history of these shows, a tool-room equipment is laid out for exhibition. Here Messrs. Buck and Hickman have a Pratt and Whitney 10-in. toolmaker's lathe, with a box of about fifty tools. A Brown and Sharpe Universal milling machine, of the latest type, a Pratt and Whitney 14-in. pillar shaper, a Prentice 20-in. swing drilling machine, a little Giant tool grinder, a Millers Falls power hack saw; cases of the fine small tools which one can only obtain from America, and the Pratt and Whitney measuring machine, measuring to $\frac{1}{20,000}$ part of an inch, and indicating to about $\frac{1}{40,000}$th.

Several specimens of work done by the Bradley hammer are shown by Messrs. Buck and Hickman. They are, for large quantities of engineers' parts, as good as turned work—accurate, smooth, and polished. The cycle component makers, and the makers of small arms have shown us how to utilise the capabilities of the hammer, drop, or otherwise, and dies. But the method has not been utilised by engineers to anything like the extent desirable. The cost of dies, of course, is rather heavy, but that is relative, and it depends on how the work is set about, whether with experienced men, proper tools, and system, or otherwise. Suppose a pair of dies costs anything from a sovereign, to three or four sovereigns; that is a mere trifle in comparison with the results obtained, and the amount of tooling saved. Certainly, looking at these stampings at Messrs. Buck and Hickman's stand, and those more elaborate of of the makers of cycle parts, one feels that the stamping of engineers' work is yet in its infancy. We shall refer once more to this in another page, when speaking of the Crescent Company's cycle exhibit. One of the Bradley hammers will deal from 200 to 500 blows a minute, and 200 common forgings can be turned out under it in a day.

At the stand of Messrs. Schischkar and Co., and at some others, we noticed the jig vice, briefly mentioned in last year's account of the Show, as newly invented. Judging by the number seen this year, it has taken with the cycle makers, and may therefore be noted again.

Instead of solid jaws, a number of hexagon steel pins are contained in jaw casings. The casings are open at the ends, which are opposed to each other, and closed at the opposite ends with plates pierced with holes, through which the pins, which are reduced at the outer ends, project. A spiral spring encircles a portion of the reduced end of each pin, and being within the plate constantly tends to force each pin outwards. When a piece of work of irregular shape, globular or otherwise, is clamped between the rods in the jaws, the pins accommodate themselves to the outline, being pressed back against their springs, in which position they are secured by locking the side bolts. Messrs. Schischkar and Co. have a rather large collection of machine tools of various classes, among which may be noted a heavy capstan lathe of 9-in. centres, weighing about a ton, with 6-ft. bed. The turret base is exceptionally large—16 in. in diameter. The tool-holders slide radially in grooves on the turret face. It would be classed with the flat turret type of lathe. The movements are not automatic, excepting the screw-cutting motion. The hollow spindle takes bars to 1¾ in. in diameter. The machine is obviously a good slogger, with broad belt cones, and serviceable for turning out studs in quantity. Messrs. Pfeil and Co. have a good selection of machine tools, English and American, comprising lathes and drill ing machines, planer and shaper, grinders, key seaters, and small tools. In the galleries there were some exhibits of machine tools more or less connected with the cycle manufacture.

An account of the machine tools at the National Show we shall have to postpone until our next issue.

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXXI.

Schneider-Canet Naval Turrets—(*continued*).

Ship Turrets Worked by Electricity and by Hand Power, with Central Ammunition Tube (Figs. 647 to 655, pages 659 and 662).—The Schneider-Canet system of electric turrets has been largely supplied for various ships; they are now generally preferred to hydraulic turrets.

The increasing importance given to the application of electric energy on board modern ships was a sure sign that this comparatively new source of power would find its place in the working of turrets. It was first applied in various forms in the Schneider-Canet system of ordnance, for working hoists, for the elevation and lateral training of guns, opening out of the breech, firing the guns, in night sights, &c. The marked preference given to the new system is, moreover, fully justified, for the working of such installations by means of a liquid under pressure is an incomplete and not a satisfactory solution of the difficulties encountered, notwithstanding the degree of perfection to which the hydraulic system has been carried after many years of experimenting with progressive designs. The main difficulties with the hydraulic system lie in the defects of principle that surround the applying of an hydraulic motor for this special use; among the most serious may be mentioned:

1. The system involves the use of a large number of pipes, the rapid repair of which is often impossible.

2. The influence which great variations in temperature may have on the general working of the system.

3. The difficulty of training the gun accurately and rapidly with a *personnel* that has not been previously fully trained to the work.

4. The practical impossibility of arranging the

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SCHNEIDER-CANET ELECTRICALLY WORKED TURRET FOR TWO 12-CENT. GUNS.

(*For Description, see Page* 653.)

Fig. 647.

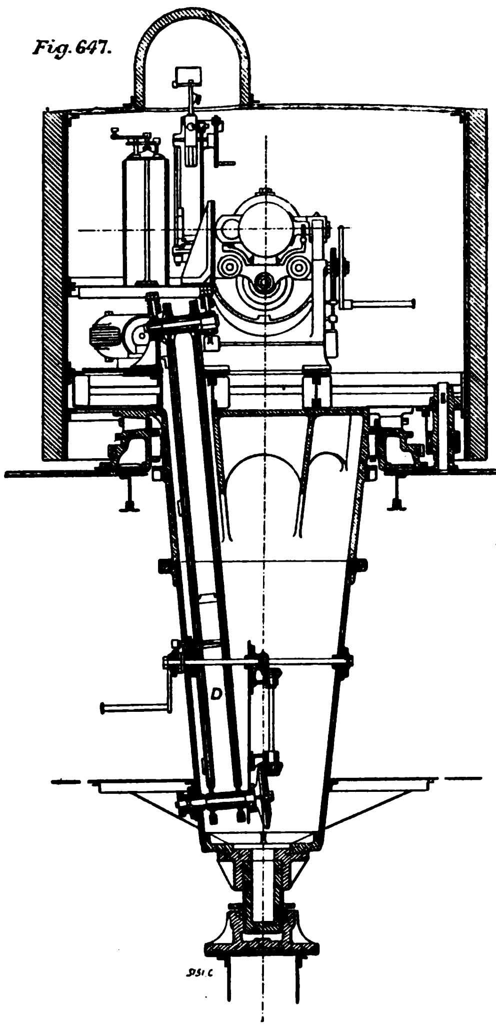


Fig. 648.

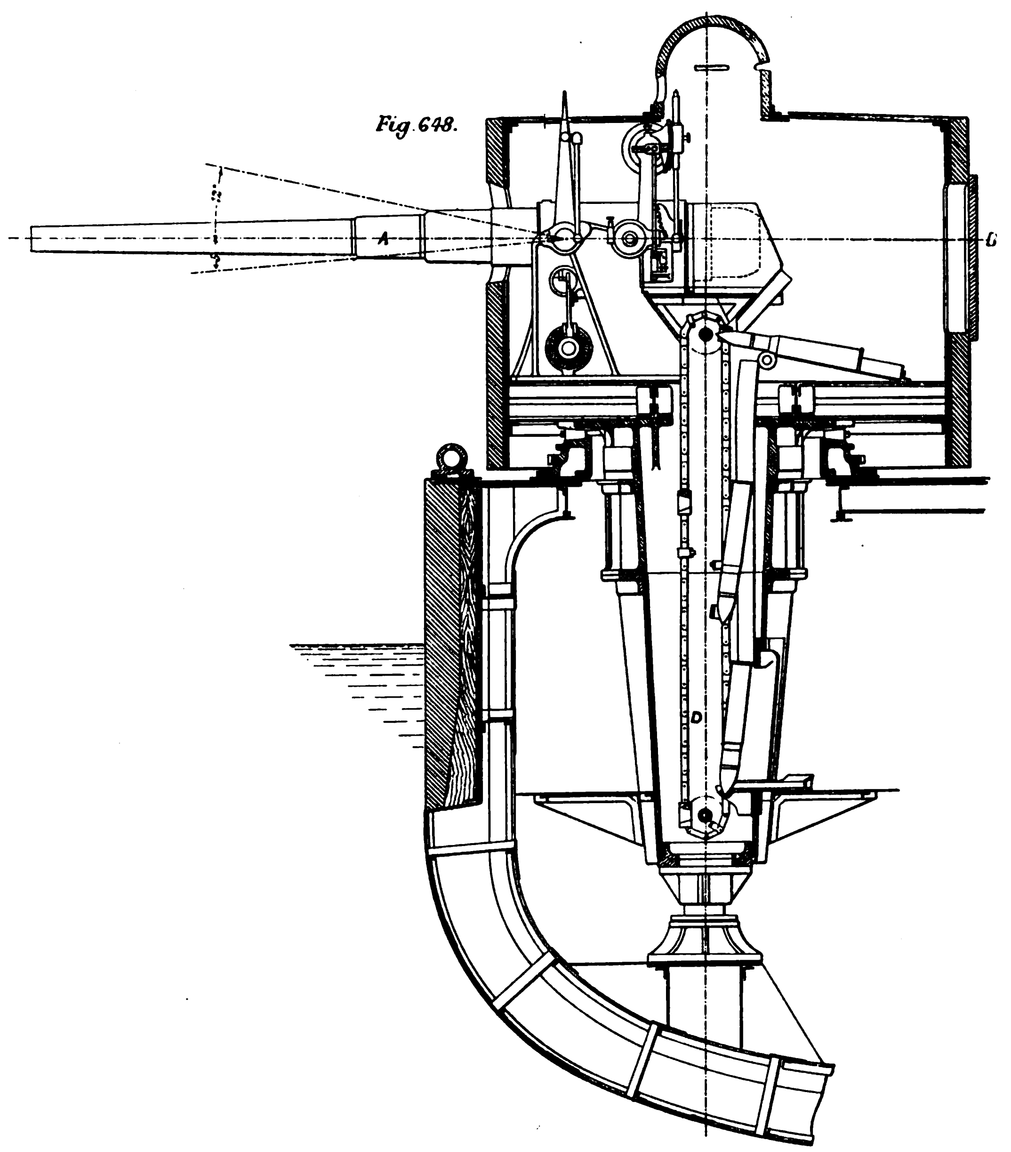
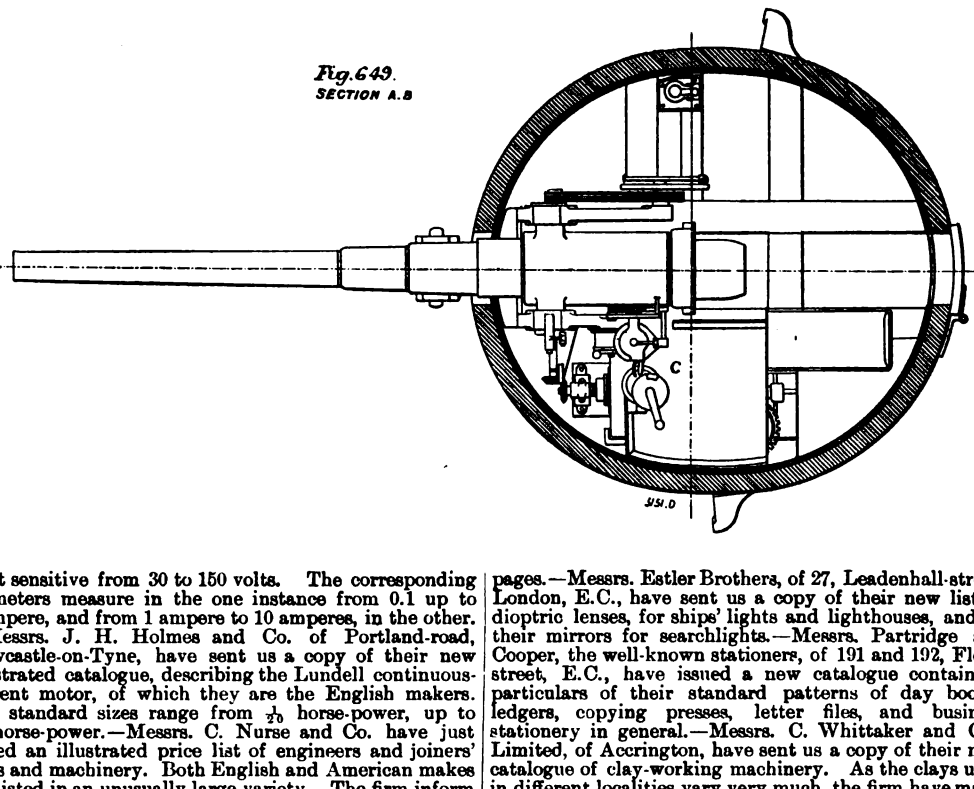


Fig. 649. SECTION A.B



Our Coal Abroad.—The exports of coal from the United Kingdom in October were 3,601,090 tons, as compared with 3,299,177 tons in October, 1898, and 3,223,926 tons in October, 1897. The heaviest exports were made, as usual, to France, the shipments to that country last month being 638,512 tons, as compared with 530,313 tons and 542,047 tons respectively. The aggregate shipments of coal in all directions for the ten months ending October 31 this year were 36,107,649 tons, as compared with 29,555,049 tons in the corresponding period of 1898, and 30,929,465 tons in the corresponding period of 1897. The great stride forward which our exports have made this year is, no doubt, due to the augmented demand following the partial suspension of business occasioned by the great strike in South Wales. The exports to France in the first ten months of this year were 5,616,470 tons, as compared with 4,453,617 tons and 4,695,927 tons respectively; to Italy, 4,644,353 tons, as compared with 3,898,026 tons and 4,182,764 tons; to Germany, 4,263,736 tons, as compared with 3,798,319 tons and 4,067,925 tons; to Sweden and Norway, 3,851,558 tons, as compared with 2,832,451 tons and 2,762,996 tons; and to Russia, 3,187,370 tons, as compared with 2,013,594 tons and 1,857,317 tons respectively. In addition to the direct imports of coal from the United Kingdom, coal was also shipped for the use of steamers engaged in foreign trade to the extent of 10,093,440 tons in the first ten months of this year, as compared with 9,214,186 tons in the corresponding period of 1898, and 8,651,741 tons in the corresponding period of 1897. In one way or another, accordingly, coal left our shores in the first ten months of this year to the aggregate extent of 46,201,089 tons, as compared with 38,769,235 tons in the corresponding period of 1898, and 39,581,206 tons in the corresponding period of 1897. We have thus been sending our coal abroad this year at the rate of something more than 1,000,000 tons per week.

Catalogues.—Messrs. Fielding and Platt, Limited, of Gloucester, have issued a new catalogue relating to the "Fielding" gas and oil engines, the types illustrated ranging up to 100 horse-power. For use in distant countries where there are few transport facilities, the firm supply a "sectional" oil engine, no individual part of which weighs more than 400 lb. The gas producers supplied by the firm are also described in the catalogue.—Messrs. Polland and Co., of 5, St. Nicholas Buildings, Newcastle-on-Tyne, have sent us a copy of a pamphlet describing the "Baz" pocket volt and ampere meter. Several patterns of voltmeters are supplied, of which the most sensitive has a scale reading from 0.5 to 3 volts, and the least sensitive from 30 to 150 volts. The corresponding ammeters measure in the one instance from 0.1 up to 1 ampere, and from 1 ampere to 10 amperes, in the other. —Messrs. J. H. Holmes and Co. of Portland-road, Newcastle-on-Tyne, have sent us a copy of their new illustrated catalogue, describing the Lundell continuous-current motor, of which they are the English makers. The standard sizes range from $\frac{1}{20}$ horse-power, up to 60 horse-power.—Messrs. C. Nurse and Co. have just issued an illustrated price list of engineers and joiners' tools and machinery. Both English and American makes are listed in an unusually large variety. The firm inform us that they will send copies of this catalogue to any address for 6d., which barely covers the cost of postage, since the volume consists of over 300 large pages.—Messrs. Estler Brothers, of 27, Leadenhall-street, London, E.C., have sent us a copy of their new list of dioptric lenses, for ships' lights and lighthouses, and of their mirrors for searchlights.—Messrs. Partridge and Cooper, the well-known stationers, of 191 and 192, Fleet-street, E.C., have issued a new catalogue containing particulars of their standard patterns of day books, ledgers, copying presses, letter files, and business stationery in general.—Messrs. C. Whittaker and Co., Limited, of Accrington, have sent us a copy of their new catalogue of clay-working machinery. As the clays used in different localities vary very much, the firm have made arrangements by which samples of clay can be tested at their works, thus providing data for the selection of the most suitable machinery.

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NOTES FROM THE NORTH.

GLASGOW, Wednesday.

Glasgow Pig-Iron Market.—At the forenoon session of the pig-iron warrant market last Thursday about 10,000 tons changed hands. Prices were very firm, and Scotch iron rose respectively 1½d. and 1d. per ton. About 15,000 tons were included in the afternoon sales, and prices were very firm, the afternoon advance ranging from 1½d. per ton to 3d. per ton. The settlement prices were: Scotch iron, 72s. 4½d. per ton; Cleveland, 70s. 10½d.; Cumberland and Middlesbrough hematite iron, respectively, 79s. 6d. and 81s. 3d. per ton. Only a small amount of business was done on Friday forenoon; the tone, however, was firm, and an advance was registered all round ranging from 1d. to 2½d. per ton. There was rather more doing in the afternoon market, which was strong, Scotch iron leaving off 6d. per ton up on the day, Cleveland 3d., and hematite iron 4½d. per ton. The sales for the whole day amounted to about 35,000 tons. The settlement prices were: 72s. 10½d., 71s. 1½d., 79s. 10½d., and 81s. 4½d. per ton. An active business was done on Monday forenoon, when the tone was irregular on the easier tendency of the trade advices from New York. About 50,000 tons were dealt in, and there was a decline all round, ranging from 4d. to 5½d. per ton. In the afternoon the market continued very flat, when other 20,000 tons changed hands, and on the day Scotch iron closed 9½d. down, Cleveland 6d., and hematite iron 7½d. per ton. The settlement prices were: 72s. 1½d., 70s. 6d., 79s. 3d., and 81s. 4½d., per ton. At the forenoon iron market on Tuesday some 20,000 tons of iron were dealt in. The tone was flat, and there was a decline in prices ranging from 7d. to 10d. per ton. In the afternoon about 30,000 tons changed hands, and the market became rather firmer, as much as 1d. per ton being recovered from the forenoon's close. The settlement quotations were: 71s. 7½d., 69s. 9d., 78s. 7½d., and 81s. 4½d. per ton. A good business was done this forenoon. The tone was firm, but the best prices were not maintained. They all advanced 1½d. per ton. The turnover would be about 30,000 to 35,000 tons. In the afternoon about 20,000 tons changed hands, and the tendency continued firm, and prices finished at the best, the settlement prices being: 72s., 70s, 79s, and 81s. 4½d., per ton. The following are the quotations for No. 1 makers' iron: Clyde, 84s. 6d.; Gartsherrie and Calder, 85s.; Summerlee, 86s.; Coltness, 88s. 6d.—the foregoing all shipped at Glasgow; Glengarnock (shipped at Ardrossan), 83s.; Shotts (shipped at Leith), 86s.; Carron (shipped at Grangemouth), 88s. 6d. per ton. Consumers both at home and abroad continue to show a strong desire to cover their requirements for all classes of iron, for deliveries well on in the following year, even up to the end of 1900. As a consequence, makers of g.m.b. iron have again advanced their prices, thus further widening the disparity between the prices of warrant iron and their quotations, a disparity in price which, it may be said, is absolutely inapplicable. A very important feature cropping up within the past few days is the strong demand that has set in for special brands of Scotch iron, and where makers are able to sell, heavy advances are being asked. American advices are again somewhat mixed, strong for near delivery, but uncertain for forward delivery. A big business continues to be done with local manufactured iron and steel works, which have evidently been booking a fair amount of fresh work. Business has lately been done in hematite pig iron at 86s. per ton delivered at the steel works during December and January. In February of this year the price was 64s. per ton. Founders are quiet, and there is not much fresh inquiry from Germany. The furnaces in blast now number 82, of which four are making basic iron, 40 hematite iron, and 38 ordinary, being the same as at the corresponding date of last year. Messrs. Connal and Co.'s stocks of pig iron stood yesterday afternoon at 268,111 tons, as compared with 272,142 tons yesterday week, and showing a reduction for the week amounting to 4031 tons.

Finished Iron and Steel.—Finished iron is firm at an advancement, which has been made during the week to the extent of 10s. per ton on all brands. Common Crown bars are now selling at 8*l*. 15s. per ton net at Glasgow. The Scotch steelmakers have issued a circular fixing cash day for the 10th of each month, which is practically equivalent to an advance of prices. There is a decidedly firmer tendency in the prices of steel, though nominally they are the same as those quoted last week. A demand for an advance of wages has been made of 5 per cent.

Glasgow Copper Market.—Nothing was done in copper last Thursday, either forenoon or afternoon, but sellers raised their quotations 1s. per ton. Nothing was done on the following day, and the cash quotations were withdrawn. The same report serves almost exactly for Monday and for yesterday, except that in the forenoon the price was marked down 2s. 6d. per ton. The quotations were erratic this forenoon, but in the afternoon they showed a recovery of about 12s. 6d. per ton, to 75*l*. 7s. 6d. per ton cash buyers, and 73*l*. 7s. 6d. three months' buyers.

Babcock and Wilcox's Recent Contracts.—Messrs. Babcock and Wilcox, Limited, have recently booked an order from Messrs. Thomas Wilson, Sons, and Co., Limited, Hull, to fit one of their large passenger boats, the s.s. Martello, with four of their largest-size marine type of water-tube boilers. Messrs. Babcock and Wilcox have also received an order from the British Admiralty to fit their boilers in the new vessel H.M.S. Espiegle. In addition to the above, this company have, during the last month, booked orders for the supply of fifteen boilers to be fitted on sand-pumping dredgers for the Queensland, New South Wales, and Indian Governments (the dredgers themselves being built by Sir W. G. Armstrong, Whitworth, and Co., Limited; also for the supply of boilers for two vessels trading to Odessa, the vessels being built by La Société Anonyme John Cockerill, Hoboken; and three boilers for the Paisley electric lighting scheme at a cost of 1635*l*.

West of Scotland Iron and Steel Institute.—At the second meeting of the West of Scotland Iron and Steel Institute, which was held on Monday evening, a discussion took place on "Central Condensing Plant for Iron Works." The chief speaker was Mr. James Riley, who praised Mr. Ray's paper very highly, and told what the Glasgow Iron and Steel Company were doing at the Wishaw Iron and Steel Works in the way of applying the principle to the engine of a steel bar mill, the condensing plant being about 400 yards away from the engine. They expected to be able to reduce the coal bill for the steel works to the extent of 25 per cent., and to be repaid in three years when all the engines are connected with the condensing system.

Institution of Engineers and Shipbuilders in Scotland.—At this week's meeting of the Institution a discussion took place on Dr. Purves's paper on "Lighthouse Engineering at Home and Abroad." Professor A. Barr sent a written communication to open the discussion, and Mr. Mallison, of Lloyd's, delivered a speech on the subject, chiefly reflecting on the incongruous character of the Commissioners on Northern Lighthouses, not one of whom has any practical or theoretical knowledge of the construction or the wo king of lighthouses. Dr. Purves replied at some length, especially thanking Professor Barr and Mr. Mallison for what they had said. Mr. John Barr, Kilmarnock Water Meter Works, read a short paper on "The Flow of Water over Bell-Mouthed Pipes." The discussion on this paper was held over till next meeting. Mr. W. J. Luke, naval architect, Clydebank Shipbuilding Yard, followed with a paper on "The Use of Bilge Keels in Modulating the Rolling of Ships." The discussion on this paper was also held over.

Chemical Industry Society.—At a meeting of this society, held in Glasgow last night, a paper by Dr. Anderson and Mr. Roberts, of the University Laboratory, was read by the former, on the "Elimination of Nitrogen from Coal in the Blast-Furnace and in Gas Retorts," and it was followed by one on the "Manufacture of Coke in Scotland." An excellent discussion took place on both papers.

NOTES FROM SOUTH YORKSHIRE.

SHEFFIELD, Wednesday.

Sheffield Electric Light.—The Corporation are applying to the Local Government Board for power to borrow another 100,000*l*. for the extension of its electric light and power undertaking. Last Saturday, when the city was enveloped throughout the day in a dense fog, the demand for current was abnormal, and the machinery and boilers were kept working at full pressure. Extensions have just been completed for the reception of a 2000 horse-power plant, which has to be ready for use early in the year. Further plant is needed.

Sheffield and the War.—Messrs. Vickers, Sons, and Maxim have booked an order from the Admiralty for the guns and gun mountings of four battleships. The gun mountings will be made at Barrow and the guns at Sheffield. The company are so busy in the gun-mounting department of the Barrow Works, that the present producing capacity is being doubled. On account of the development of each department of their business, Messrs. Vickers are about to increase their capital to 3,000,000*l*. by the issue of 250,000 1*l*. shares at 2*l*. premium. Messrs. Brown are issuing 40,000*l*. new capital at a premium of 20 per cent.

Coal-Mining in Yorkshire.—Interesting statistics have been published with regard to the coal-mining industry of Yorkshire. It is stated that from 1894 to 1898 inclusive, the number of workers employed in and about mines in Yorkshire has decreased by fully 20 per cent., whilst the output has increased by nearly 10 per cent. The output of the county in 1894 was 23,442,174 tons got by 90,995 men, or an average of 257½ tons per man for the year. In 1898 the output was 25,630,758 tons; men employed 72,556; average 353¼ tons per man. At the same time the complaint of irregular working is more general now than for many years past; and the increased output with fewer men is attributed by many to the increased use of coal-getting machinery in the mine, and of improved equipments at the pithead, whereby large quantities of coal are dealt with more automatically than was formerly the case.

The Midland Iron Company, Limited.—At the beginning of the year there was a reconstruction of this company, and the directors announce that the profits for the first nine months ending September, after making provision for interest on debenture and ordinary charges, were 8806*l*. 2s. 2d. There was brought forward from the previous year 1945*l*. 9s. 8d., making an available total of 10,751*l*. 11s. 10d. Out of this they propose to pay a dividend of 15 per cent. and carry forward 1487*l*. 10s. 7d. The reserve fund of the old company amounting to 15,000*l*., being invested in the assets of the company and not available for distribution, has been written off the freehold estates, &c.

Demand for War Material.—At the present time there is a scarcity of orders for heavy gun forgings, but there is plenty of work in engine forgings and castings for shipbuilding and the mercantile marine, both for the Government and private customers. For certain classes of shells, such as those now being used in the Transvaal, large orders have recently been placed, and more are expected. This refers more especially to the Lyddite shell and quick-firing ammunition. There have been further advances in the prices of iron, and makers of open-hearth steel have put up their quotations another 5s. per ton. There is a very heavy weight of orders on hand. Old steel railway rails have doubled in price in the past few months.

Coal and Coke.—Some of the leading railway companies have already opened negotiations with South Yorkshire coalowners for next quarter's supplies. The impression is being entertained that there is going to be a "boom" in the coal trade. Coalowners can command almost any price for steam coal, and gas coal is scarce. All sorts of coke are in brisk demand. The recent heavy fogs have seriously disorganised the mineral railway traffic.

NOTES FROM CLEVELAND AND THE NORTHERN COUNTIES.

MIDDLESBROUGH, Wednesday.

The Cleveland Iron Trade. — Yesterday there was a numerous attendance on 'Change, but the market was disorganised, and little business was transacted. This state of affairs was brought about by London holders of Middlesbrough warrants realising, and thus causing a smart drop in warrants. The result was that buyers of pig iron, who have been very busy lately, paused when they saw the fall. It was, however, generally admitted by legitimate traders that fluctuations in warrants do not now form a considerable factor in the scale, and sellers of iron were not at all disposed to reduce their quotations. Customers still complain of the scarcity of pig, particularly those buyers who require the iron to ship abroad, for Continental firms are now getting anxious with regard to their stock for the winter. Sellers put the price of No. 3 g.m.b. Cleveland pig iron at 71s. for both prompt and forward delivery, and it was not easy to purchase at less, though some buyers endeavoured to do business at as much as 1s. below the foregoing quotation. Producers, however, all of whom are well sold, would not entertain any such offer. No. 1 Cleveland pig was quoted 72s.; No. 4 foundry, 70s.; and grey forge, 69s. Middlesbrough warrants came down with a rush to 69s. 7½d., and they closed very quiet at 69s. 8d. cash buyers. East-coast hematite pig iron was not obtainable for this year's delivery, and it was almost impossible to get at quotations. Makers have not only no stock, but they have sold their output for a month or two ahead, and there is now only some 11,000 tons in the warrant stores, so that it may almost be said that there is no iron available. Perhaps about 82s. 6d. may be given as a nominal figure for early delivery of Nos. 1, 2, and 3. There was nothing at all doing in Middlesbrough hematite warrants. Spanish ore was strong. Rubio was 20s. ex-ship Tees. To-day there was no change in the market so far as quotations for makers' iron were concerned. The amount of business doing was only small. Middlesbrough warrants rallied a little and closed 69s. 11d. cash buyers, but holders as a rule were not prepared to do business at that figure.

Manufactured Iron and Steel.—A most satisfactory and encouraging account may be given of the manufactured iron and steel trades. In every department there is not only very great activity, but customers keep coming forward with new orders and are eager to place them. Quotations all round have a very decided upward tendency, and further substantial advances have again been made for several descriptions. Iron ship-angles are now 7*l*. 12s. 6d. to 7*l*. 15s.; iron ship-plates, 7*l*. 17s. 6d.; steel ship-angles, 7*l*. 15s. to 7*l*. 17s. 6d.; steel ship-plates, 8*l*.; common iron bars, 8*l*. 15s.; best bars, 9*l*. 5s.; and steel boiler-plates, 9*l*. 5s.—all less the customary discount. Heavy sections of steel rails are stiff at 7*l*. net at works, and a good demand for them is reported.

Engineering and Shipbuilding.—Engineers keep very well employed. Messrs. Head, Wrightson have just received some good orders for bridge-work, and other firms in the district are kept very busy. Shipbuilders are chock full of work, and recently additional orders for vessels have been given to north-eastern firms. Most of the yards are in a position to keep in full swing for the greater part of next year.

Coal and Coke.—There is continued firmness in the coal trade. Bunker coal is scarce and very firm in price. For early delivery, sales have been made at 13s. f.o.b.; for forward delivery higher prices are asked. There is practically no gas coal to be had for early delivery, and it is difficult to fix quotations. Deliveries on contracts are heavy. Manufacturing coal is steady, without much change in price. Coke is very firm, and none too plentiful. Rates have a strong upward tendency. Average blast-furnace coke delivered here is quoted from 22s. 9d. upwards.

NOTES FROM THE SOUTH-WEST.

Cardiff.—The placing of Admiralty orders for 150,000 tons of steam coal to be delivered between the present date and the close of March, 1900, at prices ranging from 18s. to 19s. per ton, has had an appreciable effect upon the market, and steam coal for prompt and early shipment has become almost unobtainable. The best descriptions have been quoted at 18s. 6d. to 20s. 6d. per ton, while secondary qualities have brought 17s. to 18s. per ton. The house coal trade has also been firm; No. 3 Rhondda large has been making 17s. 9d. to 18s. per ton. Coke has also been in strong demand; foundry qualities have brought 28s. to 30s. per ton, and furnace ditto 24s. to 25s. per ton. As regards iron ore, the best rubio has been quoted at 18s. to 18s. 6d. per ton.

Official and Private Steam Trials.—The Lords of the Admiralty have directed that in future, when a vessel is built at a private dockyard, and is sent to a naval port for her official trials, the contractors are to be allowed to subject the vessel to a basin trial of her machinery, and also a

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preliminary trial at sea before she commences her official trials. Contractors generally will welcome this order, as it has frequently happened that a ship has been sent on a 30-hours' trial without the engineering staff having a fair opportunity of making necessary adjustments in the machinery. The Admiralty also direct that in future every vessel is to have a basin trial after her machinery has been opened out for inspection on completion of her official trials.

Welsh Coal for the Navy.—The British Admiralty authorities placed on Friday orders with Welsh firms for the supply of about 150,000 tons of the best steam coal. These requirements are for coaling the fleet off South Africa and other foreign stations, and deliveries are to be made between the middle of November and the end of March. The prices obtained by the contractors range between 18s. and 19s. per ton net. The following is a list of the contracting firms, and the quantity of coal to be supplied by each: Insole's Merthyr Colliery, 40,000 tons; Cambrian Collieries, Limited, 20,000 tons; Ocean Coal Company, Limited, 20,000 tons; National Colliery, 20,000 tons; Nixon's Navigation Coal Company, Limited, 20,000 tons; Ferndale Coal Company, 10,000 tons; Locket's Merthyr Colliery, 6000 tons; Ynisfano Colliery, 5000 tons; and Crawshay Brothers, Limited, 3500 tons.

Obsolete Vessels.—The Lords of the Admiralty have decided to offer for sale out of the service the corvettes Carysfort, Conquest, and Constance, the armoured cruiser Shannon, the third-class cruisers Hyacinth and Heroine, and the turret ship Prince Albert, all now lying at Devonport. The three corvettes were built in 1881-3 at a cost of 369,432*l*.; the two third-class cruisers in 1880-2 at a cost of 185,000*l*.; the Prince Albert in 1865-6 at a cost of 208,345*l*.; and the Shannon in 1877-8 at a cost of 302,722*l*.

The Swansea Valley.—Continued activity prevails in the tinplate trade. The steel trade is also in a flourishing condition. Work at the spelter establishments is regular and satisfactory, and the outlook at the Mannesmann Tube Works is encouraging. The various foundries are well off for orders.

The "Montague."—Although No. 3 slip from which the Bulwark was launched at Devonport has been vacant for more than a fortnight, there is no probability of the keel of the new battleship Montague being laid until the end of next month. During the past fortnight over 200 tons of steel plates and angles have arrived for the new vessel, and the staff of the machine-shop have been busily employed preparing this for the actual work of construction, so that when the keel of the Montague is laid down, the early stages of her building will probably be advanced quite as rapidly as those of her predecessors. The Lords of the Admiralty have placed an order with the Steel Company of Scotland for the stem of the Montague. The stem-piece will be of cast steel, and will weigh about 30 tons.

The "Blonde."—The dockyard officials at Devonport have been instructed to survey the Blonde, cruiser, recently ordered to pay off in consequence of defective boilers, and to give an estimate of the cost of reboilering and otherwise refitting her. She will be supplied with water-tube boilers, but of what type has not been decided. The Bellona, which relieves the Blonde, was recently reboilered and refitted at a cost of about 50,000*l*.—more than half the vessel's original cost when she was built in 1889-91. It is not likely, however, that the Blonde's refit will cost nearly so much as that of the Bellona, as it is understood that a complete set of water-tube boilers suitable for her engines can be purchased for less than 10,000*l*., while the other work necessary to render the vessel efficient will certainly not cost over 20,000*l*.

MISCELLANEA.

The armoured trains used in South Africa are fitted with steam pumps and a considerable length of hose, thus enabling them to draw their water from any watercourses crossed by the line. The pump used in some cases is of Merryweather's "Valiant" pattern, and takes its supply of steam from the boiler.

The *Australian Mining Standard* states that the Fosterville Gold Mining Company, New Zealand, is profitably working a reef yielding only 2 dwt. 7 grains of gold per ton, the total cost of mining, milling, and recovery being but 5s. 9d. per ton treated. Another company in the same district is stated to have paid dividends out of a 2-dwt. extraction.

A placer bed, containing but one pennyworth of gold to the cubic yard is now being worked on Flint Creek, Montana. The gravel bed is 65 ft. to 85 ft. deep, and is free from large boulders. An ample supply of water being available, it was possible to work the bed by hydraulic methods, and the local conditions being in other respects exceptionally favourable, the owners have found it possible to work at a profit in spite of the extremely low content of the precious metal.

In an American patent recently published, Mr. W. A. McAdams, of Brooklyn, claims that the tensile strength and the toughness of a number of aluminium alloys can be greatly augmented by cooling them as rapidly as possible after pouring. He asserts, for example, that an alloy containing 72 parts of aluminium, 24 parts of zinc, and 4 parts of copper when cast and cooled in the ordinary way, showed a tensile strength of 22,000 lb. per square inch, whereas a similar bar cast and rapidly cooled, showed a tensile strength of 39,000 lb. per square inch. The reason given for the benefit derived by the adoption of quick cooling is that segregation is thereby diminished.

A novel arrangement of rail joint has been adopted for the street railways of Scranton, Pennsylvania. The rails in question are of T-section, and weigh 57 lb. per yard. The joint is made in the first instance with long fishplates, only differing from the ordinary American pattern in being a little heavier than usual, and this is reinforced by a 4-ft. length of the same rail inverted and riveted to the flanges of the main rails by eighteen ⅞-in. rivets. These rivets are closed by portable pneumatic riveters, and four of them are of copper, and thus act as a "bond" to convey the current from one rail to the next. The rails used are furnished in 60-ft. lengths, thus reducing the number of joints.

Very contradictory opinions as to the use of compressed air machines for painting have been forwarded to a committee of the American Association of Railway Superintendents of Bridges and Buildings. Whilst six members favoured the machines three opposed them, and nine replies were non-committal. It would seem from the statements made that unless careful workmen are employed there is considerable waste of paint, and the committee finally report that "the air machine, like all new things, will have to overcome a certain amount of prejudice before it will come into general use. As it is improved by experience, and the men operating it understand it more thoroughly, it will be extremely useful on large buildings and some bridges." As to the sand blast, they report that this seems likely to come into general use for cleaning ironwork preparatory to painting it.

Dr. Ludwig Mach has successfully alloyed aluminum with magnesium, and thereby obtained a compound which can be worked like brass, and which is lighter still than aluminum. The densities of the two metals are: Magnesium, 1.75; aluminium, 2.75; they both melt at 800 deg. Cent., and their dilations amount to 0.023 and 0.027 millimetres per metre and per degree Cent. The metallurgical properties depend upon the composition of the alloy. A 10 per cent. magnesium alloy resembles zinc, a 15 per cent. alloy is like brass, and a 25 per cent. like a compound bronze. The alloys can be soldered, it is stated, though that point does not appear to be fully settled, keep well in dry and damp air, and give good castings. The alloy is almost as white as silver, and so hard that it is possible to cut aluminium with a sharp-edged piece of magnalium. It can be turned, bored, &c., quite as well as brass, and clean and neat threads of ¼ millimetre pitch can be cut with ease. It does not file so readily as brass, but is superior in this respect to copper, zinc, and aluminium. Magnalium is suitable for lens mountings, and would make good divided circles and arcs for instruments, in which light weight is a consideration. If bought by volume it is a little less expensive than brass.

An interesting machine has recently been built for the Pencoyd Iron Works by Messrs. William Sellers and Co., of Philadelphia. The machine in question is a multiple-punching machine, capable of punching ten holes at a time, the spacing of these punches being variable, and any punch can further be put out of action without interfering with the others. In addition to this the machine spaces the rivet holes automatically to any desired pitch from zero to 8 in., advancing by sixteenths. It is thus possible to punch plates without using templates, even when the drawings show considerable irregularity in the rivet arrangements. Thus at the end of a plate extra holes may be needed for the attachments of brackets, stiffeners, or the like. To accomplish such work the ten punches are suitably spaced, those not needed being put out of action, and the first line of rivets across the plate punched by the machine. The plate is then pushed forward automatically to any distance desired, the punches readjusted to suit the next line of rivets and a second stroke made. This is repeated until the last of the special holes have been pierced, and then all the punches but two being put out of action, the holes near the edges are punched, the work being fed forward automatically at each stroke through a distance equal to the pitch. At need the latter can be varied by the attendant at any time by simply setting a couple of indices.

Mr. A. W. Richter, assistant-professor of experimental engineering at the University of Wisconsin, has recently made a very extensive series of experiments on the transmission of heat through metal plates. One side of the plate tested was exposed to steam at 212 deg. Fahr., whilst water, the rate of flow of which could be varied, was kept moving over the opposite face of the plate. Professor Richter concludes that the quantity of heat transmitted in B.T.U. may be represented by the following formula, viz.:

$$q = \frac{D\,(t - t_1)}{(a + B)} \cdot \left(\frac{x}{A} + 1\right).$$

t = temperature of steam.
t_1 = ,, water.
x = pounds of water moved over the surface per hour.
a = thickness of plate in inches.

A, B, and D are constants having the following values in different cases:

Values of A:

Mild steel, very smooth surface	6900
Brass, planed surfaces	7000
Cast iron, good surface, well rattled ...	8500
Mild steel, rough surface	9000

Values of B:

Brass	0.623
Cast iron	0.91
Mild steel	0.675

Values of D:

Brass	312
Mild steel	285
Cast iron	285

For the laboratory production of calcium carbide by the electrical method, Mr. S. A. Tucker, of the Columbia University (as he states in the *American Electrician*), employs a furnace consisting of a simple plumbago crucible, pierced at the side to take one of the carbon electrodes, whilst the other is suspended vertically over the charge by a chain. This charge consists of 56 parts of quick lime and 36 parts of coke finely powdered and evenly mixed. The vertical carbon is lowered until it forms an arc with the horizontal one, and the material is then gradually added. Good results are obtained with a current of 150 amperes at 50 to 60 volts, and it takes but a few minutes to form a carbide ingot of fine crystalline structure. The operation may be watched through thick smoked glasses. To form chemically pure carbides the plumbago crucible above mentioned may be lined with a layer of carbon. Mr. Tucker gives the following Table showing the properties of a number of these carbides and other products of the electric furnace:

Name.	Formula	Discoverer.	Remarks.
		Decomposed by Water.	
Aluminium	Al_4C_3	Moissan, 1894	Water evolves methane.
Barium ..	BaC_2	,, 1894	,, acetylene.
Calcium ..	CaC_2	Wöhler, 1862	,, ,,
Cerium ..	Ce_2C	Moissan, 1896	Water evolves acetylene, ethylene, and methane.
Glucinum ..	Gl_4C_3	Lebeau, 1895	Water evolves methane.
Lanthanum	LaC_2	Moissan, 1896	Water evolves acetylene, ethylene, and methane.
Lithium ..	Li_2C_2	,, 1896	Water evolves acetylene.
Manganese	Mn_3C	Troost and Hautefeuille	Water evolves methane and hydrogen.
Potassium	K_2C_2	Davy, 1808	Water evolves acetylene.
Sodium ..	Na_2C_2	Berthelot, 1866	,, ,,
Strontium..	SrC_2	Moissan, 1894	,, ,,
Thorium ..	ThC_2	Moissan & Etard, 1896	Water evolves acetylene, hydrogen, and hydrocarbons.
Uranium ..	Ur_2C_3	Moissan, 1896	Water evolves acetylene, methane, hydrogen, and solid and liquid hydrocarbons.
Yetrium ..	YC_2	Petterson, 1895	Water evolves hydrogen.
Zirconium	Z_2C	Moissan, 1896	Water evolves methane, acetylene, and ethylen.
		Not Decomposed by Water.	
Boron ..	B_6C	Moissan, 1894	Harder than corundum.
Chromium	Cr_3C_2	,, 1894	,, topaz.
Molybdnum	Mo_2C	,, 1893	
Silicon ..	SiC	Acheson and Moissan, 1893	,, corundum.
Titanium ..	TiC	Moissan, 1895	Takes fire at red heat.
Tungsten ..	W_2C	,, 1893	Harder than corundum.
Vanadium..	VaC	,, 1893	,, quartz.

The French Parliamentary paper (Etat H) embodying the shipbuilding programme has just been presented to the Chamber. It includes 112 vessels of all classes, of which 22 are described as completed and 67 as in hand, while 23 are proposed to be began. In the first category are the battleships Charlemagne, Saint Louis, and Gaulois, the commerce-destroying cruisers Guichen and Châteaurenault, two third-class cruisers, one gunboat, and 14 various torpedo craft. The largest of the vessels in hand are the battleships Henri IV., Jéna, and Suffren, and the armoured cruisers Jeanne d'Arc, Dupetit-Thouars, Gueydon, Condé, Gloire, Dupleix, Kléber, Desaix, Montcalm, Sully, Marseillaise, and Amiral Aube. The various torpedo craft in the list are 10 destroyers and 38 boats of other classes. The vessels in hand are classified as follows in regard to their anticipated dates of completion:

—	1900.	1901.	1902.	1903.	Total.
Battleships	2	1	..	..	3
Armoured cruisers	1	5	3	3	12
First-class ,, ..	1	..	..	..	1
Destroyers	6	..	4	..	10
Gunboats	3	..	..	..	3
Submarine	3	..	6	..	9
Squadron torpedo-boats ..	6	4	..	..	10
First-class ,, ..	9	9	..	..	18
Turbine torpedo boat ..	1	..	..	..	1
Totals..	32	19	13	3	67

The shipbuilding programme for 1900 is in a sense provisional. M. de Lanessan has announced his attention of presenting a scheme for the increase of the fleet, but is expected to take the advice of the chiefs of the navy, and will be heard on the subject by the Budget Committee. The principal vessels now proposed to be laid down are two battleships, "A 8" and "A 10" (Brest and Toulon), the largest yet built in France, and an armoured cruiser, "C 11" (Cherbourg). The plans of the battleships indicate a displacement of 14,865 tons; length, 439 ft.; beam, 78 ft. 9 in.; stern draught, 27 ft. 6 in.; armament, four 12-in. breechloaders, eighteen 6.4-in., twenty-six 1.8-in., and two 1.4-in. quick-firers, and five torpedo tubes, of which two are submerged; vertical triple-expansion engines of 17,475 indicated horse-power, supplied by water-tube boilers, and driving three screws, to give a speed of 18 knots; normal coal capacity, 905 tons; extreme, 1825 tons; complement, 42 officers and 780 men. The armoured cruiser is intended to displace 12,416 tons, with a length of 475 ft. 9 in.; beam, 71 ft. 2 in.; draught, 26 ft. 3 in.; armament, four 7.6-in., sixteen 6.4-in., two 1.8-in., and four 1.4-in., and five torpedo tubes, of which two are submerged; vertical triple-expansion engines of 24,000 indicated horse-power, supplied by water-tube boiler, driving three screws, and giving a speed of 21 knots; coal capacity, 1350 tons; complement, 23 officers and 687 men.

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SCHNEIDER-CANET ELECTRICALLY WORKED TURRET FOR TWO 12-CENT. GUNS.

(*For Description, see Page* 653.)

Fig. 650.

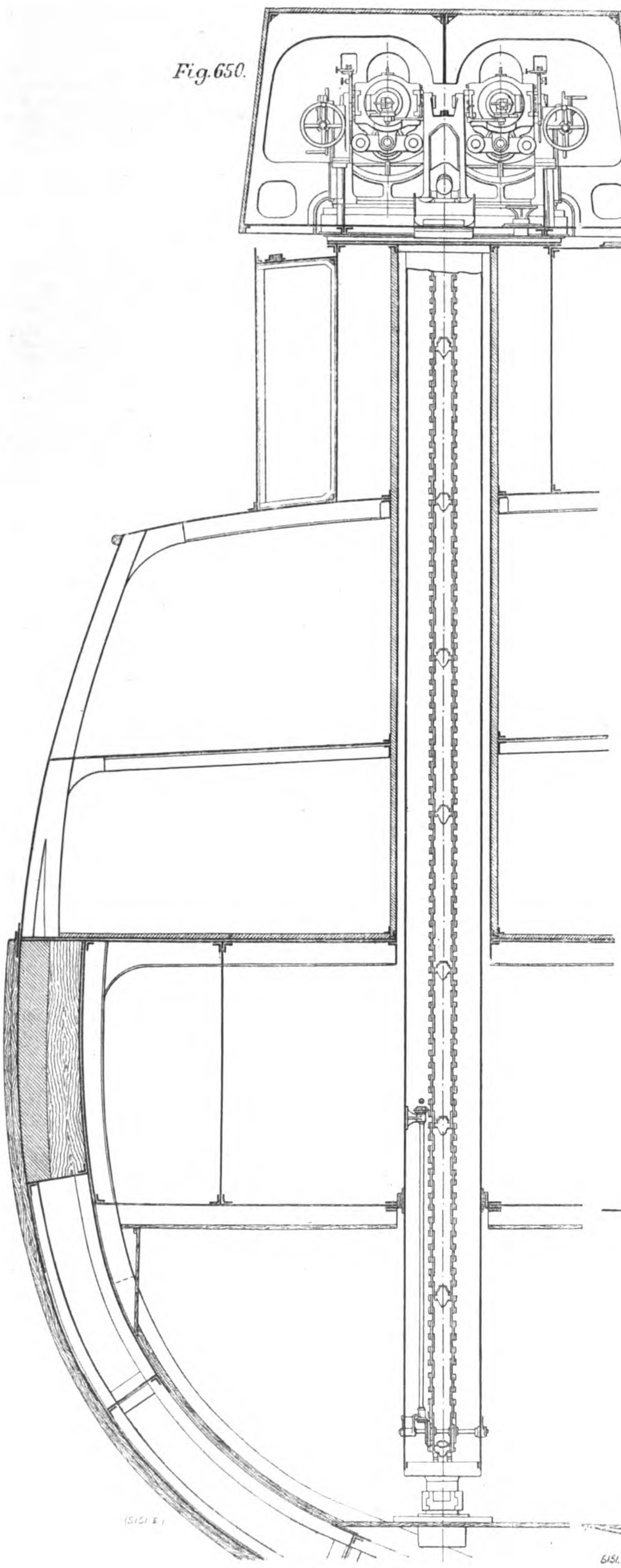
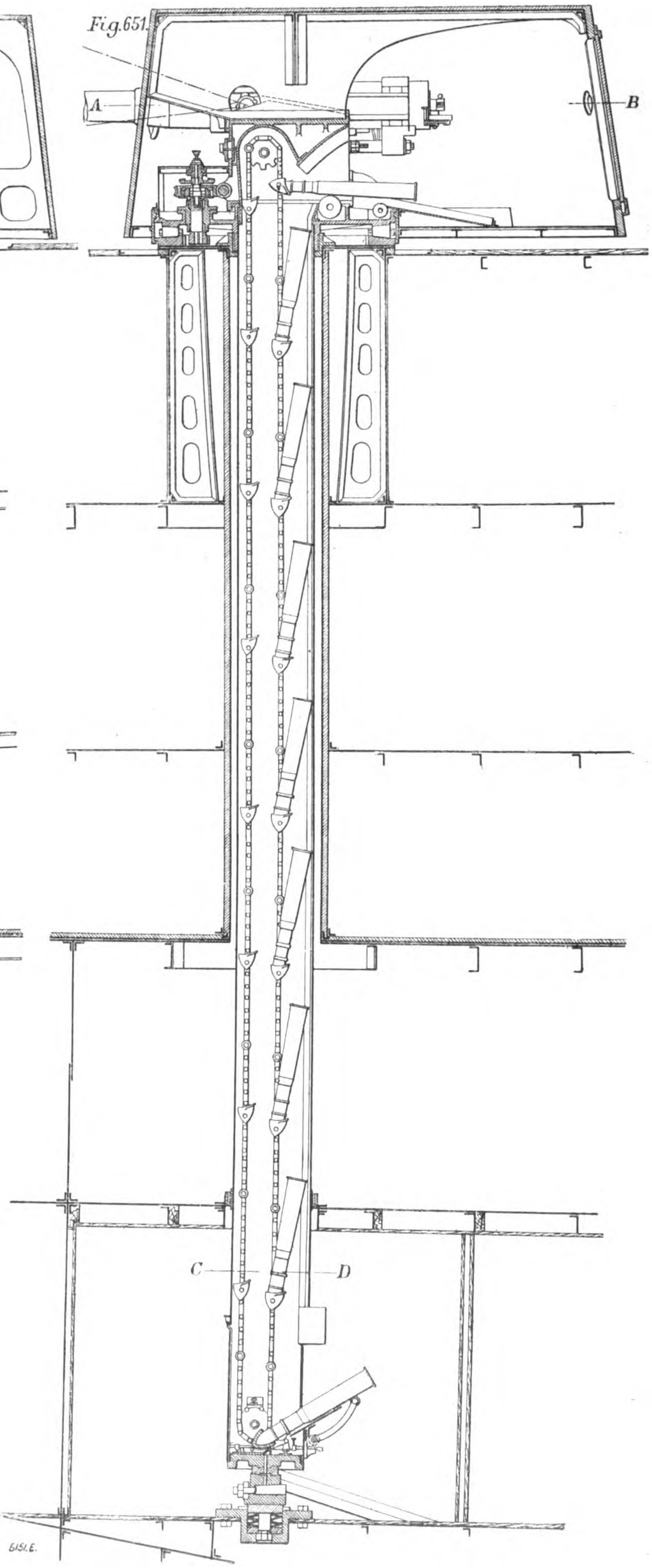


Fig. 651.



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SCHNEIDER-CANET TURRET FOR 15-CENTIMETRE GUN.

(*For Description, see Page* 685.)

Fig. 656.

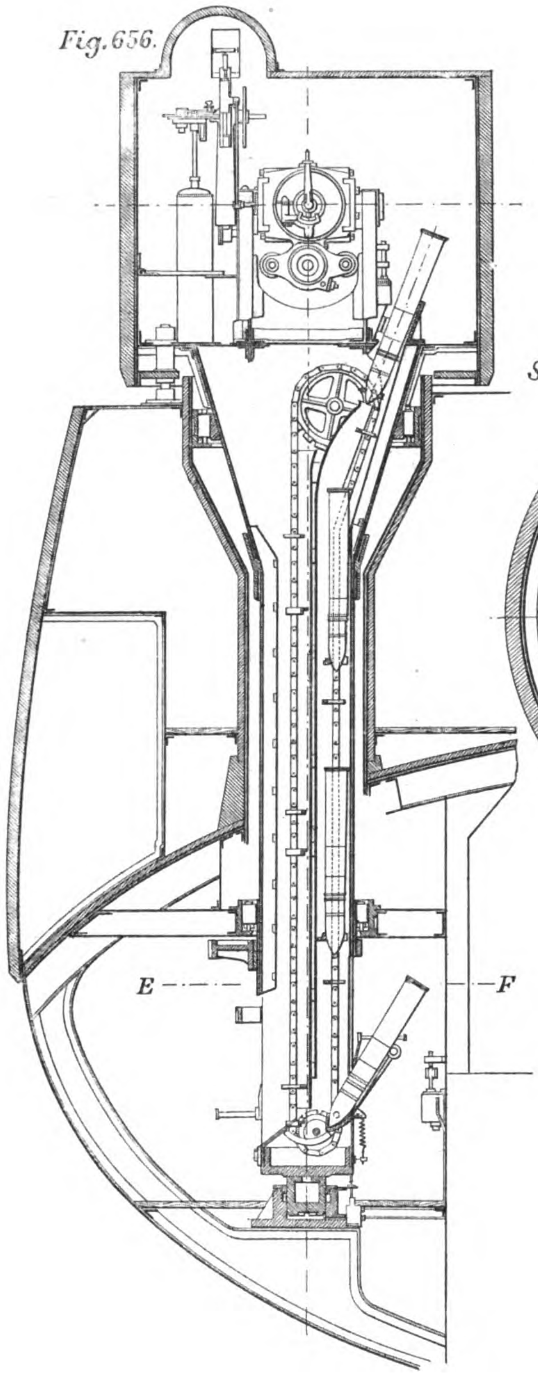


Fig. 657.

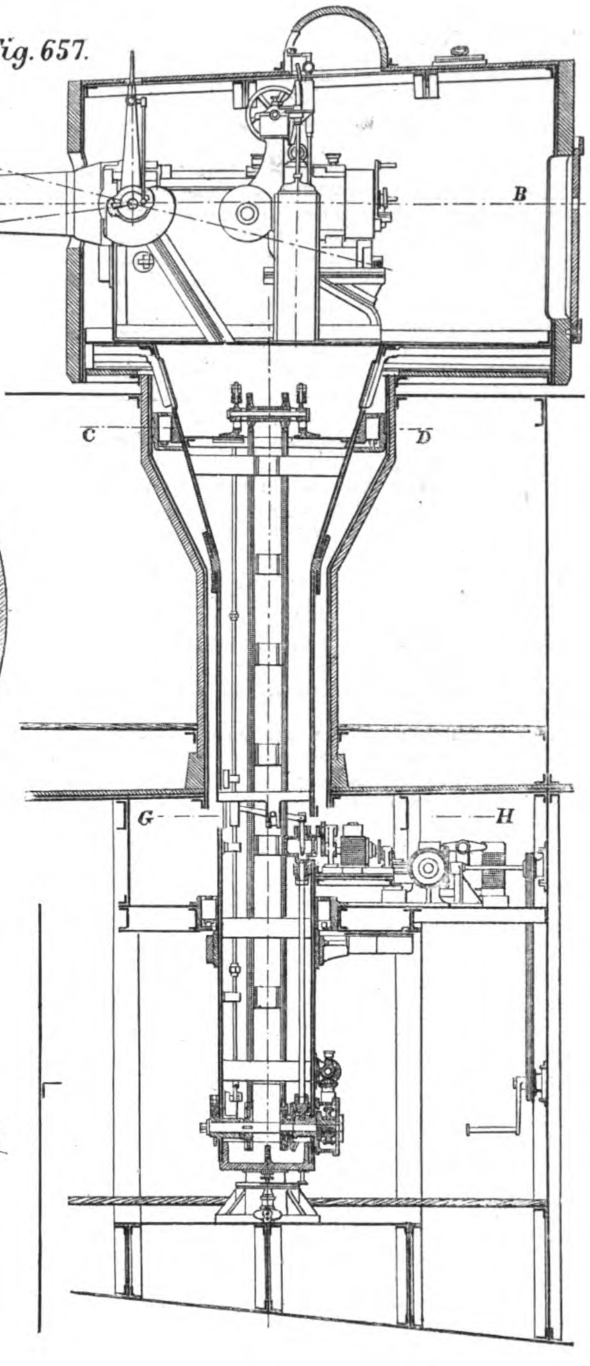


Fig. 659. Section C.D.

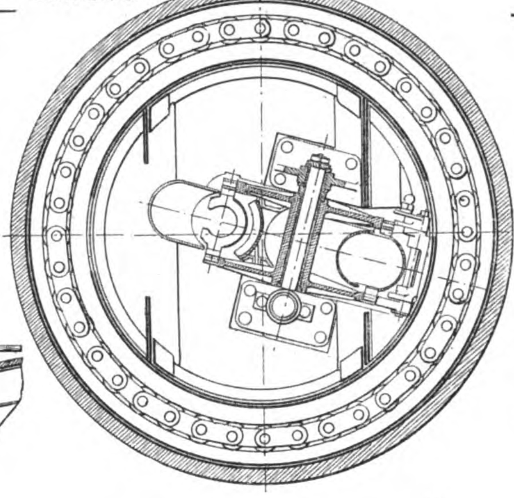


Fig. 660. Section E.F.

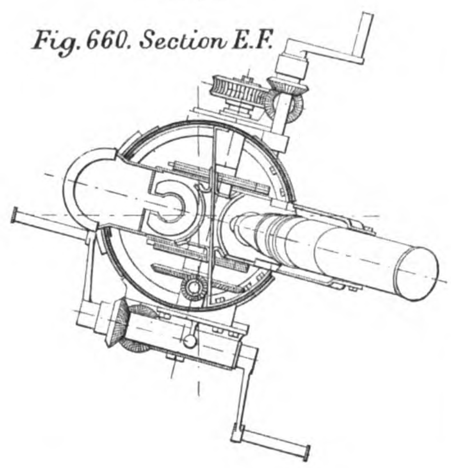


Fig. 661. Plan G.H.

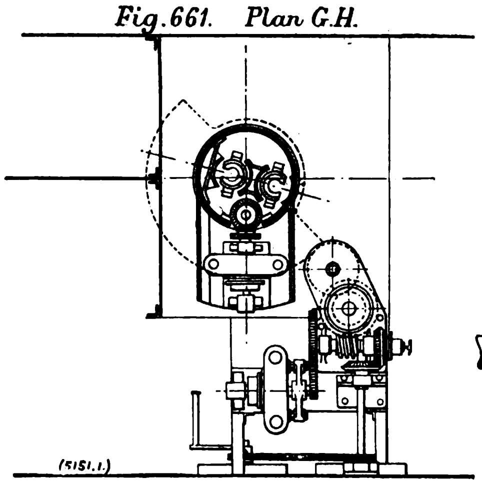
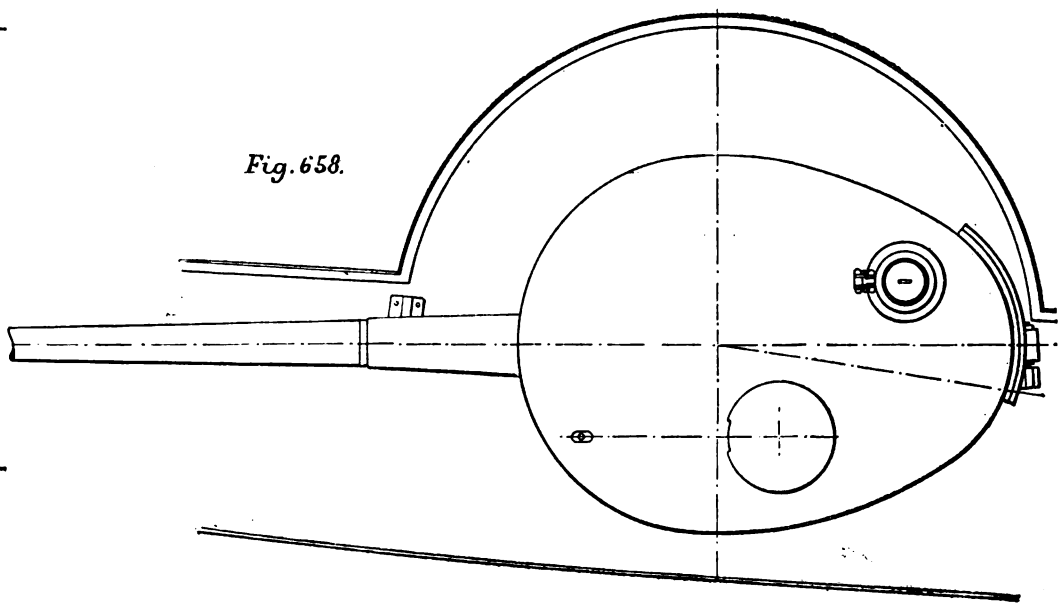


Fig. 658.



hitherto existed, it is generally the local custom to assess the property at a nominal rate, and sometimes by votes of towns or municipalities, property is exempted from taxation for a series of years, notwithstanding that such an exemption is considered without warrant of law, and imposes an undue burden upon a portion of the property owners.

The paper by Mr. Main dwelt upon the methods used in appraising the value of a mill building, and referred specially to the elements of depreciation, to a comparison between a new and an old mill, in the style of construction, the presence of available floor space, the increase in cost of operation due to inconvenient arrangement of rooms, and the increase in cost of insurance. The market value of machinery was determined on the basis of the comparative ability to turn out a product in quantity and quality equal to that of the most improved machines, and also its actual condition with respect to wear and tear. The summary of the methods used by the mills is as follows:

1. Determine amount of machinery required to produce the same results as the mill under consideration.
2. Determine floor space required for this machinery if arranged in rooms of proper size.
3. Determine savings which could be made by having well-arranged buildings and rooms.
4. Capitalise this saving at 10 per cent. and deduct same from cost of buildings of modern mill. The result is the value of present buildings, if new.
5. Depreciate buildings still further, if necessary, for poor style of construction, bad light, &c.
6. Depreciate still further for age. This final result is the present value of the existing buildings.
7. Determine savings which could be made by having modern and well-proportioned machinery.
8. Capitalise this saving at 10 per cent., and deduct the sum from the cost of proper amount of modern machinery to do same work as present machinery. This gives the value of present machinery, if new.
9. Depreciate this value, if new, for wear and tear, and this gives the value of the existing machinery.
10. To the 6th and 9th results add the value of shafting, belting, piping, and supplies, which are based on the cost of same for a modern mill, also the value of the land, water power, water-power plant, and other taxable property which the mill may own.

The summary of the methods used by a city, was made in the following manner:

1. Determine cost of reproducing existing buildings exactly as they are constructed. This is the value if new.
2. Depreciate value if new by an estimated amount determined by an external examination of the various parts which can be seen. This gives the present value of buildings.
3. Determine cost of replacing the machinery in the mill by similar machinery. This is the value if new.
4. Depreciate value new for wear and tear by an estimated amount determined by an examination of such parts as can be seen. This result gives the present value of the machinery.
5. Make a schedule of shafting, belting, piping, and supplies and estimate cost of installing same.
6. Depreciate first cost for any visible wear and tear to get present value.
7. Estimate value of land from value of adjacent land.
8. Estimate value of water power by capitalising yearly cost of steam power at a low rate of interest.
9. Estimate cost of reproducing water-power plant as it is, and depreciate for wear and tear as above.
10. To above present values add value of any other property belonging to mill.

This very able paper naturally gave rise to a long-continued discussion, which tended rather to the experience of individuals with the local assessors, than to actual criticism.

There is no subject brought before the meetings of the Association which develops more interest than that of the methods for computing costs of manufacture. It has received the attention of special committees, and numerous papers by members of experience have been read on it; all of these have elicited discussions not merely at the formal sessions, but in what is sometimes termed the "annex meeting," consisting of discussions in the hotels or on the excursions. The paper on the subject at this meeting, by Captain James G. Hill, of Lowell, Mass., was listened to with close attention. He referred to the rule governing the cost of yarns, varying as the square root of the third power, but this does not include expenses of variations in counts in the picking, carding, drawing, and the first process of roving, nor the expense of making the change in the gears of the machinery. Taking for example, No. 22 yarn, the prime cost of which is about 2 cents per pound; by applying the above rule to No. 20, the cost would be about $1\frac{4}{5}$ cents per pound, whereas the actual cost is considerably more, or about $1\frac{9}{10}$ cents per pound. General rules of this nature are applicable only to plain cotton mills. The following Table was given by the author as showing the relative cost of the different departments in such a cotton mill:

Classes or Subdivisions.	Per Cent.
Overseering, &c.	15.87
Picking	1.45
Carding	4.46
Drawing	2.68
Roving and spinning	18.52
Ring cleaners	0 58
Back boys	1.65
Doffers	2.45
Spooling	3.86
Warping	1.18
Web drawing	1.51
Slashing	0.83
Weaving	44.96
	100.00

He gave the following formula for obtaining the average number of yarn:

$$N = \frac{P + T}{\frac{P}{F} + \frac{T}{W}}$$

In this formula

Let N equal the average number of yarn
" W " " " warp
" F " " " filling
" T " threads per inch of warp
" P " picks " " filling.

The following six essential factors in finding the costs of cloth were suggested:

1. Accurate average numbers are required.
2. Reduce the pounds to hanks or skeins.
3. Divide the pay-roll of the preparatory processes by the total pounds.
4. Divide the remaining pay-roll by the total number of hanks for a constant.
5. Multiply the average number of each grade or description of cloth by this constant.
6. Add 3 and 5 together for your total cost.

For the general expense and repairs, the amount was divided by the total hanks for a constant, and this was multiplied by the average number of each style of goods.

For the cost of the cotton, some mills increase the item by adding to the cost per pound, the net waste, whereas the more conservative mills increase it by the gross waste.

This subject is to be taken up by the Association for general discussion at the Spring meeting.

Like other American technical societies, an irregular amount of each session is devoted to what are termed topical questions, which may be passed over in respectful silence, or which may form a nucleus around which a most interesting and active discussion will be formed. The attractions of the papers and the entertainments furnished by the local committee, occupied so much time on this occasion, that but few of the topical questions received any consideration.

That one asking whether a systematic method of costs can be determined for weaving, was discussed in a manner which criticised the question itself as being one of those interrogatories which none could answer; but the next question, asking whether it would be better to have one overseer in charge of each special operation in a large manufacturing plant, or to have a larger number of men in charge of smaller sections, developed a consensus of opinion from some of the most experienced members of the organisation, all of whom believed that there should be one person responsible in each department. The general American cotton mill, it should be noted, is organised on the very broad basis of carrying on the whole of the operations, converting the cotton into cloth, and in many instances finishing it for the market. The divided work on the English system is confined for the most part to the new mills; but the question of the elasticity of conditions was considered by many of the speakers.

This was followed by the important topical question inquiring, What class of machinery was required to obtain the most improvement in order to arrive at a minimum cost in manufacturing? to which one member only had the temerity to make a very sensible rejoinder, that good yarn was essential to good cloth.

"Textile Education by Mail," was the subject of a paper by Mr. Christopher P. Brooks, Director of the New Bedford Textile School. He stated that the method of good technical instruction by correspondence, was an American idea which had grown to such an extent that instruction has been given to over 100,000 pupils. The method is to send special printed instruction papers, which the student works out and sends back for correction. It is conceded that while this method of instruction has its limitations, yet it is, on the other hand, applicable to many who are engaged in constant employment under circumstances which would not permit them to follow instruction under the usual methods.

This Association has always given a great deal of attention to the important subject of textile schools, and the paper upon this phase of the improvement of employés received great interest. The discussion indicated that the demand for a higher class of employés, especially those fitted for positions of subordinate authority, was being developed by the correspondence schools, and also that it formed a means of development for more capable persons to whom circumstances would have otherwise denied opportunities of self-advancement.

The meeting gave consideration to the subject of uniform numbering of textile yarns, which is to be taken up at a conference during the Paris Exposition in 1900. The differences in the methods of numbering the sizes of yarns and also of different yarns of the same material in various goods, was presented to the Association, and referred to a committee who reported at a later session a resolution of endorsement.

Preliminary to the afternoon session, those in attendance at the meetings were taken in carriages around the city of Montreal, and thence through its large park to the summit of Mount Royal at the back of the city, from which eminence was afforded a view of the city and the fertile country for many miles around.

The afternoon session was opened by an historical paper on "Eli Whitney and His Cotton Gin," by Mr. M. F. Foster, who had collected various traditions from the vicinity of Augusta, where Eli Whitney, the Connecticut school teacher, made his first experiments on the saw gin for removing the cotton lint from the seed. In the paper, the author expressed a desire that the Association might erect a proper memorial tablet.

The question of cotton ginning took a more practical turn in a paper by Mr. J. E. Cheesman, of New York City, who presented the facts of the pre-historic roller gin and its latest developments to the present day; the last of which was a modification of the roller gin invented by the speaker, in which the application of stripper blades to a roller gin has largely increased the capacity of the present machine, the improvements being the elliptical motion given to the stripper blades which handle the cotton so deftly, as to closely resemble the results of hand ginning.

The Association has been considering the various improvements in cotton bales at its meetings for many years past, and a paper on "The Round Bale," by Mr. Louis Simpson, of Valleyfield, Canada, was almost a matter of course. The author conceded the fact that the present system of baling was defective, but was inclined to question the improvements of the new cylindrical form of baling, largely on the commercial questions of differences in price. He referred to the two classes of ginneries at the South, one owned by responsible parties who treated their own crop, and the other, public ginneries, where cotton from any source was cleaned; it was to this latter class were due many of the difficulties in the commercial condition of the cotton fibre. The paper caused a very active discussion upon the subject, as many of the members expressed the opinion that the cylindrical bales were a step in advance. The discussion was interrupted by the President, in order to permit a paper on "The Dederick Bale," to be read by Mr. W. H. Perkins,

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of Boston, Mass., who advocated a bale of small dimensions and great density which was packed from cotton in layers compressed by a square plunger and press which was lined with the bale covering and brought to convenient dimensions and of great density.

The evening session was held at the Temple Club in Montreal, and was begun by a paper on "What must be Done to Spin Fine Yarn on a Filling Frame," by Mr. Arthur H. Gulliver, of Ashton, R.I.

The requisites for this improvement the speaker held to be due to a superior class of help under efficient supervision, and also to the exercise of great care in the condition of the machinery, especially that of the bobbins. This last question was the subject in another direction of a paper on "Oiling Fly Frame Spindles," by Mr. Russell W. Eaton, of Brunswick, Me., who, on newly taking charge of a mill, had found a great amount of oil stains in the cloth, the cause of which was finally traced back to cracked bobbins on the fly frames. The oil in these cracks exuded on the stock, and developed into stains in the cloth. The first remedy was the condemnation of a large stock of bobbins, and this developed an improvement in the method of oiling these fly frame spindles, which prevents the oil from rising up on the spindle.

It is always useful to learn of the results of a paper read before a technical society, and the continuation of a paper upon the theoretical possibilities of drying fabrics at low temperatures and pressures below the atmosphere, which was presented by Mr. Charles H. Fish, of Dover, N.H., at a meeting a year ago, found its sequel in a paper by the same author, giving some practical results. The drying fans the author employed were enclosed in a case from which the air was partially exhausted, and this caused a very rapid volatilisation of the water in the fabrics.

In anticipation of the trip to Valleyfield on the next morning a paper on the "Description of the Electric Power Transmission Plant at Valleyfield," by Mr. J. J. Ashworth, general manager of the Canadian General Electric Company, Limited, was submitted, describing this highly successful installation. It is the first instance in which an electric drive is used in connection with waterwheels in any of the Canadian cotton mills. At this water power there is a fall of only 13 ft. head, but with practically unlimited quantity of water. After an investigation of the installations of electric power transmission at the mills in the United States, the company decided on the construction of a single generating plant, and a system of electric distribution by motors in different buildings which would drive several mill shafts.

The first power-house provides for four generating units of 500 horse-power, each driven by two McCormick vertical turbines, as it was not thought advisable to put horizontal turbines with the very low head.

This plant is to be extended by adding two units of 3250 horse-power. The generators are of the revolving Field type, and arranged to run together or separately. The current from this plant is also used to illuminate the mill, and will, when completed, have a total capacity of 5400 horse-power; as such it will be the largest electric plant now operating a textile factory in the United States or Canada.

A new example of the old problem was shown in a paper of admirable brevity on the "Economy of Using Turbines at Full Gate," by Mr. Frank P. Vogl, of Claremont, N.H., who gave the results of the difference in power required on a steam engine running in connection with two waterwheels, a better result being obtained when one wheel was operated at full gate than when two wheels were operated at half gate. The results of an example of this kind very naturally differ according to the type of turbine wheel used, as some of the turbines give results of excellent efficiency from full gate until less than half gate, while the efficiency of many turbines is impaired by the slightest closure of a gate below the maximum opening.

The recent generation of gas from the Nova Scotia coal in the vicinity of Boston, has put into that market a large quantity of coke possessing greater density than that produced by processes hitherto used, and this made the paper on "The Advantages of Coke over Coal as a Fuel for Generating Steam," by Mr. Arthur C. Freeman, of Waltham, Mass., a very timely production. The advantage of cleanliness from the absence of dust, smoke; the few ashes, the quickness of kindling, easy control of fires, and the freedom from clogging the boiler flues, were all set forth in the paper. The suggestions in regard to management comprised the following points:

The firing should be replenished lightly and often, and the bed of fuel should never be over 7 in. or 8 in. in thickness.

It is better to refrain from disturbing the top of a coke fire, and the level condition should be kept up in firing.

Shaking bars are recommended for furnaces burning coke, but if dead bars are used, a light poker is to be employed to detach pieces of clinker from the grates.

It is advisable to keep water in the ashpit or to introduce a jet of steam.

The comparative evaporative power of this coke was 89 per cent. of the best bituminous coals and about 6 per cent. greater than the Buckwheat sizes of anthracite coals, but the paper did not give the relative value for generating steam on the basis of the market cost of fuels.

The merits of mechanical stokers have been presented before this Association from time to time for many years, but it does not appear that these devices have been used in American mills until very lately, and even then not to the extent to which such devices are applied in English boiler plants.

Mr. Byron Eldred, of Boston, Mass., presented a paper on the subject of "Mechanical Stokers." In many of the later stokers, the thinness of the fuel at the rear of the grates reduces the efficiency of the furnace from the excessive amount of air which finds its way into the combustion chamber.

The author described the American under-feed stoker, which was designed for the purpose of obviating these difficulties by feeding the coal slowly by a screw under the middle of the grate, where it is slowly roasted or coked. An air blast of from 1 oz. to $1\frac{1}{4}$ oz. is used with this system, which, it is claimed, results in smokeless operation of the furnaces, and also high evaporative efficiency. Tables of comparative tests made under the supervision of Mr. George H. Barrus, consulting engineer, gave a result of 21 per cent. of increased evaporation per pound of coal. The evaporation per pound of dry coal from and at 212 deg. Fahr. gave 10.07 for hand-firing and 12.19 for stoker firing.

The absence of discussion that evening was undoubtedly due to the entertainment, largely musical in its character, which was furnished by local talent, and which made a very enjoyable termination to the evening session.

On the next morning a special train took the party to Valleyfield, a distance of 43 miles, where they saw the 2500 horse-power electric transmission plant installed by the Canadian General Electric Company, Limited, of Canada, in the mills at Valleyfield, by which the water power from the Rapids of the St. Lawrence River at this point was applied to operating the mills in such a successful manner that the electric power plant is to be increased.

The ladies of the party were entertained at the house of Mr. Louis Simpson, the manager, while the gentlemen took a hurried lunch at a club which the mill had established for the recreation of its workpeople; and thence back to Montreal, where they entered a special train which took them to Lachine, at the head of the celebrated Rapids, where they took a steamer and returned to Montreal by water.

This excursion trespassed so far on the day that the afternoon session was a short one, and was devoted to cordial resolutions of thanks to the Canadian hosts.

In the evening most of the members attended a theatre party as the guests of the Local Committee, while an informal dinner was given at the St. James' Club to the past and present officers, and the authors of papers at the meeting.

On Saturday morning the special train returned most of the visiting members to Boston, whence they radiated to their several homes, but a goodly number remained for a days' travel to some of the points of picturesque or historical interest in the Dominion, notably a visit to the walled city of Quebec, which still preserves a good deal of its mediæval appearance.

BUENOS AYRES.—The population of Buenos Ayres at the close of July, 1899, was estimated at 779,872.

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXXII.

SCHNEIDER-CANET NAVAL TURRETS—(*continued*).

Closed-In Turret for One 15-Centimetre (5.91-In.) Gun (Figs. 656 to 663, pages 683 and 687).—In the turrets of this type the gun is mounted on a carriage consisting of two beams at the front end of which the trunnions are placed. These beams are joined in the rear by a jacket in which the gun slides during recoil and return. The recoil cylinder, placed on the axis of the gun, is cast in one piece with the jacket. The piston-rod is keyed on the breech and coil, the lateral surfaces of which form slides during the travel of the gun. The slide consists of two wrought-steel cheeks, strengthened by flanges and stayed together. The recoil cylinder is on the Schneider-Canet system, with central counter-rod; two sets of springs placed on the sides insure by reaction the running out of the gun. The general arrangements for working are similar to those described in a previous article for the 12-centimetre guns. The mounting and slide rest on the platform, which also carries the armour. Under the platform is bolted the ring, to which the central socket is attached. The whole of the turret is carried on a hydraulic cylinder, that forms a pivot and is fixed to the bottom frames of the ship.

The gun is elevated by hand power, by means of a crank and a pinion; the latter works through two bevel wheels, a helicoidal wheel, and an endless screw to the shaft, on which is keyed a square pinion which engages the toothed sector fixed to the carriage. A jointed sight-line follows the gun in all its displacements. Lateral training is obtained by hand or by electric power, the displacement of the gun being produced by the rotary motion of a pinion which gears in a toothed ring fitted round the central socket, the pinion being worked by a helicoidal wheel and a endless screw. In operating the mechanism by hand, the shaft carrying the endless screw is put in motion by two bevelled wheels worked by a crank and a plate-chain. When electric power is resorted to, the helicoidal wheel is worked direct by a dynamo and two pinions. The motor is controlled by a cylinder called *cartouche électrique*, the working lever of which is within easy reach of the gunner.

Ammunition is raised to the platform by a hoist that consists of two plate-chains, united at intervals by gun-metal saddle-pieces. At the lower end of the tube the cartridge is placed in a special carrier, in the bottom part of which is fitted a lever; this moves under the action of the saddle-piece, lifting up the cartridge and placing it ready for hoisting up the tube. A treadle worked by the gunner on the top platform throws the mechanism of the hoist out of gear when necessary; the hoist can therefore be stopped during the time required for taking a cartridge from the carrier. The hoist is worked by hand or electric power through pinions and bevel wheels, which drive the shaft carrying the chain wheels.

Closed-In Turret for 20-Centimetre (7.874-In.) Gun (Figs. 664 to 667, pages 686 and 687).—In this type the gun is mounted on a carriage, the arrangements of which as well as those of the slide which supports it, are similar to those of the corresponding parts of the 15-centimetre (5.91-in.) gun just described. The slide rests on a turning platform which carries the protective armour; the top part of the central tube for the passage of ammunition ends on the right-hand side of the platform. The tube is guided at two points along its height by rings of vertical rollers. It is fitted outside with a circular rack for lateral training, and inside with the guides for the hoist. The whole rests on a hydraulic cylinder, forming a pivot.

The elevating mechanism is governed by hand, by means of a handwheel which works, through an endless screw and a helicoidal wheel, a pinion that gears in the toothed rack fixed on the left side of the carriage. Lateral training is effected by hand, or by electric power. The motion is obtained by the rotary action of a pinion which gears in the circular rack fitted to the central tube; the pinion is keyed on a vertical axle worked by a helicoidal wheel and an endless screw. The mechanism is driven by a series of friction rings placed in the thickness of the helicoidal wheel. In operating the lateral training device by hand, the shaft on which the helicoidal wheel is fitted, is set in motion by two square toothed pinions which engage those keyed on the handwheel axles. When electric power is resorted to, the dynamo works a square

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SCHNEIDER-CANET TURRET FOR 20-CENTIMETRE GUN.

(*For Description, see Page* 685.)

Fig. 664.

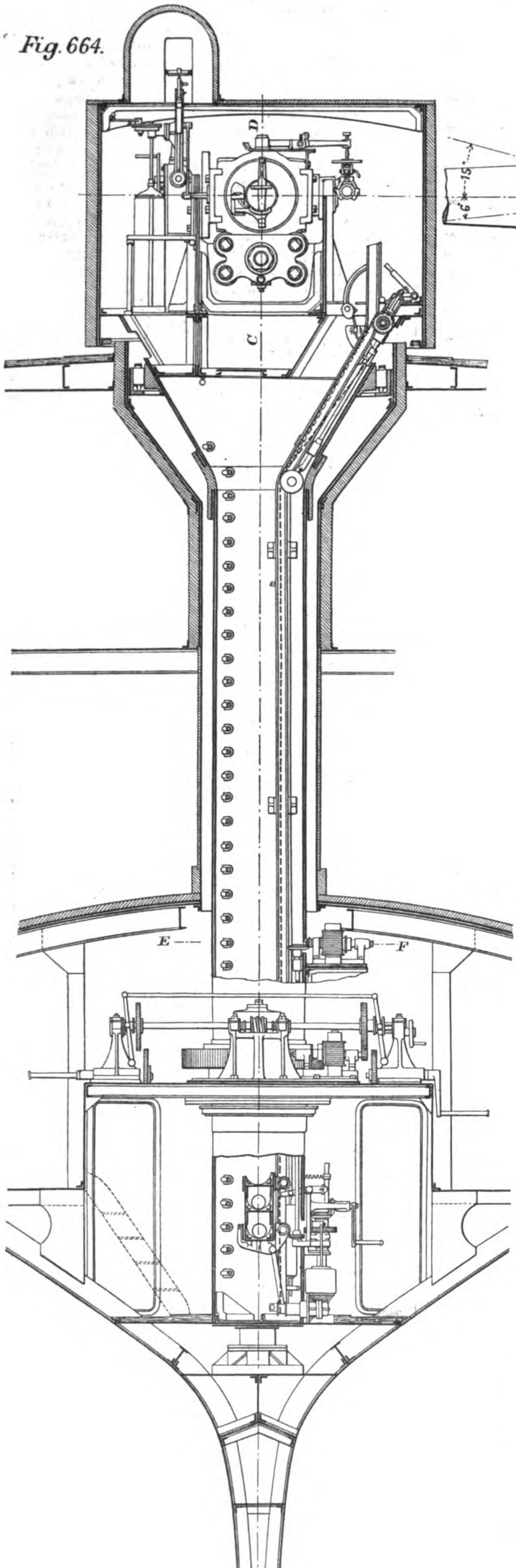
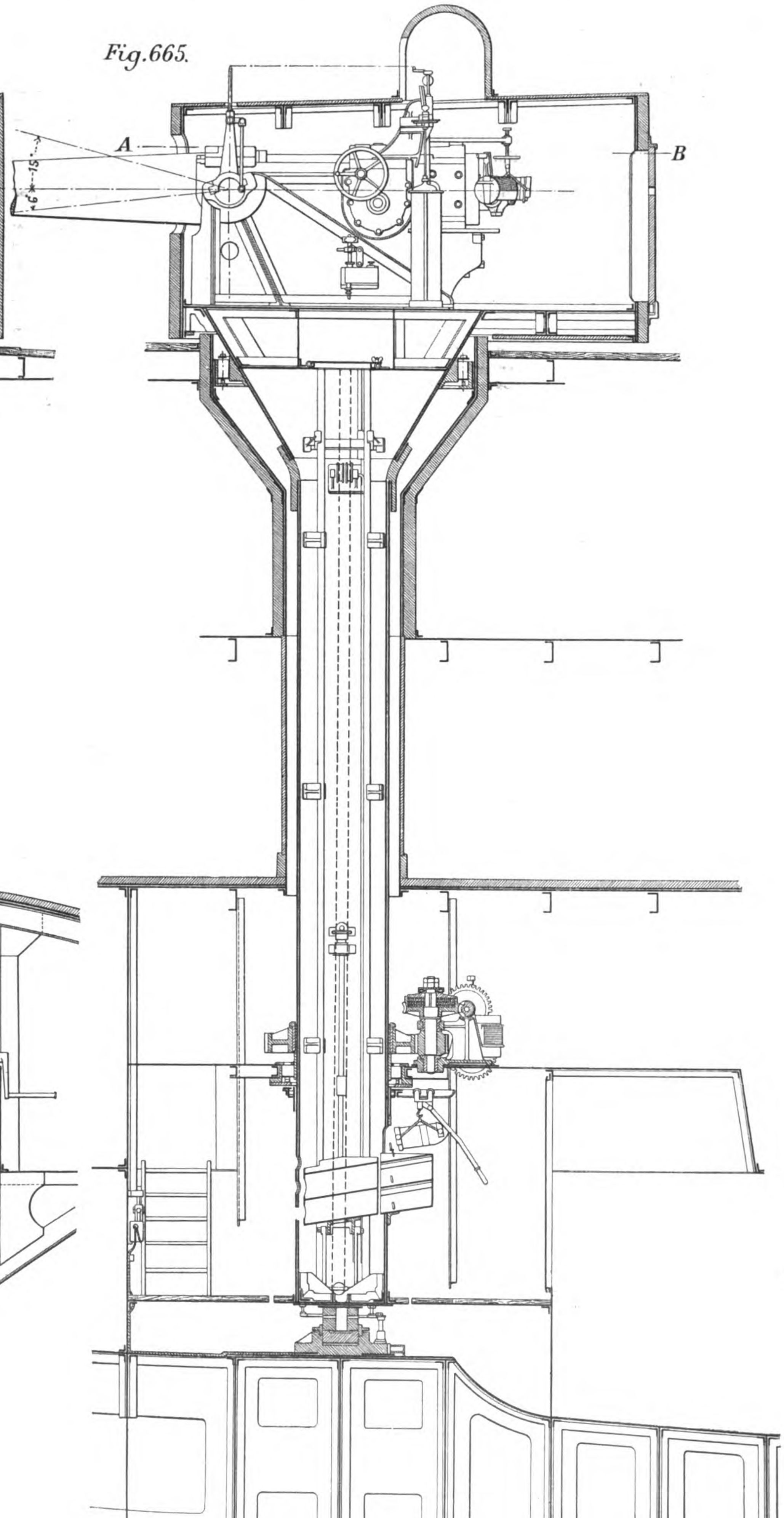


Fig. 665.



SCHNEIDER-CANET TURRETS FOR 15 AND 20-CENTIMETRE GUNS

Fig. 666.

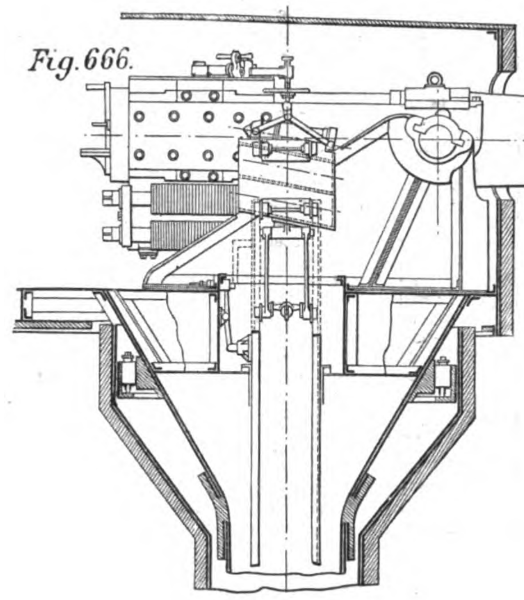


Fig. 667. Section A.B.

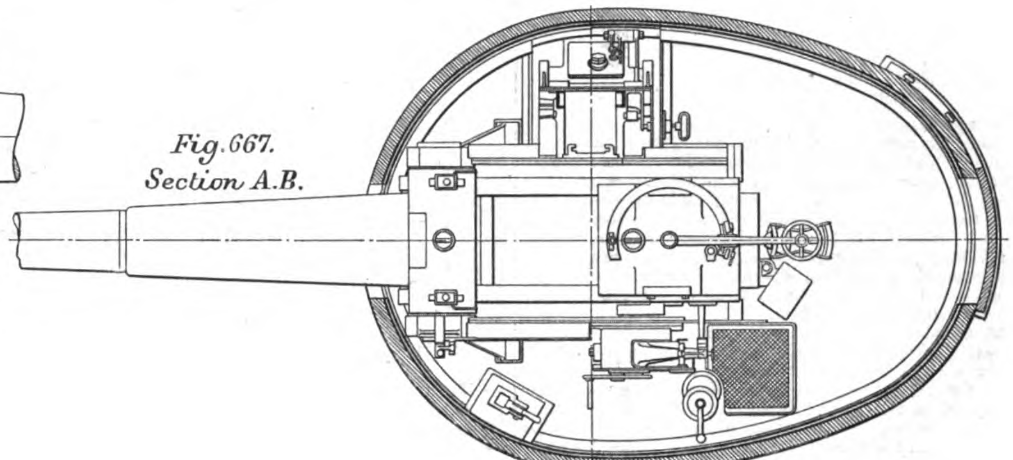


Fig. 669. Section E.F.

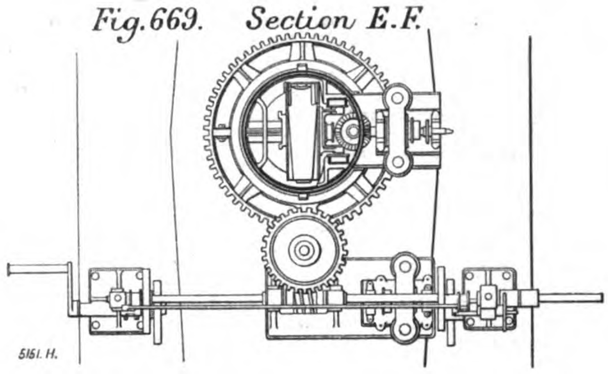


Fig. 668. Section C.D.

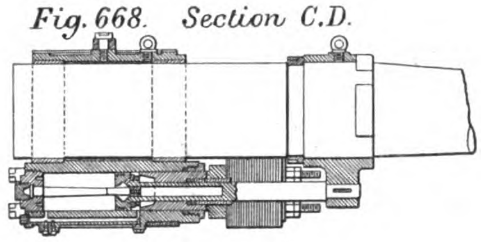


Fig. 662. Section A.B.

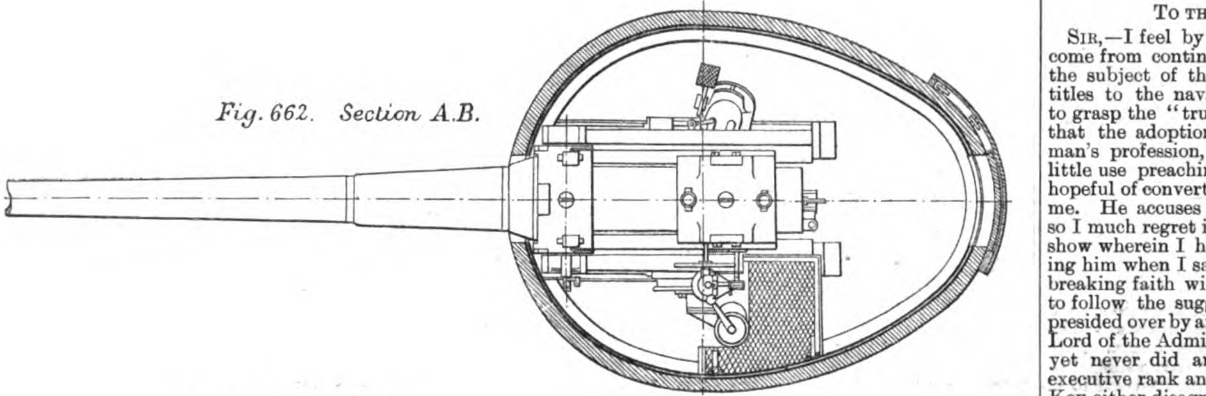
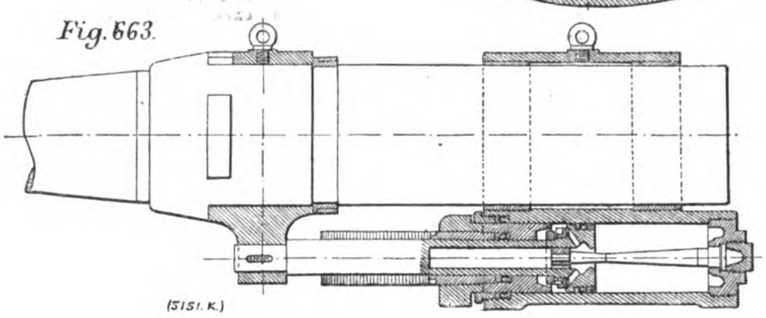


Fig. 663.



pinion which transmits its motion to the driving axle through one of the toothed wheels that form part of the hand-working device for training the gun. By means of a lever and clutch the hand and power transmissions can be thrown in and out of gear.

The hoist consists of a casing with two compartments one above the other. The casing is raised from the magazines to the platform by a chain set in motion either direct, by means of a crank and a set of conical gear, or through a dynamo fixed to the central tube below the armoured deck, the dynamo transmitting its motion to the lower mechanism of the chain by a vertical shaft placed inside the tube. A disengaging lever makes it possible to render these two mechanisms independent of each other. The case for hoisting the charges is guided in its travel by rollers which turn in the slides fixed within the ammunition tube. When the charge has reached the platform it is received by an oscillating table carried by a horizontal frame. A lever placed within reach of the gunner on the platform, enables him to check the chain at the moment when the hoisting of the case carrying the charge is completed.

Leeds Tramways.—There is now a definite prospect of an electric service on the Headingley and Chapeltown sections of the Leeds tramways. A new large engine at the power station is running satisfactorily.

Catalogues.—We have received from Messrs. Walter Newbold and Co., of 28, Gracechurch-street, London, E.C., a copy of their new catalogue of machine tools. The articles described include lathes of all types, drilling machines, planing machines, and punching machines. Prices are given in all cases.

NAVAL ENGINEERS.

To the Editor of Engineering.

Sir,—I feel by no means confident that any good can come from continuing the discussion in your columns on the subject of the proposal to give executive rank and titles to the naval engineers; for if people are unable to grasp the "true inwardness of things," and fail to see that the adoption of bogus titles, unconnected with a man's profession, can only result in ridicule, it is very little use preaching to them, and I am therefore far less hopeful of converting "Hopeful" than he is of converting me. He accuses me of misquoting him. If I have done so I much regret it, though I submit that he has failed to show wherein I have done so. I trust I am not misquoting him when I say that he also accuses the Admiralty of breaking faith with the engineers, because they declined to follow the suggestions of a departmental committee, presided over by an officer who afterwards became First Sea Lord of the Admiralty, and remained so for several years, yet never did anything towards giving the engineers executive rank and titles; thus showing that Sir Cooper Key either disagreed in the first instance with the majority report of the committee, or else that a fuller consideration of the subject convinced him of the fallacy of the idea. In any case, however, it cannot be called a breach of faith.

I claim to have the good of the service at least as much to heart as any of your correspondents, and I object to the use of the word "grievances," in services such as the Army and Navy. It sounds disloyal; and it is certain that anybody can manufacture grievances, if they lay themselves out to do so, as none of us are so well off as we deserve to be—in our own estimation.

If any class of officers in the Navy has a "grievance" it is the executive branch, as they are the only ones who have had their rank lowered during the last forty years. In other words, the other branches of the service have been levelled up; and as all rank, either social, military, or naval, is comparative, it follows that the rank of the executive has been relatively degraded, in the exact proportion in which the others have been exalted; and the engineers' branch is one of those which has been levelled up apparently somewhat too rapidly, as it seems to have turned some of their heads. Yet we do not hear the executive branch grumbling about the degradation of their relative rank. They are not so foolish as to be jealous of the paymasters, the doctors, and the engineers, because they have been granted nominal rank, and several gold lace stripes on their sleeves. Many of us can remember when they had no stripes at all. Nor do we see lieutenants of eight years' standing swaggering about, and telling their friends that they rank with staff engineers.

It is a matter of absolute indifference, so far as the interests of the service are concerned, whether the engines of Her Majesty's ships are worked by glorified engine-room artificers ranking with warrant officers (as the engineers themselves did, not so very long ago), or by engineer officers calling themselves lieutenants, commanders, and captains; and I rather think the former will be the result of this agitation, if the engineers get

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too big for their boots; as the so-called "tiffies" do most of the work now. Your correspondent "Efficiency," in his happy quotation, unwittingly supplies us with an epigrammatic description of what these captain and commander engineers would be. Those who would:

"Merely hold the highest rank
And draw the highest pay
But hide behind the 'tiffy'
When a job came in the way."

The vast majority of officers and men in the Royal Navy are far better off than they would be if they were out of it. The conditions of service were known to them —or at any rate to their parents or guardians—when they elected to honour the service with their company. It seems therefore to be illogical, not to say graceless and disloyal, to set about manufacturing "grievances" as soon as they find themselves established as members of an honourable profession which they have been lucky enough to get into. Those who do so are like the dog that bites the hand that feeds him.

The naval engineers—or rather that section of them who are pursuing this agitation—may save themselves further trouble, as they will not get the apple they are crying for. They have no means of enforcing what they are pleased to call their "demands." The army doctors got their "demands" complied with, as they were able to coerce a weak War Minister through the medical schools of the country, which, being more or less in the nature of close guilds, were able to cut off the supply. The engineers can bring no such pressure to bear. There are tens of thousands of competent engineers in England and Scotland; and the executive officers of the Navy, though not trained to do manual work as fitters, are not so ignorant of engineering as is commonly supposed. If all the naval engineers went on strike to-morrow their "demands" would not be granted, nor their "grievances" redressed. Their places would speedily be filled, and they would discover, too late, that the service could do very well without them.

"Every cobbler to his own last" is a good maxim, and it applies to all of us. The executives have no wish to do the engineers' work, nor do they require the engineers to do theirs. There is work enough for both. In conclusion, Sir, it appears to me that your correspondent "Hopeful" is extremely illogical. First he tells us that many of the naval engineers are a "scratch collection." Then in his next letter he ventures on prophecy, and tells us that "had the whole of the recommendations of Admiral Key's committee been carried out, including the granting of executive rank and titles, we should have been spared the humiliation of seeing the naval engineering profession so despised that no one with any standing would join it." And then he coolly asks the Admiralty to confer upon this scratch collection of the residuum of the engineering profession executive rank and titles!

What for? For the purpose of improving their engineering efficiency afloat? or their social status ashore?

Truly I think I have a far higher opinion of the naval engineers than "Hopeful" has. I had thought he was one of them, but that seems almost impossible.

Your obedient servant,
FAR EAST.

TABLES OF SQUARES.

TO THE EDITOR OF ENGINEERING.

SIR,—A paragraph in the issue of ENGINEERING for November 17, on a volume of "Tables of Squares," will be read with some interest by your American readers and those conversant with American drawing-office practice, as showing a great lack of knowledge of the latter. I have not seen the particular volume referred to, but, from the criticism, it would appear to be almost identical with another similar book having a wide usage in America, and without which no draughtsman considers his everyday library complete.

The tables are not used for the purpose of computing areas, as assumed by the writer of the paragraph—although his suggestion will be welcomed by those of us unacquainted with the formula given—but for determining the hypothenuse of right-angled triangles. In structural work their value will be readily appreciated; for instance, the rise and span of a roof truss being given, the length of the rafter or top chord is quickly found by the simple process of adding the squares of the given dimensions and taking from the tables the length opposite to their sum, this being, of course, the square root of the latter. Similarly, the lengths of the various web members of a truss can be determined, also diagonal bracing of all kinds, the oblique edges of plates, bridge work, &c., without a multitude of figures, thus economising time and tedious labour.

It is in such simple and apparently trivial methods as these that we can find some explanation of the success of American competition.

Yours faithfully,
November 22, 1899. DRAUGHTSMAN.

AUTOMATIC GENERATOR FOR ACETYLENE GAS.

TO THE EDITOR OF ENGINEERING.

SIR,—In your notice of an automatic generator for acetylene gas by the St. James's Illuminating Company, it is stated that the polymerisation of the acetylene into benzene (not benzine, as it is printed, which is a different hydrocarbon entirely) is prevented by the water-jacketing of the generators. Seeing that the heat liberated by 1 gramme of carbide is over 400 calories (Lewes), and that the acetylene must be kept nearer 200 deg. than 400 deg. (Lewis) if polymerisation is to be prevented, it is very difficult to see how water-jacketing can have any appreciable effect where carbide is decomposed at the rate of considerably above 170 grammes per minute in a confined space, only a small portion of which is in connection with the water jacket.

The subject of overheating is of such vital importance in acetylene generation, that I am confident you will be only too glad to have this brought under your notice.

Yours faithfully,
W. DOMAN.

129, Cheapside, London, E.C., October 30, 1899.

[We have delayed publishing the above letter till we were able to obtain from the makers of the apparatus referred to a statement of the maximum temperature actually reached in the generator. This they inform us has never in all their investigations exceeded 288 deg. Cent. or 550.4 deg. Fahr., which they assert is insufficient to affect the acetylene. We are obliged to our correspondent for pointing out the printer's error referred to, which somehow escaped correction in the proofs.—ED. E.]

WESTINGHOUSE GAS ENGINE.

TO THE EDITOR OF ENGINEERING.

SIR,—Allow me to thank Mr. Crossley for sending to your correspondence columns the results of the tests of Messrs. Crossley and Co.'s 10, 25, and 55 horse-power nominal engines. The results of the tests of the two larger engines afford very convincing proof that the conclusion at which I had arrived from theoretical reasoning, viz., that the thermal efficiency is independent of the size of the explosion cylinder, is true. The thermal power of the gas used in the tests of the two large engines, ascertained by Junker's calorimeter, was found to be equal to 634 British thermal units per cubic foot. According to the Tables given by Mr. Crossley, the brake efficiency of the 10 horse-power nominal engine is equal to that of the 55 horse-power nominal engine; but in the case of the tests of the 10 horse-power, the thermal power of the gas was not tested. The apparent equality may, therefore, have been due to the use of gas of a slightly higher thermal power. In the case of the 25 horse-power engine the coefficient of brake efficiency corresponding to a consumption of 15.2 cubic feet of gas per brake horse-power, is equal to .205, and in the case of the 55 horse-power for a consumption of 14.2 cubic feet, is equal to .219, if we adopt 1000 foot-pounds as the value of the British thermal unit. The difference, viz, .014, is certainly not more than we should expect from the difference in the mechanical efficiencies of the two engines. If we adopt 772 foot-pounds as the value of the British thermal unit, the corresponding coefficients of brake efficiency would be equal to .265 and .284 respectively. The difference, .019, is certainly more than I think the difference in the mechanical efficiencies sufficient to account for, but no candid inquirer can possibly have any doubt as to the true value of the British thermal unit being about 1000 foot-pounds.

The consumption of 18.25 cubic feet of gas per brake horse-power, in the case of the 10 horse-power engine, was taken from the Table contained in Mr. Dunlop's letter published in your issue of August 25.

November 28. ONLOOKER.

LOCOMOTIVE LIFE-GUARDS.

TO THE EDITOR OF ENGINEERING.

SIR,—Would some locomotive engineer kindly explain the reason that has led to the placing of railroad engine "life-guards" on the leading bogie truck rather than on the frame of the engine itself? If we suppose a heavy stone or bar to be on one of the rails, it would appear that its effect, on being struck by one of the guards, would be to twist the bogie round and so throw the engine off the line. Were the guard part of the frame itself, the whole weight of the engine would resist the twist, and probably save an accident. Why should a light trolley have upset the express locomotive at Wellingborough?

I am, &c.,
ALFRED J. ALLEN.

London Institution, E.C., November 28, 1899.

STATICALLY INDETERMINATE STRUCTURES.

TO THE EDITOR OF ENGINEERING.

SIR,—In reference to your article in ENGINEERING, of November 17, page 633, where you deal with, among other things, the question of statically determinate *v.* statically indeterminate structures, it may be worth while calling attention to a valuable article in the "Zeitschrift für Bauwesen," 1899, Parts VII. to IX., where H. Reissner, of Berlin, treats of the dynamics of frameworks, and shows that statically indeterminate structures have this distinct advantage, that if vibrations arise in them the fact of their being statically indeterminate is of considerable assistance in effecting the rapid damping of these vibrations.

In treating the problem he assumes that, as in the vibrations of tuning-forks, membranes, strings, &c., the work dissipating forces are approximately proportional to the velocity.

I am, Sir, your obedient servant,
J. GILCHRIST.

BARNABY'S THEORY OF CAVITATION.

TO THE EDITOR OF ENGINEERING.

SIR,—I wish only to answer certain questions. Anything more on the theory of cavitation would not be "worthy of further notice," as "P. R. O." declares, with that extreme politeness one is exposed to meet with from anonymous correspondents.

A definition of the "eddies" I spoke of, as produced by cavitation, is asked for. Considering that they are said to be "a sure cause of loss of energy," they are presumably composed of water and not of air.

A theory must apply to all cases. Now, the form of the Daring's stern, whatever may be its merits—and they are occasionally very great—may not properly be called an ordinary one; it is certainly not to be met in one vessel out of ten thousand. Accordingly, any theory based on such a peculiar case is not general, and nothing proves that it is applicable in different circumstances.

A reference to my paper, not on "Aeration," as "P. R. O." puts it, but on "the rupture of the column of water set in motion by a propeller," will show that most cases are there considered.

With screws rising above the surface, as most rudders do, rupture is said to take place at relatively low speeds; with ordinary forms of sterns and ordinary immersion, it is said to begin at higher speeds: with the forms adopted by Mr. Thornycroft for his turbine propellers, it is said to occur still later; and finally, should the screw be made to work in a tube acting as suction-pipe, then it is said to arise exactly as in pumps. This is the meaning of the words "radical difference."

"P. R. O." will excuse me, and, no doubt, your readers will be grateful, if I decline to continue this controversy.

I remain, Sir, yours truly,
November 27, 1899. J. A. NORMAND.

TO THE EDITOR OF ENGINEERING.

SIR,—The very remarkable speed now being attained by comparatively small craft when driven by Messrs. Parsons' turbine engines, have suggested considerations to me which would appear to go far towards demonstrating the truth of my views *re* "cavitation," as expressed in my letter published in ENGINEERING of the 17th inst. —a letter which, owing to the kakography of the original document, due to writing with an injured wrist, contains some misprints in the letterpress, and errors as to the indicated approximate direction in which the cavitation would in each instance exert its negative force.

In considering Messrs. Parsons' epoch-making trials, and their bearings on my theory of cavitation, the following salient factors would appear to have much significance:—

(*a*.) The comparatively small size of the craft used in relation to speed attained.
(*b*.) The abnormally great horse-power developed.
(*c*.) The abnormally great speed attained.
(*d*.) The rapidity with which such speed is attained.
(*e*.) The large number of "scoop" propellers used.

It goes without saying that under such circumstances an abnormally high shaft velocity is rapidly reached, and that such is accompanied by an abnormal development of cavitation. I have reiterated the adverb "abnormally," as in my view the dynamical conditions that arise under such disadvantage are a sort of "quicksand" which swallows up much horse-power. But with the abnormal shaft velocity now attainable by turbine-driven engines, other conditions of cavitation and circumstances supervene, which bear a wholly different complexion and produce startlingly novel results. The faults above referred to still remain, and the quicksand will swallow its victim and exact its toll of horse-power; but luckily for the success of Mr. Parsons' trials, his engines could afford to pay such toll, and still provide a force sufficient to indefinitely increase the shaft velocity and extend the area under cavitation. Then arises the remarkable facility with which further increases of speed may be obtained. The area of cavitation has begun to extend inwards and downwards; it reaches the point B, Fig. 1, (page 639 *ante*) and with increasing shaft velocity it gradually approaches the leading edge of the blade; and the negative pressure exerted by this extended cavitation is exerted at an angle which enables it to largely reduce the slip of the blade, and to increase the propelling reacting force of the water. Or, in other words, such propellers so driven obtain a small proportion of the advantageous cavitation that is readily procurable with my blades—the material difference being that in the latter case the "quicksand" circumstances of propulsion are wholly different from those attendant upon the driving efforts of the ordinary crank-driven machinery; and the true efficiency of propellers so driven has, in my opinion, to be measured on an absolutely new basis.

The following considerations are pertinent to the truth of this proposition: Excessive velocity of revolution and excessive amount of water displaced (*i.e.*, excessive pressure), at any given portion of a revolving blade, causes cavitation to arise immediately behind the centre of such displacement. With "scoop" propellers, those two factors most rapidly supervene towards the ends of the blades, and behind that portion having the greatest "pitch." When such are being driven by ordinary machinery, the shaft velocity attainable is sufficient for the purpose of developing such cavitation, and possibly of extending its area somewhat inwards and behind that portion bordering upon the discharge edge of the blade marked *d*, *c*, in Fig. 1 (of illustration of my letter of the 15th ult.). Now, my view of the true significance of cavitation thus located is, that it develops a negative pressure of about 20 lb. to each square inch of surface under cavitation, and that such force is expended — almost wholly—in retarding the revolution of the propeller. There may be, and doubtless there are, a certain amount of eddies within the area of cavitation, as adverted to by Mr. Normand, or attendant upon its closing in; but the loss of energy thereby caused is (in my view) comparatively microscopic. It thus follows that such cavitation is an undiluted toll, and the excessive churning is avoided, and the area of beneficial cavitation is much enlarged and more readily reached; and the direction of the negative pressure thereby developed will be at a more

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SCHNEIDER-CANET TURRET AND AMMUNITION HOIST FOR 24-CENTIMETRE GUN.

(*For Description, see Page 718.*)

Fig. 670.

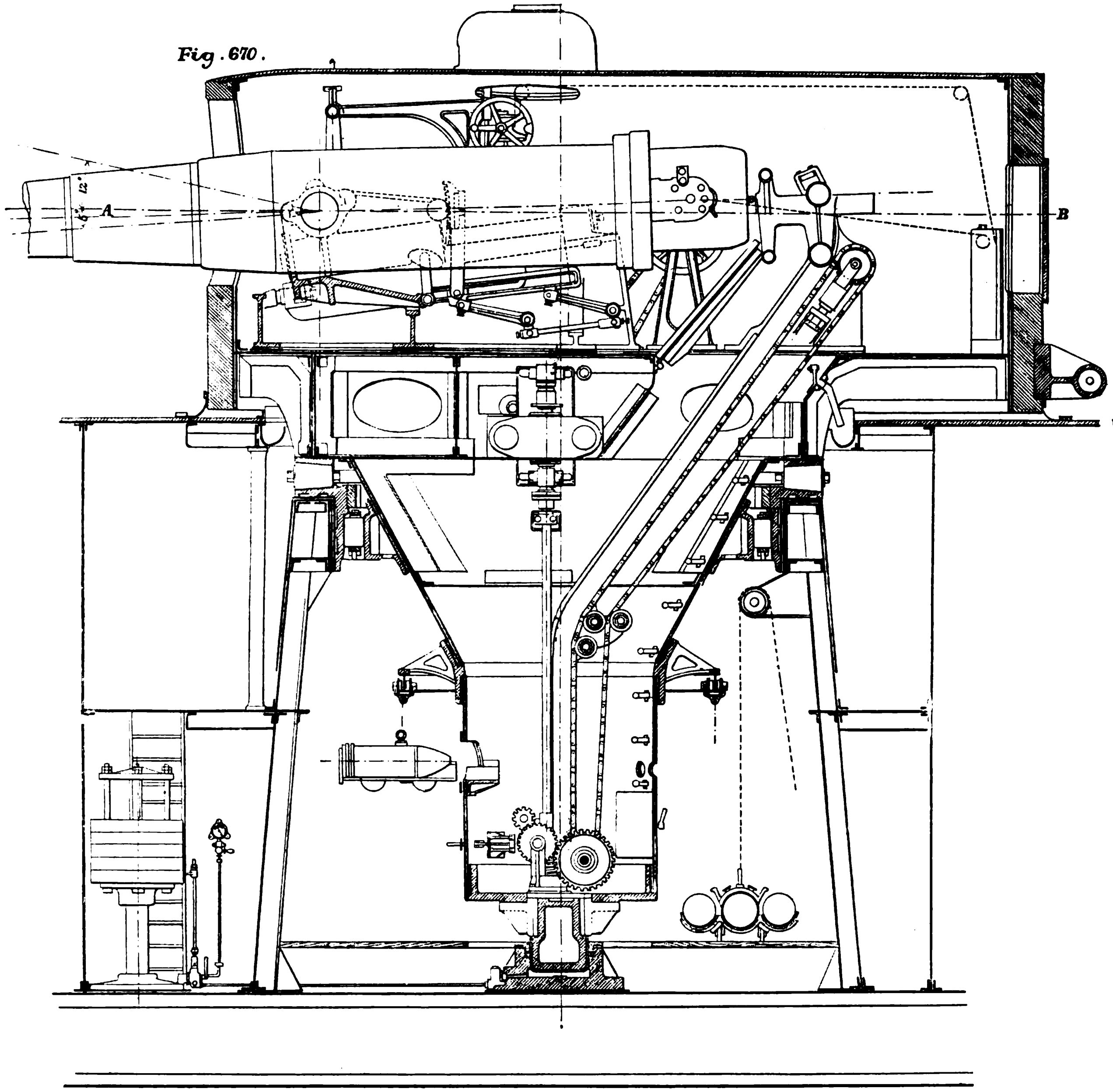
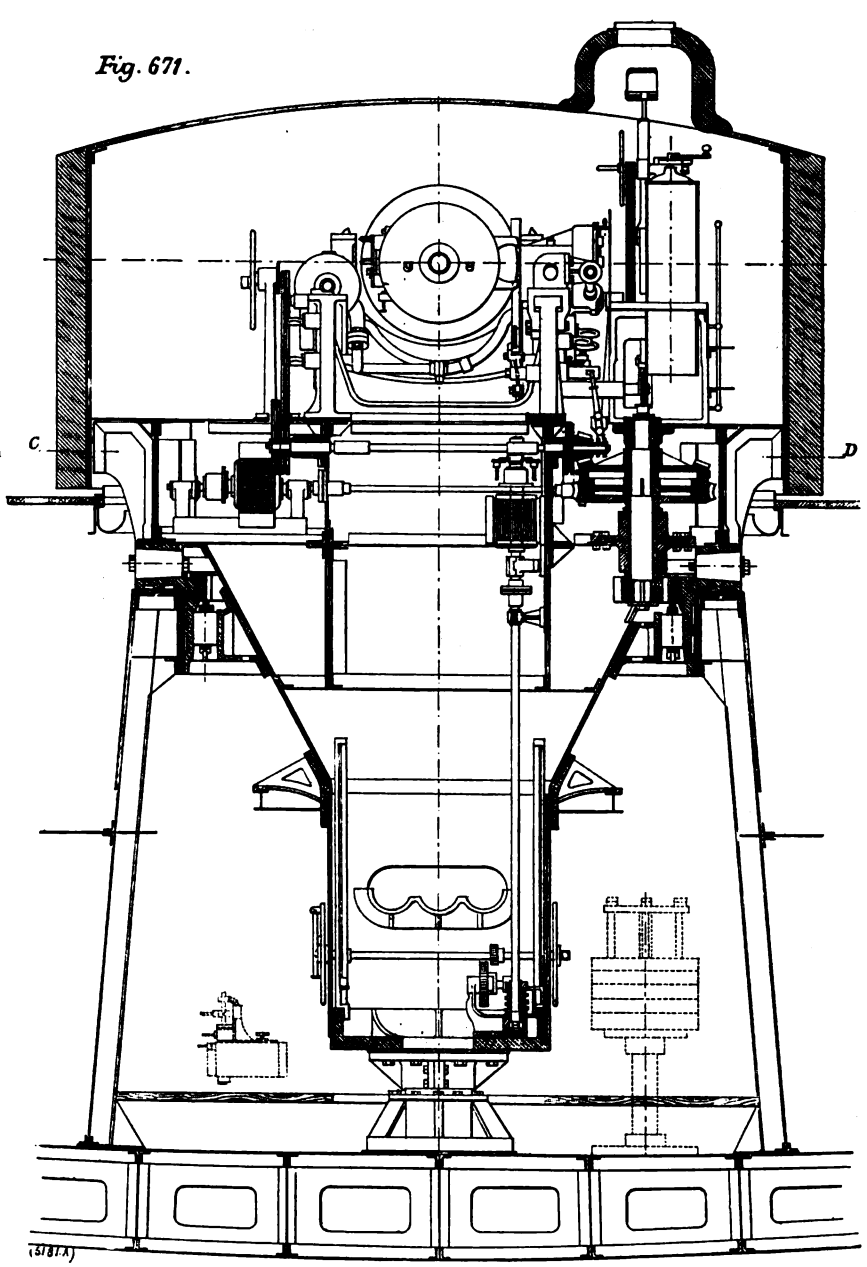


Fig. 671.



than we have been with cylindrical boilers. We suffered severely in our short war with Spain from dropped furnaces in cylindrical boilers. I do not think that a properly designed water-tube boiler will give more trouble from the use of impure feed water, such as sometimes we must have at sea, than any other boiler. I do not think tubes are more liable than furnaces to fail from a deposit of scale. In any event, the evaporating plants of all ships are being made adequate to give fresh feed water. The only danger of salt water in the future should come from leaky condensers.

Admiral Melville then considered the working of this form of boiler in foreign countries, and decided that most reported failures came from the failing of a tube, when the furnace door was open; the bad management of water-tube boilers was the principal cause, and if proper precautions were used, they can be successfully operated for the steam generating plant of ocean-going vessels, and are a necessity to the best design of a warship. He then stated what he considered the advantages and disadvantages as compared with cylindrical boilers, thus:

Advantages.	*Disadvantages.*
Less weight of water.	Greater danger from failure of tubes.
Quicker steamers.	Better feed arrangements necessary.
Quicker response to change in amount of steam required.	Greater skill required in management.
Greater freedom of expansion.	Units too small.

Advantages.	*Disadvantages.*
Higher cruising speed.	Greater grate surface and heating surface required.
More perfect circulation.	Less reserve of water in boiler.
Adaptability to high pressures.	Large number of parts.
Smaller steam pipes and fittings.	Tubes difficult of access.
Greater ease of repair.	Large number of joints.
Greater ease of installation.	More danger of priming.
Greater elasticity of design.	
Less danger from explosion.	

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SCHNEIDER-CANET TURRET AND AMMUNITION HOIST FOR 24-CENTIMETRE GUN.

(*For Description, see Page* 718.)

Fig. 672. Section A.B.

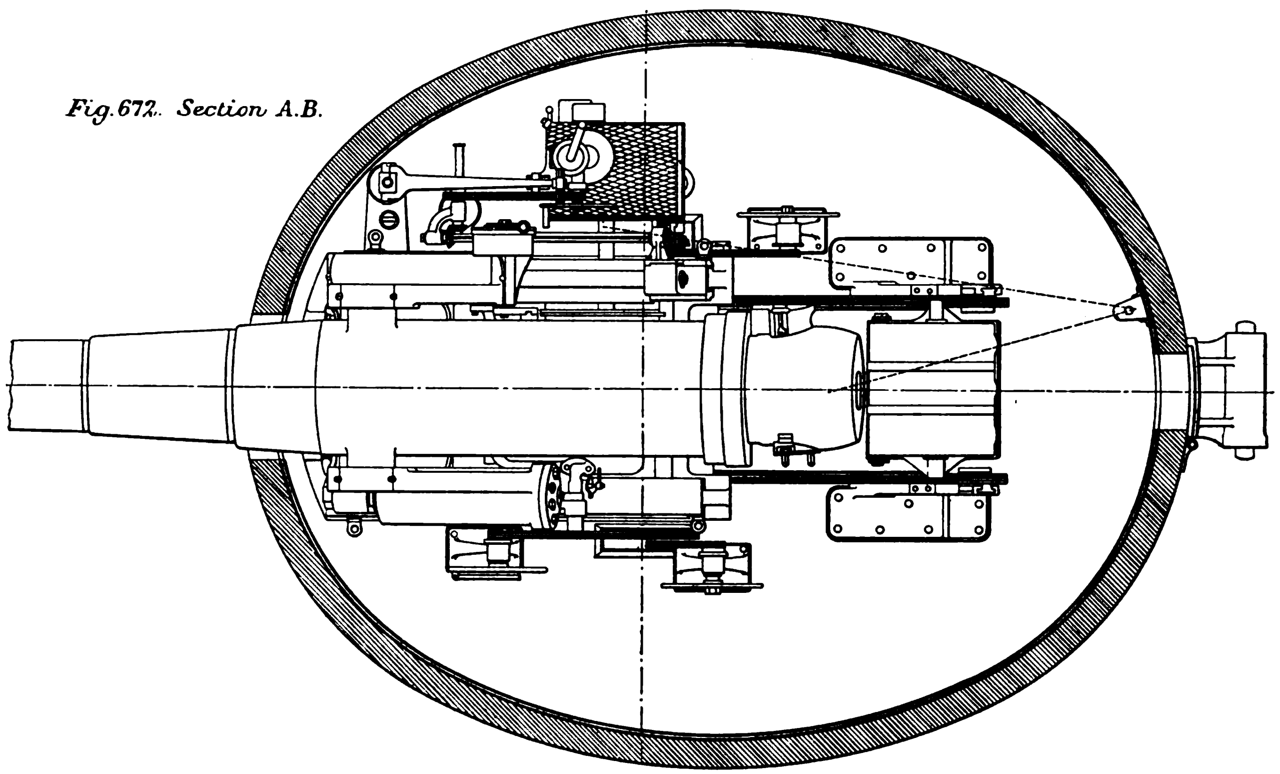


Fig. 673. Section C.D.

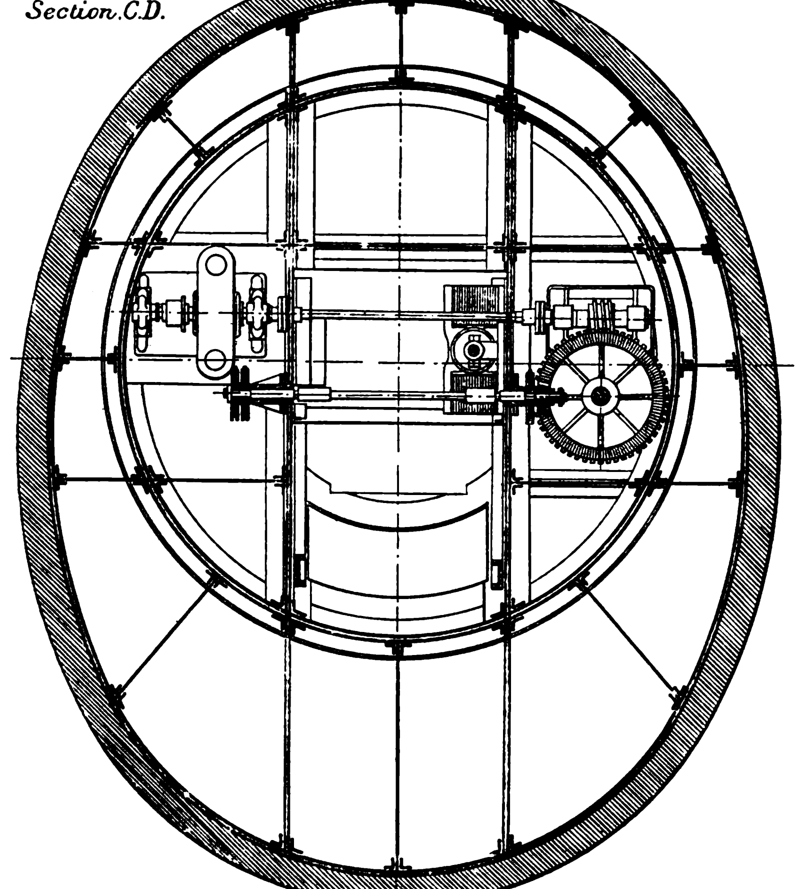


Fig. 674.

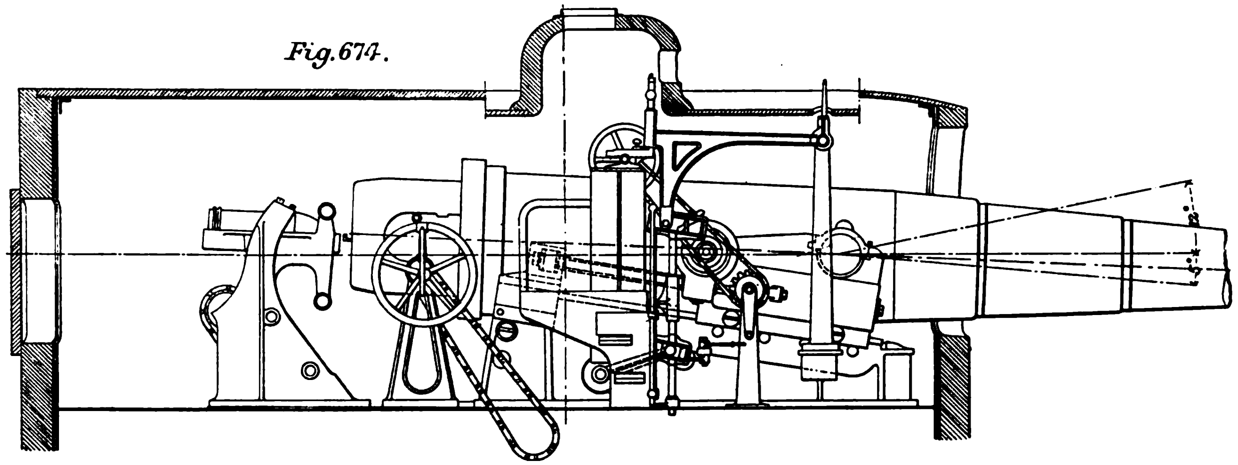
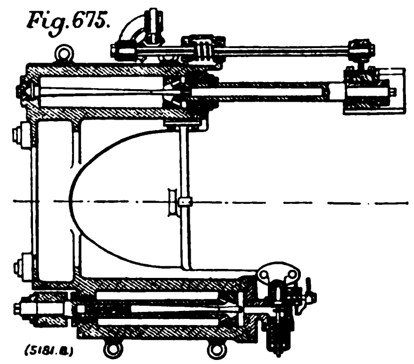


Fig. 675.



A saving in space has been claimed for water-tube boilers, but I do not find this claim sound when account is taken of the increase in grate and heating surface necessary in water-tube boilers to insure satisfactory working, and because of small units the space for accessibility is increased rather than diminished. The fact that water-tube boilers raise steam quickly is of the greatest advantage. I have stated elsewhere that I consider the battle of Santiago to have developed the necessity of the use of water-tube boilers whether it taught us anything else or not. It would have been of the greatest advantage to have had, during the blockade of Santiago, boilers capable of raising steam in less than half an hour. Coal need not have been used to keep all the boilers under steam all the time. The Massachusetts might have shared in the glories of the fight if she had been fitted with water-tube boilers. The Indiana would have kept up with the Oregon and the Texas. The New York would have developed at least 3 knots more speed, and the Navy would been spared a controversy. I think the Colon would not have gotten as far away as she did. But we did not have the water-tube boilers.

The higher pressures possible with water-tube boilers give us smaller and safer steam pipes and better valves.

It decreases the size of the fittings and the difficulty of tracing the labyrinth of a ship's piping. It increases the efficiency of the engine. The introduction of compound engines forced us to use cylindrical boilers. In the same way the use of quadruple-expansion engines necessitates, for economy, the use of water-tube boilers.

But the quick steam raiser is, because of that very fact, not so safe as its predecessor. Of course, nothing on a man-of-war is very safe in war times, but we want things as safe as possible, and the boilers are the key to the situation in the modern battleship. I think that safety in handling water-tube boilers may be assured by using skill in the fire-rooms. I have more than ten years' successful experience with water-tube boilers on which to found this opinion and I submit that the boilers, placed as they are behind the heaviest armour and below the thick protective deck, are, at the worst, the safest apparatus on a battleship. If we can make them work well, we would do wrong to refuse to use water-tube boilers on our ships.

The author thought for yachts, cylindrical boilers were better, and he inclined to the opinion they were better for merchant vessels as a rule. He concluded as follows:

I have always opposed the use of boilers containing screw joints in contact with the fire, and have attempted to secure boilers having no cast metal in the pressure parts. Cast steel is not yet good enough to put between 300 lb. of steam and our firemen. I believe in straight-tube boilers as being easier of examination and repair than bent-tube boilers. I believe in large-tube boilers for the same reason, and because the tubes are thicker and have more margin for corrosion. I believe in boilers having as few joints as possible. Water-tube boilers must have freedom of expansion of the various parts, and the simpler the boiler the better. It should not be necessary to introduce reducing valves between the boilers and the engines to secure a steady steam pressure at the latter, nor should it be necessary to have automatic feed arrangements to insure steady water level in the boilers. To be successful a boiler must be easy of repair. Lightness is a natural attribute of all water-tube boilers, but it is not wise to go too far in this direction. The ratio of grate surface to fire surface occupied for the complete boiler plant must be as large as possible. The units should be large, the grates short, and not too wide. The passage of gases through the tubes should be sufficiently long to insure economy. These gases should be well mixed before entering the spaces between the tubes for the same reason and to prevent smoke. The circulation of the water in the boiler must be free. Tubes should not be too long and the fire-rooms must always be sufficiently wide to provide for free withdrawal.

The foregoing is what we want. We have most of the above desiderata in several well-known types of boilers, and ultimately we shall discover the value of each of the foregoing points, and then it will be possible to differentiate between the various types more perfectly than we now can.

In the meantime, all that I have to say is that the use of water-tube boilers has been definitely decided upon for our naval vessels, because water-tube boilers give tactical advantages of great moment, and because, with care in the selection, manufacture, and management of water-tube boilers, other disadvantages may be neutralised.

There was but little discussion on this paper, because the Admiral is not a man to take a position unless he has carefully considered it and is fully prepared to defend it. It is a rash man who rushes into an argument with the hero of the Jeannette Expedition, and the Society are not only prudent, but, moreover, they were pretty fully persuaded Admiral Melville was quite correct.

(*To be continued.*)

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXXIII.

Schneider-Canet Naval Turrets—(*continued*).

Closed-in Turret for 24-Centimetre (9.449 *In.*) *Gun.*—The turret to be now referred to is a type which Messrs. Schneider and Co. have designed especially for the armament of protected coastguard ships. It is illustrated by Figs. 670 to 675, pages 716 and 717. It contains four main parts, namely: the mounting and its slide; the turret and its rotary mechanism; the training apparatus and the hoists.

The mounting consists of a carriage formed of a recoil cylinder and provided with the trunnion plates. The lower part of the cylinder is fitted with slides, with outside clamps and with inside guides; front buffers limit the travel of the carriage. The slides are made with two cheeks; these have a soleplate bolted to the turret platform, the top flanges constituting slide-paths in which seatings are cut for the rollers that facilitate the travel of the carriage during recoil and running out. The right-hand cheek carries the sight support, the sight-line not being affected by the recoil. The recoil-cylinders are on the Schneider-Canet system, with central counter-rod; the pipe which unites the two cylinders ends on one side at the rear of the right-hand cylinder, and on the other in a valve on the cover of the left-hand cylinder. The liquid flows from right to left by lifting the intermediate valve; this falls back on its seat when recoil is spent, and the flow of the liquid ceases. The gun remains run in until a valve placed on a pipe that establishes communication from one cylinder to the other, is turned by hand, when the gun runs out again under the action of gravity. The turret is arranged for central charging and consists of:

(*a*) The movable platform, with two longitudinal beams placed underneath the mounting cheeks.

(*b*) The path on which horizontal rollers turn, placed at the top of a frame formed like a truncated cone, which surrounds the central tube; this frame is made with a roller path for the vertical rollers.

(*c*) The central tube, made in two parts joined by a piece which serves also as a support for a circular line for the amunition service.

(*d*) The hydraulic cylinder which acts as a pivot bearing, and which carries most of the revolving weight; it serves also to lift the turret for inspecting the rollers.

The mechanism for elevating the gun comprises a handwheel and two bevel pinions which work a helicoidal screw; the latter drives the gearing on the axis of which is a pinion that engages a toothed sector fitted to the gun. As the helicoidal screw recoils with the gun, it is made to move on a square shaft parallel with the slides. This mechanism can be worked direct by the gunner who stands in the hood, or by his aid from the platform. Lateral training is obtained by hand, or by electric power. The required motion is given by the rotation of a pinion which gears in the toothed circular rack fixed to the part forming a roller path. This pinion is keyed on a shaft guided by collars fixed on the flooring; it is joined to a helicoidal wheel by an elastic coupling. The helicoidal wheel is driven by an endless screw fitted to the motor shaft. Lateral training is obtained by acting on the handwheel placed on the left side of the mounting; this works, through a cogwheel and a plate chain, the horizontal shaft fitted with a pinion that gears in a wheel keyed on the vertical axle working the rack. A disengaging lever serves to isolate one set of mechanism from the other.

Ammunition is raised to the gun in a carrier made with three compartments placed side by side, its lower part being fitted with a lever provided with rollers that travel in the guides inside the central tube. The carrier is raised by a chain that turns round a toothed wheel below, and on a tension pulley above. The motor is placed between the two floors of the platform; it sets in motion a vertical shaft, at the lower end of which is keyed an endless screw working a helicoidal wheel; the latter is joined to the chain-wheel shaft by an elastic coupling. Two commutators serve, one for raising the system and the other for lowering it. The hoist can be worked by hand, by means of two cranks placed outside the system and keyed on a horizontal shaft; this also carries the pinion which works the toothed wheel on the cogwheel shaft. The pinion can be shifted to the side of the toothed wheel, thus disengaging the hand-working mechanism.

Barbette Turret for 24-Centimetre (9.449-*In.*), 42.5 *Calibre Gun.*—Turrets of this type have been supplied to the Spanish Navy, for the armoured cruisers Princesa de Asturias, Cardenal Cisneros, and Cataluña. The principal characteristics of this type are the following: The whole of the revolving part rests both on a hydraulic pivot and also on a series of horizontal rollers, the latter arranged on the top deck; at the lower part it is guided by the pivot, and at the upper part by a series of vertical rollers. The mounting has an oscillating carriage, with hydraulic recoil cylinders and air recuperators for running out the gun. The gun and mounting are entirely balanced on the trunnions, thus allowing rapid elevation by means of an ordinary winch worked by hand-power or by an electric motor. The gun can be charged at any horizontal angle, and up to a certain vertical angle, the ammunition service is effected direct to the breech. The gun is held in the carriage by tongues and grooves; the breech end is entirely cylindrical.

The platform is circular in shape; it consists of two longitudinal beams, two transverse stay-girders and six lateral radiating girders, all strongly connected and fixed to a flooring made of steel plates. On the top flanges is another flooring strengthened in front where the gun mounting rests. A circular vertical plate held in place by angles fixed to the ends of the beams, and by six vertical uprights, carries the turret frame. The cylindrical socket is formed of two plates butt-jointed together; its top part is placed within a drum built up of plates, which joins it to the platform, the lower part being closed by a cast-steel piece which constitutes a hydraulic pivot on which rests the whole system. The pivot has a gun-metal lining, and revolves inside a cast-steel hydraulic cylinder. The water required for working the hydraulic pivot is delivered by a small pump, placed near the cylinder and worked by hand or electric power. The fixed roller paths for the horizontal and the vertical rollers are provided in one single cast-steel ring, fixed to the upper deck. The socket is fitted with a drum, placed at a suitable height, round which turn the chains for lateral training.

The mounting consists of the coil around the gun and of the oscillating carriage. The latter is formed of a trunnion ring in front and of a rear jacket joined to the ring by means of four cast-steel string beams, the rear jacket being formed by two lateral forged-steel blocks and two cast-steel stay bars; the blocks contain the recoil cylinders and recuperators, and each of the cast-steel stay bars has seatings for two rollers, on which the rear end of the gun rests. As has already been mentioned, the gun is fixed to the encircling coil by tongue and groove joints; the gun rests on the carriage with the interposition of four rollers of forged steel placed in two lateral cheeks forged in one piece with the coil. The gun is thus always supported by the four front rollers of the coil and the eight rollers of the carriage, the efforts for the running in and out of the gun being thereby reduced to a minimum. The recoil cylinders are bored in the forged-steel lateral blocks; their centres and those of the gun and of the carriage trunnions are in one same plane; this does away with all effect of percussion, and the system has only to withstand, during firing, the efforts of the recoil cylinders which are in direct opposition to the recoil force of the gun. The piston-rods are fixed, in front, to the encircling coil and continued in the rear as counter-rods of equal diameter, thus forming hydraulic brakes of constant volume. The vents for the flow of the liquid are determined by the ballistic data of the gun and are calculated so as to obtain a practically constant resistance in the cylinders. The working of the recoil cylinders is independent of that of the recuperators, but in order to simplify the system and to reduce to a minimum the number of joints, the recuperators have been placed in the same blocks with the hydraulic recoil cylinders, the counter-rods on their leaving the recoil cylinders being utilised for forcing liquid into the air receivers. When the recoil is complete, the air expands and forces back the liquid, which, in its turn, drives back the counter-rods of the recoil cylinders, thus running out the gun again. An air compressor is placed in the turret, and in this an initial compression of 15 kilogrammes (213 lb. per square inch) is obtained. This is sufficient to run out the gun under an angle of 15 deg. A small hand pump placed under the carriage provides for the running in of the gun when necessary. The recoil cylinders and air receivers have no piping, and as they are bored in forged-steel blocks they offer a great resisting power and are perfectly tight. The carriage trunnions are placed exactly in the centre of gravity of the oscillating system; they are covered with a gun-metal lining and rest in suitable bearings in two cast-steel supports strongly bolted to the platform.

The required elevation for the gun is obtained by the displacement of two racks fitted under the carriage and guided by rollers. These racks engage two square pinions keyed on the same shaft as a helicoidal wheel; a crank drives the endless screw which works the helicoidal wheel through two bevel pinions. Two men working the crank can elevate the gun from — 5 deg. to + 15 deg. in 30 seconds. A dynamo can also be employed for turning the endless screw shaft by a double set of gearing, and the time required is only 12 seconds. Should the gun not run in, the angular displacement of the carriage could be effected by hand-power by means of a ratchet lever acting on the end of the dynamo shaft. The lateral training mechanism contains two plate chains, two hand winches, and two dynamos. The chains that surround the drum on the socket are worked by two square pinions keyed on the same axles as two helicoidal wheels. Lateral training is obtained by the revolution of the

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helicoidal wheels; the latter are worked by two dynamos which drive direct the endless screws that gear in them, or by hand-power through cranks and winches; clutches enable the dynamos to be disengaged from the winches. The helicoidal wheels are joined to their shafts by means of friction clutches which serve to limit the efforts on the transmission gear which result from a sudden stoppage of the turret. A speaking-tube establishes communication with the gunner to the men who work the cranks on the orlop deck. The gunner works the dynamos for lateral training direct by acting on a hand-lever placed in the turret. Lateral training has a limit of 240 deg.; when the ship is on a level keel this takes, by hand, 1 minute 35 seconds, and by electric power 35 seconds.

The device for supplying ammunition consists of a carrier which can hold the projectile and the two cartridges forming the powder charge; and a winch fitted to the socket worked by hand or by electric power to raise the carrier up to the firing platform at the rear of the gun. Guides are provided for the carrier and the apparatus is completed by a hand rammer. The carrier consists of a case suspended on two roller pivots; the projectile is placed in the middle and the powder charge in two lateral movable charge holders. When the carrier is at the lowest part of its travel, it arrives automatically opposite a charging table, and the projectile and powder charge are slid into it by hand, the charging table being suitably inclined for the purpose. The winch which works the hoisting chains is then set in motion; as soon as the hoisting operation starts, the carrier straightens and rises vertically until it reaches the turret, when it follows the incline of the guides; near the end of its travel it arrives in a horizontal position at the rear of the gun. The incline given the carrier at the end of the lift is obtained automatically by means of two racks fixed to the guides, and two pinions which form part of the carrier, which turn when they meet the fixed racks on the guides in raising or lowering motion. The hoisting apparatus contains all the necessary devices for safe working.

The electrical plant comprises one dynamo for elevating the gun, two dynamos for lateral training, one for the hoist and one for the pivot compressor, besides the electric machines referred to in the preceding description. The auxiliary apparatus consists of a hand-pump for running in the gun; a hand-worked compressor for starting the air recuperators, and a pump worked by hand or by electric power to maintain the required pressure under the step bearing of the turret.

SUGAR MACHINERY.

MUCH has been written recently as to the hardships experienced in our sugar-growing colonies owing to the system of bounties giving a great advantage to Continental sugar manufacturers. It will not be thought that we seek to belittle this handicap, if we point out that the existance of such a cause for complaint, or such a plausible reason for a threatened collapse of a great industry, has developed a tendency to overlook the important necessity of modernising the plant used in our older sugar-growing dependencies. It has ever been the habit of mankind to accept extraneous causes for some impending calamity when a closer examination might reveal the fact that reform within, would postpone if it did not avert it, and our present-day system of Parliamentary assistance may tend to foster this habit instead of encouraging robust independence. We do not say that the sugar planters have not a grievance, but experts believe that, excepting in Demerara and Trinidad, the appliances in the West Indies for recovering sugar from the cane, are for the most part obsolete, and that the output in many cases might be nearly doubled. Thus the long monopoly of bygone years has had great damaging effect; there is nothing like competition for quickening interest in newer processes, and in more efficient plant, and if the present state of affairs awakens the more lax of sugar planters, gain will result. No great divergence in the methods employed need be anticipated; but the actual plant employed varies, owing to radical changes having been made in design in recent years, tending towards a higher percentage of efficiency.

We have given from time to time in ENGINEERING illustrations of successive steps in this progress, all directed towards increasing the quantity of juice recovered from the cane and cheapening the process, and on our two-page plate in this week's issue we illustrate a complete installation with the most modern adaptation of the system of crystallisation in motion, which Messrs. Pott, Cassels, and Williamson, Motherwell, have introduced with great success. Crystallisation in motion, it may be said, is the name given to the process in which the massecuite is kept in a condition of agitation after it has left the vacuum pan so that the crystallisable particles may be brought into contact by mechanical means with the crystals already formed. This is specially suited to low-grade massecuite or to the residue after the first treatment in the centrifugal machine. The credit of the original introduction is, we believe, due to the German firms who have for some years been working on this system; but the numerous Continental applications have all more or less the disadvantages of being over-elaborate, with unnecessary refinements militating against constant working and economical upkeep. Thus they jacket their vessels for steam heating or water cooling; they connect the vessel directly with the vacuum pan, necessitating gauges, thermometers, &c., to each vessel, so that instead of a simple vessel with powerful gear to give motion to the contents to produce crystallisation under ordinary atmospheric conditions, the plant has become in their hands more complex than experience has proved to be necessary, more especially for sugar factories abroad, where native labour is employed.

This plant, it is scarcely necessary to say, comes into use comparatively late in the process of sugar-making. The sugar cane has been crushed to extract the cane juice, which is mixed with milk of lime in order to prevent the inversion or acidity that is fatal to crystallisation; the juice has been raised to a high temperature and filtered before passing through a multiple-effect evaporator of the Lille or Yaryan, or other type with which our readers have been made familiar, and as a sluggish flowing liquid or concentrated juice it passes to the vacuum pan. From this it enters the plant with which we are more immediately concerned. In the vacuum pan granules have been formed for the first time, and the product when discharged is known as "massecuite." Massecuite consists of sugar crystals and molasses, the proportions varying according to circumstances; but as discharged from the vacuum pan there is much in the molasses that is crystallisable but which is not in a crystalline form, and it is therefore to supplement the work of the vacuum pan that crystallisation in motion plant has been adopted. It is claimed that with the interposition of this plant in the general process, a larger percentage and a better quality of grain is got out of the massecuite than when centrifugal plant only follows the vacuum pan; for with the latter an excessive amount of washing or steaming has to be resorted to, in order to produce the desired purity, and this reduces in amount the finished product. Again, there is great economy in handling, as the massecuite has not to be touched from the time it leaves the vacuum pan until it enters the store as sugar.

The crystallisation in motion plant, manufactured by Messrs. Pott, Cassels, and Williamson, consists of a series of wrought-iron tanks of U-shape, fitted with massive stirring blades actuated by friction and worm gear, so arranged that the spiral "stirrer" in each vessel can be started or stopped independently of the others. The main driving shaft on which the worm gear is fixed runs parallel with the ends of the tanks. A clutch working upon a feather on the end of the stirring shaft is arranged to connect and disconnect with each wormwheel by means of a friction cone. This arrangement has the advantage that, should undue resistance be offered to the motion of any of the stirring shafts owing to any foreign body being dropped into the vessel or other cause, the friction cone would slip, and thus prevent serious injury to the mechanism. The stirring gear is made with extra strong blades of cast steel, and these blades, of propeller shape, have at their tips flat bars to form a continuous spiral, so that the massecuite must travel to the sluice valve at the exit. The general form and arrangement of the plant will be seen by reference to the drawings, which we reproduce, showing the general arrangement of a factory completed and fitted up quite recently by the firm. Fig. 1 shows the front elevation, Fig. 2 the plan, Fig. 3 the end elevation, while Figs. 4 to 7 show fuller details of the plant—the crystalliser, the mixers, and the centrifugals. This installation is capable of dealing with over 200 tons of sugar per day. Each centrifugal can discharge 8 cwt. of dry sugar at one charge. The arrangement of the plant as shown is that adopted in a number of very large installations manufactured by Messrs. Pott, Cassels, and Williamson, and supplied to sugar refineries in Britain, Australia, and elsewhere.

The massecuite, after being treated in the crystallisers for 24 to 36 hours according to its quality, passes by gravitation to the "mixer," and thence to centrifugals where it is "cured." It will be seen that the crystalliser is placed between the vacuum pan and the mixer, which passes its contents to the centrifugal. This minimises handling. A spiral conveyor receives and conveys the sugar from below the centrifugal and delivers it into an elevator, which raises the sugar to the sugar store. In many countries, however, notably where earthquakes are prevalent, it is desirable to keep the buildings as low as possible. In such cases the crystallisers discharge at the floor level, and a massecuite pump is used for elevating the contents into the mixer above the centrifugals; and here it may be said that the pump made by Messrs. Pott, Cassels, and Williamson has one or two notable features, as it does not primarily depend upon the efficiency of its suction for the results obtained. The barrel is provided with a hopper, into which the massecuite flows by gravity, and on the forward motion of the plunger the contents of the barrel are dislodged and elevated. The arrangement of valves is such that no choking can take place, and the plunger is provided with a means for admitting water for lubrication purposes and to prevent crystallation taking place when the pump is at rest.

The strike mixer is a trough with an "agitator," the form of which is clearly shown on the detailed end elevation (Fig. 4), and its function is to insure a thorough mixing of the massecuite while it is passing from the crystalliser to the centrifugal machine. The mixer is horizontal with a horizontal shaft, carrying a series of blades or propellers as shown. On the charging spout of this mixer there is an interesting detail in the form of a cam making a joint against the rubber face of the spout. The illustrations given (Figs. 5 and 6) needs no explanation.

The centrifugal machine made by the firm is of the type invented and patented by Mr. David McAulay Weston, of Boston, U.S.A., at a time when the centrifugal machines in use were, without exception, of the fixed bearing type, the spindle carrying the basket being fixed and rotated about a fixed shaft held by two or more bearings. Mr. Weston was the first to recognise that a great loss of power resulted from causing an unevenly balanced load to revolve round a centre other than the true centre of gravity of the load. Setting himself to overcome this difficulty, and to construct a machine which would be free to revolve round its true centre of gravity, and which would not be bound by fixed bearings, he hit upon the ingenious expedient of allowing a rotating spindle to oscillate from a point of suspension.

Quite a number of different methods of arranging the details at the point of suspension have been employed from time to time – ball-and-socket-joints, or elastic joints formed either by rubber or springs of one form or another. Messrs. Pott, Cassels, and Williamson adopt an ingenious method, shown by Fig. 7 on our two-page engraving. It is as flexible, yet provides a much larger surface for carrying the load of the machine with its charge, (meaning in some cases as much as 2 tons) than other methods. There is no metal-to-metal contact in any place at the suspension part, and as the actual motion that takes place at that point is extremely small, no lubrication of any kind is necessary. The machine as made by the Motherwell firm, is hung from what is technically known as the top or suspending block, which is usually of cast iron. It is circular in plan and has an internal flange on either side of which a rubber ring is placed and held in position by two cast-iron collars, which in their turn are fitted to the inner spindle of the centrifugal machine. The connection between the top block and the spindle is maintained by a nut which can be tightened to give any degree of rigidity to the vertical spindle. In practice the spindle is allowed a certain amount of freedom to permit the machine when running to oscillate within reasonable limits and thus to allow it to rotate round the true centre of gravity of the load, instead of compelling it to revolve about a definite or fixed centre as if run-

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other half of the three-wire load. The auxiliary steam plant is also run in multiple, with the two 225-kilowatt rotaries in series. One of the two 225-kilowatt rotaries has been run in single phase, furnishing 220 volts and 70 per cent. of the total capacity of the machine. Both the 225-kilowatt rotaries have been run in multiple, one as a two-phase and the other as a single-phase machine, and in no instance has the polarity been reversed.

During the peak of the load, four different stations, three of them widely separated, are electrically tied together for the delivery of incandescent service; namely, the Azusa water-power plant, the auxiliary steam plant at Los Angeles, the San Gabriel sub-station, and the Los Angeles railway plant. The four stations are entirely dissimilar, as they deliver respectively 15,000 volts three-phase, 2400 volts two-phase, 500 volts direct current, and 200 volts direct current; nevertheless, they are all coupled together in parallel for the operation of entirely different and independent systems of distribution.

The intricate nature of the combinations and varieties of service rendered by this plant have necessitated a switchboard of more than ordinary interest. The usual type of Westinghouse switchboard has been provided. Panel I serves for the exciters, and carries a 100-ampere ammeter, a 150-volt voltmeter, two synchronising lamps and plugs, a double rheostat for controlling the exciter and generator fields respectively, a voltmeter plug-switch, two generator field plug-switches, two double-pole double-throw switches, one for exciting the auxiliary generator field for the rotary, and the other for exciting it from its own exciter, and ten single-pole fuse blocks. The other panels are equipped in a somewhat similar manner with suitable devices for their special purposes.

To the left of the direct current end of the third rotary is the switchboard controlling the 500-volt service, and the low tension or three-wire distribution system; the first seven panels from the front control seven separate feeders. The panels of these switchboards are provided with all the necessary devices according to the latest Westinghouse practice.

The local distribution through the city of Los Angeles is carried in creosoted wooden ducts. There are sixteen different centres of distribution in the underground conduit area, all of which are reached by 500,000 circular mil. cables, or 200,000 mil. mains. Rubber-covered cable is used exclusively, and both the 500-volt and 220-volt direct-current services are underground. The neutrals are connected solid, but the outside wires are fused through a reliable street fuse-box designed and supplied by the San Gabriel Electric Company. Manholes are made in the streets, and service boxes are placed in front of each separate property. No boosters are used at present, but one of the smaller rotaries will be used for that purpose when it becomes necessary to do so.

On the Pacific Slope electricity is destined to play a pronounced part in economical development. Natural conditions tend to make this energy almost essential to advancing civilisation. Cheap fuel has been the one element lacking as an aid to progress. What Nature has denied in the way of fuel, she has abundantly compensated for in opportunities for the development of current from mountain streams. On all parts of the Pacific Slope, from Puget Sound to San Diego, electrical projects are taking shape which will do more than all else to affect favourably the industrial activity of the cities and country districts. Two other projects for utilising the water of the San Gabriel river are already receiving attention.

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXXIV.

SCHNEIDER-CANET NAVAL TURRETS—(*concluded*).

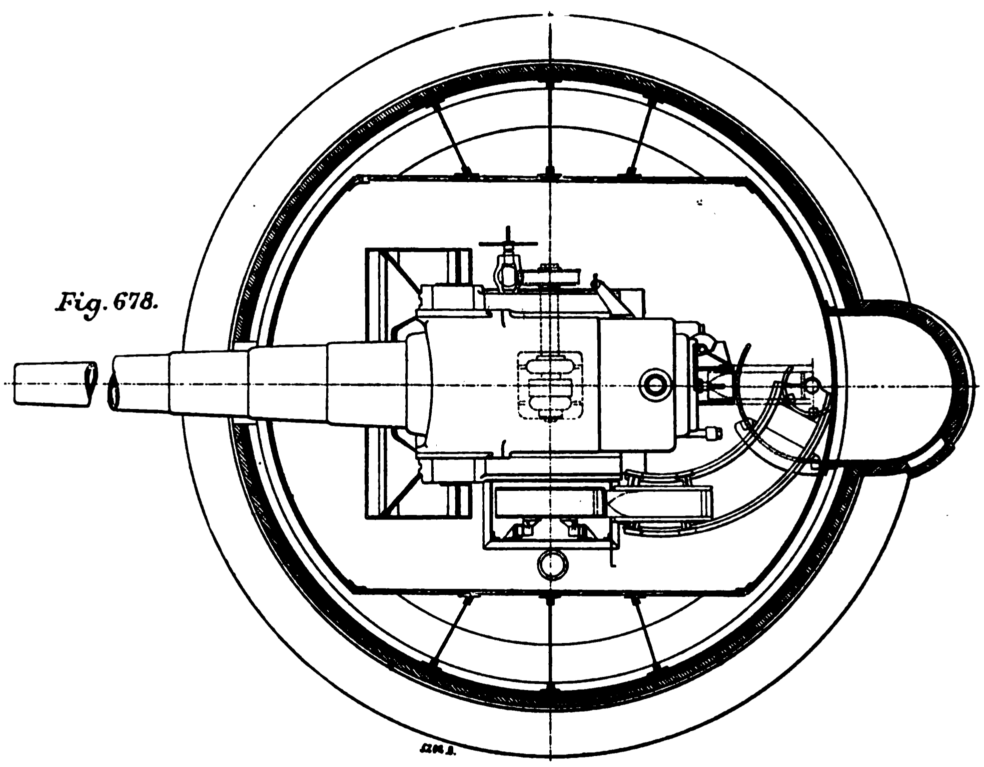
Closed Turret, Worked by Hand or Electric Power, for 28-Centimetre (11.023-*In.*) *Gun.*—This turret is illustrated by Figs. 676 to 678, page 816. The installation comprises the following principal parts: The carriage and slide; the turret and its rotary mechanism; the training mechanism and the hoist. The carriage proper consists of a jacket provided with trunnions, with the recoil cylinder and the collars that hold the compressed air recuperator; it is fitted inside with gun-metal rings which guide the gun during recoil. At the lower part, a shoe is provided on which is the sector for elevating the gun. The slide consists of two cheeks, of plates and angles, which rest on a soleplate fixed to the top flooring of the turret, and which carry the trunnion plates that receive the trunnions of the jacket. To facilitate the elevation of the gun and jacket, the trunnions are surrounded by a ring of antifriction rollers. The right-hand cheek is made with a bracket for the elevating mechanism. The recoil cylinder is on the Schneider-Canet system, with central counter-rod; it is joined to the compressed air recuperator placed under the jacket, through a pipe that opens on the front part of the cylinder, as well as through a small branch on the pipe, and ending at the rear of the cylinder in a gun-metal chest which contains the valve that controls the running in of the gun. When recoil takes place, the piston-rod enters the cylinder, and drives out a quantity of liquid equal to its volume; this acts on one of the sides of the recuperator piston, the latter serving as a compressor for the air, the expansion of which during the return of the gun, causes the liquid to resume its original place.

The turret is fitted with a central ammunition hoist, and consists of the rotating turret platform made of two floorings of plates joined together by a circular vertical beam in a line beneath the roller path, and by two longitudinal ones under the slide cheeks. The top flooring is fitted with a steel plate caisson which forms the inside of the turret and carries the rotating shell and its plating. The central tube is formed of steel plates, partly cylindrical and partly in the shape of a truncated cone, protected by armour; the two parts being joined together by a cast steel angle-ring. The top part of the tube is connected to the lower flooring of the platform by a circular caisson of cast steel, the inside surface of which forms a roller path for the set of vertical rollers. The cylindrical part of the tube is fitted with the circular rack for lateral training. The hydraulic cylinder at the foot of the central tube forms a pivot on which the greater part of the revolving weight rests, and which enables the turret to be raised for inspection of the rollers. The rotating mechanism contains the set of conical horizontal rollers, on which rests part of the weight of the platform, and the set of cylindrical vertical rollers which insures the centring of the system. A latch bolt is introduced for fixing the turret when at sea.

The mechanism for elevating the gun consists of a toothed rack placed under the jacket, and which gears with a pinion on a shaft carrying a helical toothed wheel. An endless screw that drives the latter is connected to a working crank through two bevel pinions. The gun can be trained by hand or electric power. An endless screw is keyed on the electric motor shaft; this drives a helicoidal wheel the shaft of which carries a pinion which gears in the circular rack fitted to the central tube. The electric motor is driven by a commutator of the type styled "cartouche électrique" placed on the right of the carriage within easy reach of the gunner. For training the gun by hand, the mechanism comprises a wheel, toothed on the inside of the rim, keyed on the helicoidal wheel shaft, and a suitable gearing. The two sets of gearing may be thrown in or out by means of a clutch, according to whether hand or electric power be employed.

The gun is supplied with ammunition by means of a carrier containing three compartments placed side by side, fitted with three pairs of rollers that travel in the guides placed inside the central tube. The lower pair of rollers is fitted to two arms jointed on the charge-holder; a ring is fixed on the cross-piece that unites the two arms; it holds an endless chain worked by a winch placed in the lower part of the system. The chain passes round the tension pulley between the two floors of the rotating platform. The winch is worked from an electric motor which operates a horizontal shaft provided with a brake. The carrier descends by its own weight, the speed being regulated by the brake. The motor is started with the help of a rheostat. The winch can also be worked by hand from the charging-room. Safety devices are provided for stopping the carrier at both ends of its travel. The projectile is brought to the rear of the gun in a truck provided with three compartments, and made to travel on rails, and a small turntable, placed on the top flooring of the rotating platform.

Fig. 678.



PLAN OF TURRET FOR 28-CENTIMETRE GUN.

THE LANCASHIRE, DERBYSHIRE, AND EAST COAST RAILWAY.

(*Concluded from page 747.*)

THE most important bridges and viaducts on this railway are illustrated by the diagrams, Figs. 6 to 10, on our two-page plate. By far the heaviest of these works is the River Trent Viaduct, which has four river spans, with approaches on 20 brick arches on one side, and 39 similar arches on the other. The four river spans are each 115 ft. (centre to centre) or 110 ft. in the clear, supported on cast-iron cylinders filled with Portland cement concrete, 9 ft. in diameter at their upper part, enlarged to 15 ft. at their lower extremities, and arranged in pairs. These cylinders were in all cases carried down some 16 ft. below the present river bed, through varying thicknesses of river deposits, resting on sandy gravels, to the solid blue-marl. The sinking was unaccompanied by any water difficulty, a small pulsometer pump sufficing to keep all percolation under, save in one case, where a spring was met with, and a concrete plug had to be inserted. The whole of the excavation

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SCHNEIDER-CANET TURRET AND AMMUNITION HOIST FOR 28-CENTIMETRE GUN.

(*For Description, see Page* 815.)

Fig. 676.

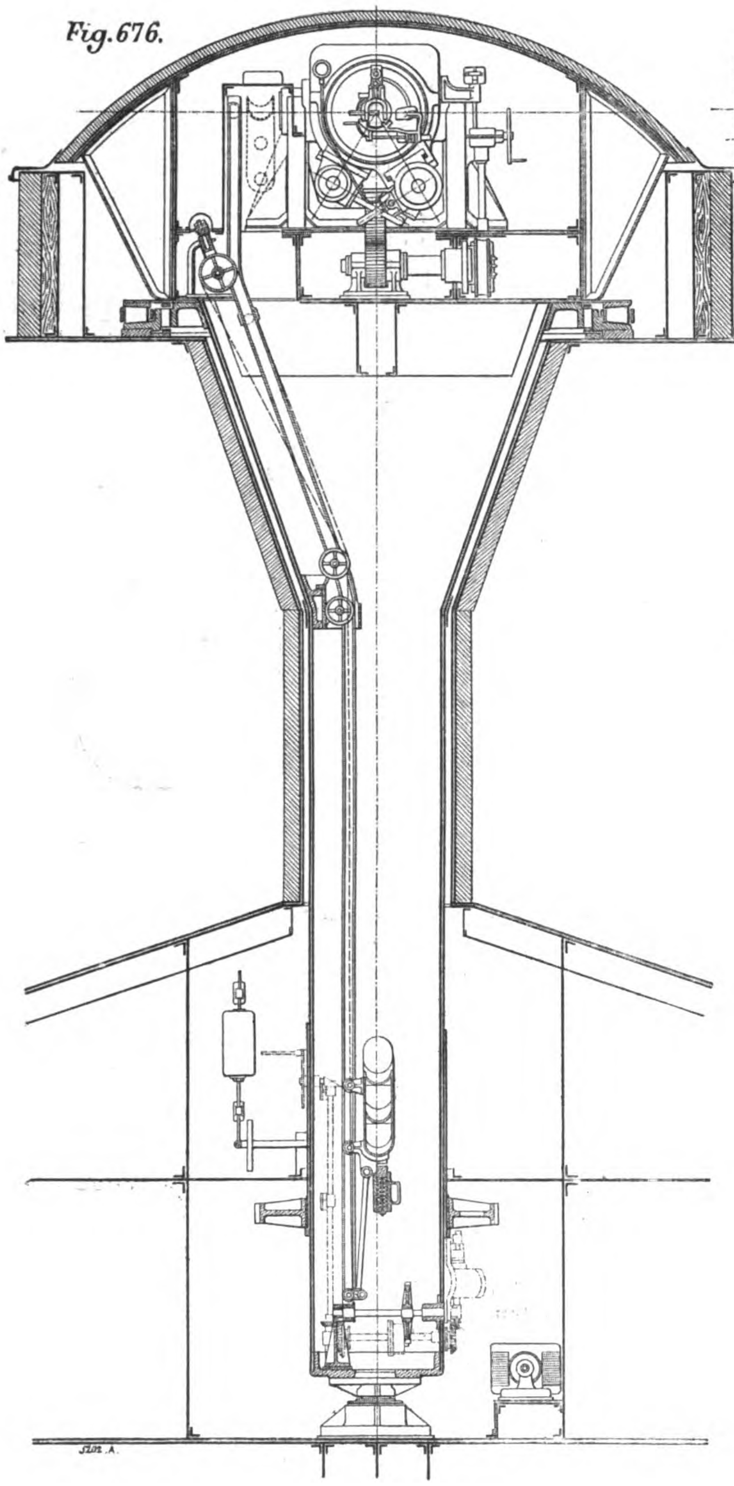
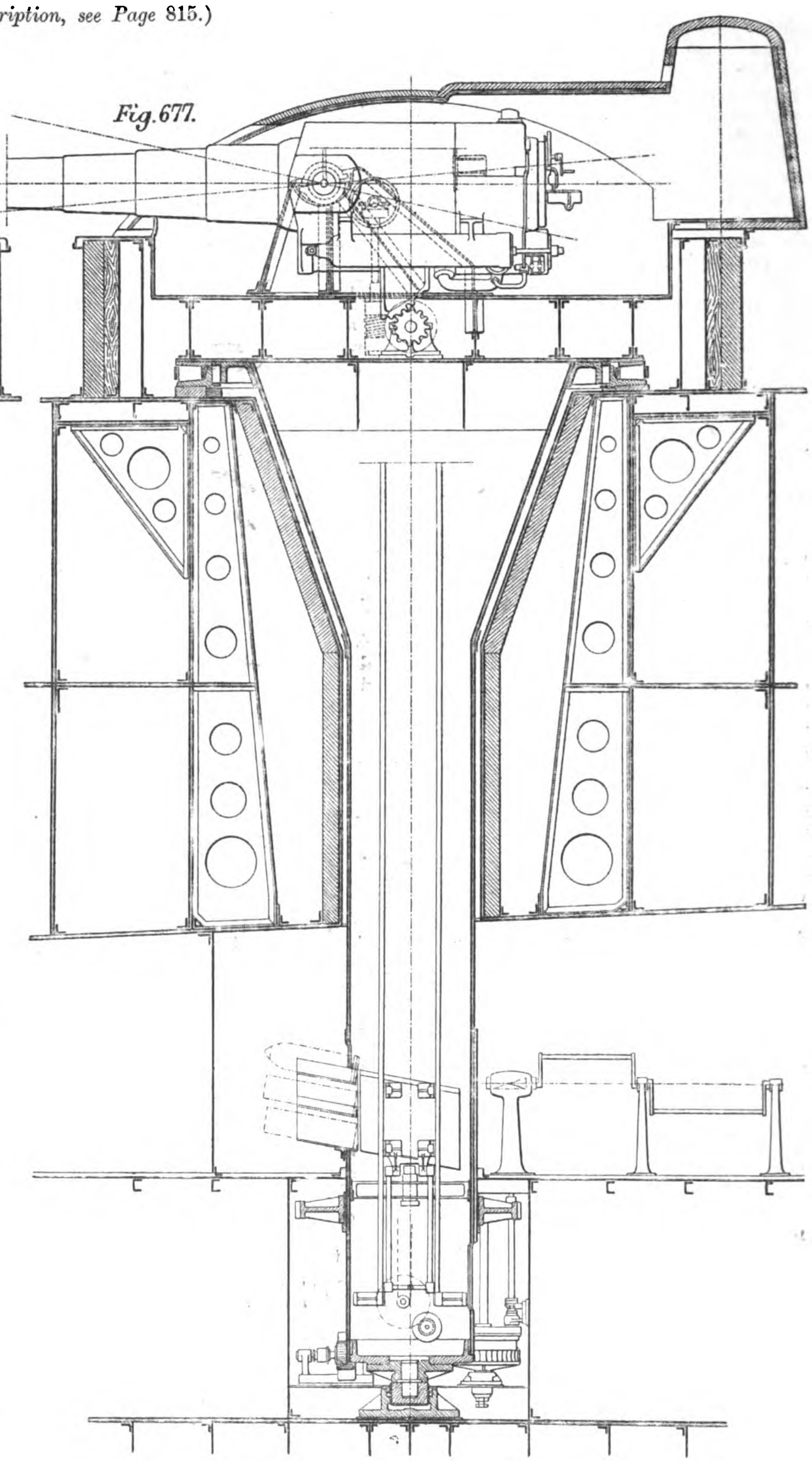


Fig. 677.



was raised by grabs through the cylinders without recourse being had to working under pressure. The steel superstructure for the river spans was supplied and erected by Messrs. Andrew Handyside and Co., of Derby; it is illustrated in full detail by Figs. 11 to 48 of our two-page plate. The girders are lattices of the N-type, the upper boom being curved so as to form a modified bowstring. The flooring consists of cross girders supporting rail-bearers with buckle plates in between, the whole being covered with special asphalte preparation. The rails are supported by longitudinal baulks bedded in the asphalte surfacing.

The height of the rail level on the river spans necessitated long approaches consisting of 59 arched spans (35 ft. each), 20 on the east side and 39 on the west side. It was originally intended to support the concrete foundations of the piers on piles, but after the piles for one span had been driven, the arrangement was modified so as to diminish the shearing stress on the concrete blocks and distribute the load more evenly. An extra line of piles was driven and the heads united by a framework to be embedded in the concrete. Eight piers were thus treated on the west side, but as the cost came out more than was anticipated, the piling was abandoned, and in all cases save one, the foundations were carried through the alluvium to the red marl, the depth below the surface varying from 20 ft. to 30 ft. In the case of one pier, where the old bed of the river was struck, the concrete block was allowed to rest on the gravel, which was very compact. These numerous spans on each side of the river were unavoidable, on account of providing the requisite flood openings required by a clause in the company's Act of Parliament.

The ruling gradient on the first section of the railway is 1 in 120, and the minimum curve 40 chains in radius. There are four stations, Skellingthorpe, Doddington and Harby, Clifton-on-Trent, and Fledborough, and several agricultural sidings at intermediate places worked by an "Armets" lock and key. In many cases the signals, where the skyline is obscured by trees, are provided with a sight-board which improves their visibilty. The station buildings on the first section, like those on the rest of the line, are particularly neat red-brick structures with gauged arched fronts and verandahs. The company have running powers to Lincoln and other stations over the Great Northern and Great Eastern joint lines from Pyewipe Junction, and the Great Eastern Railway has reciprocal running powers over the entire system of the Lancashire, Derbyshire, and East Coast Railway. At Tuxford, or the Dukeries Junction, where section No. 2 commenced, there is a large exchange station for passengers and coal traffic *viâ* the Great Northern main line to London and a junction with that line toward Retford. Tuxford is at the eastern end of Sherwood Forest or the so-called "Dukeries" (Welbeck, Clumber, Thoresby, and Rufford Parks), one of the most picturesque and richest districts in England. The Wigan Coal and Iron Company possess a ninety-nine years' mining lease over 33,000 acres

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MOUNTING WITH OSCILLATING SLIDES FOR 12-CENT. QUICK-FIRING GUN.

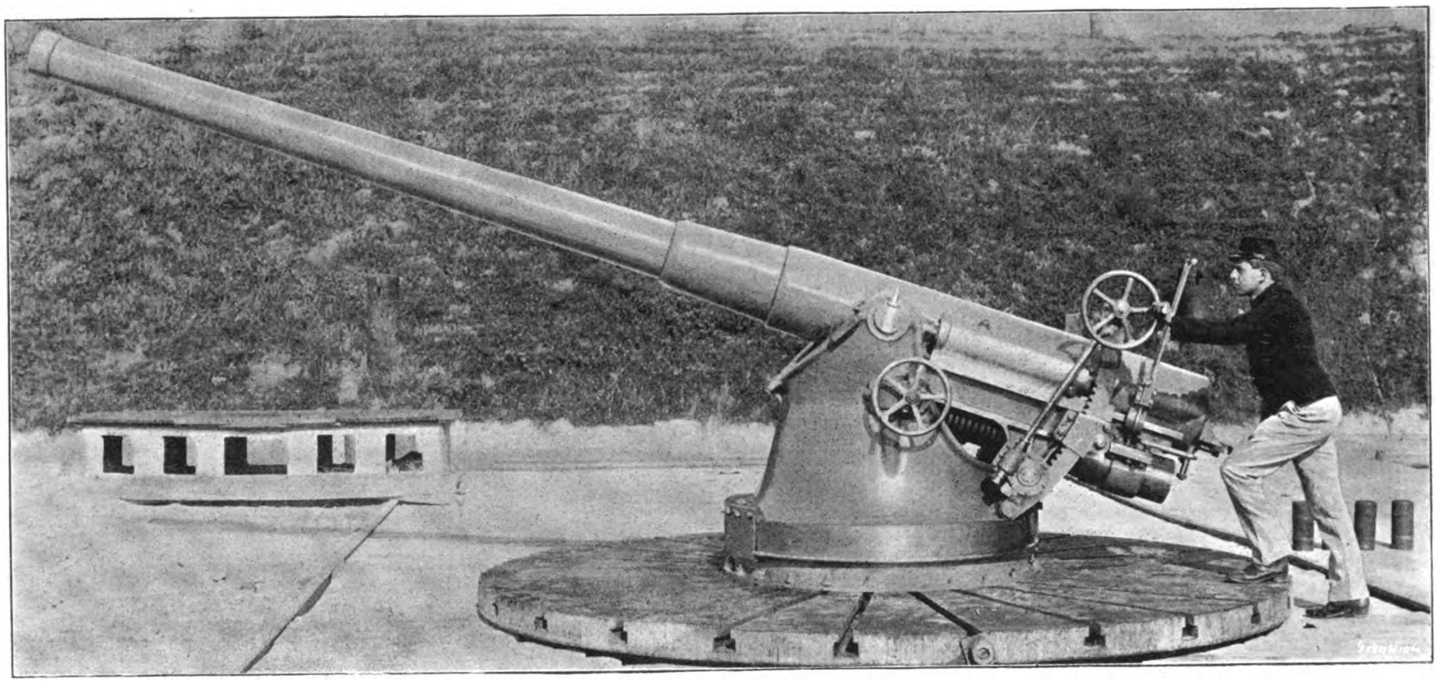

FIG. 567.

district the wash-drift has given an average yield of 4 dwt. 2¾ grains of gold per cubic yard.*

(*To be continued.*)

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXI.

NAVAL MOUNTINGS FOR QUICK-FIRING GUNS—(*continued*).

Mounting with Oscillating Slides (Figs. 567, 572, and 573).—In this type, the slides can be inclined according to the degree of elevation required of the gun. Figs. 567, 572, and 573 show a mounting of this class for a 12-centimetre (4.724-in.) quick-firing gun.

Weight of gun	3130 kg. (6898 lb.)
,, mounting ...	3150 ,, (6942 ,,)
,, projectile ...	21 ,, (46 ,,)
,, service charge (smokeless powder) ...	6 ,, (11 ,,)
Muzzle velocity in service ...	740 m. (2428 ft.)

A shield of suitable shape may be adapted to the piece.

In this mounting the bolster or bedplate is bolted to the deck as usual, and forms a path for the live ring. The traversing platform carries the trunnion standards, to which are fitted the joints of the movable slides; these bear on two circular racks, jointed to the lower part of the traversing platform. The gun-carriage proper consists of a semicircular cradle in which the gun rests; it also comprises the two lateral brake cylinders, the blocks of which run on the movable slides. The piston-rods are in the front part of these slides. The recuperator is in one piece with the gun-carriage proper, and consists of a cylinder inside which is a fixed plunger joined to the rear stay of the slides. At the opposite end is a fixed plunger, fitted with a ring on which are joined two rods that carry the sets of springs. These rods are guided, with but slight friction, in the ring of the recuperator cylinder. During recoil, the gun, carried in its housing, travels on the slides; the two lateral brakes, with central counter-rods, act in the usual way to absorb part of the force due to the recoil. At the same time, the fixed plunger enters the recuperator cylinder and displaces the movable end opposite; this acts on the two sets of springs, which are compressed by bearing against the ring of the recuperator cylinder. When the recoil is exhausted, the stored-up energy in the springs runs out of the gun (Fig. 573).

To vary the inclination of the gun, the gun-housing is moved by means of the two oscillating arcs at the lower part of the traversing platform, which travel freely in two guides at the rear of the slides. The latter are cast with bearings for a

* Reports on the Mining Industry of New Zealand, 1892, page 97.

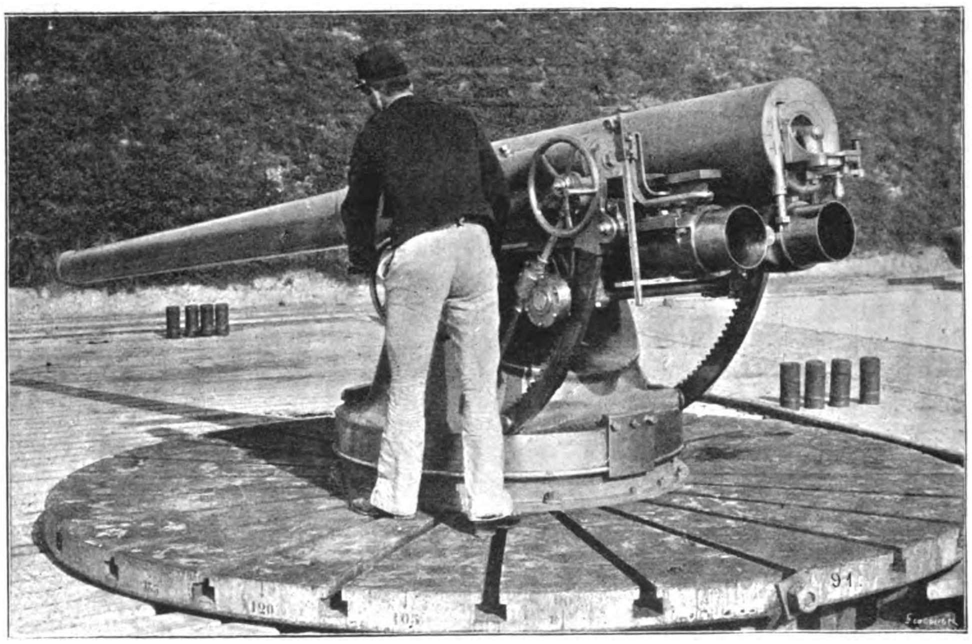

FIG. 572.

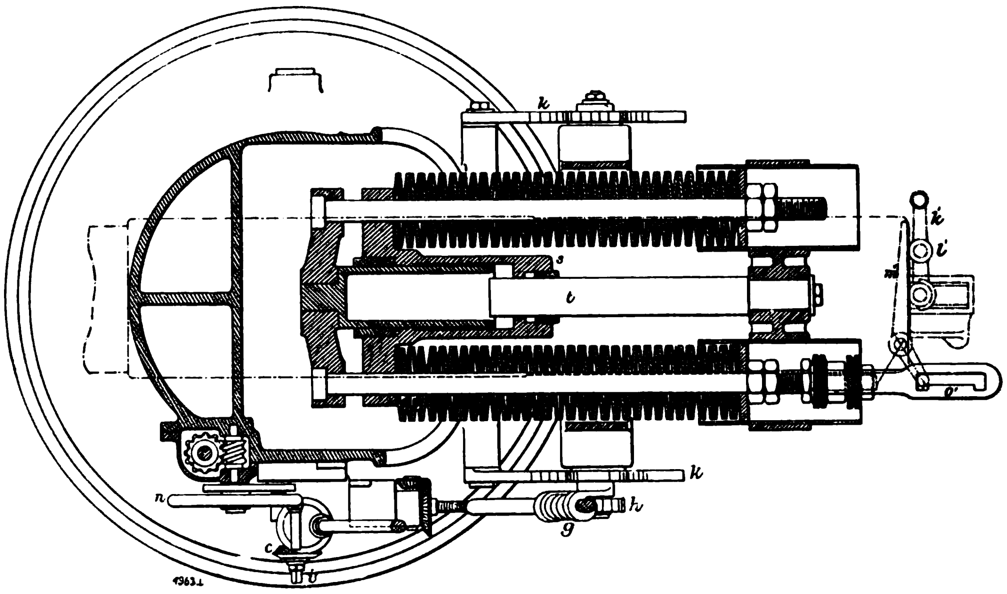

FIG. 573.

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MOUNTING FOR 65-MILL. QUICK-FIRING NAVAL GUN.

Fig 568.

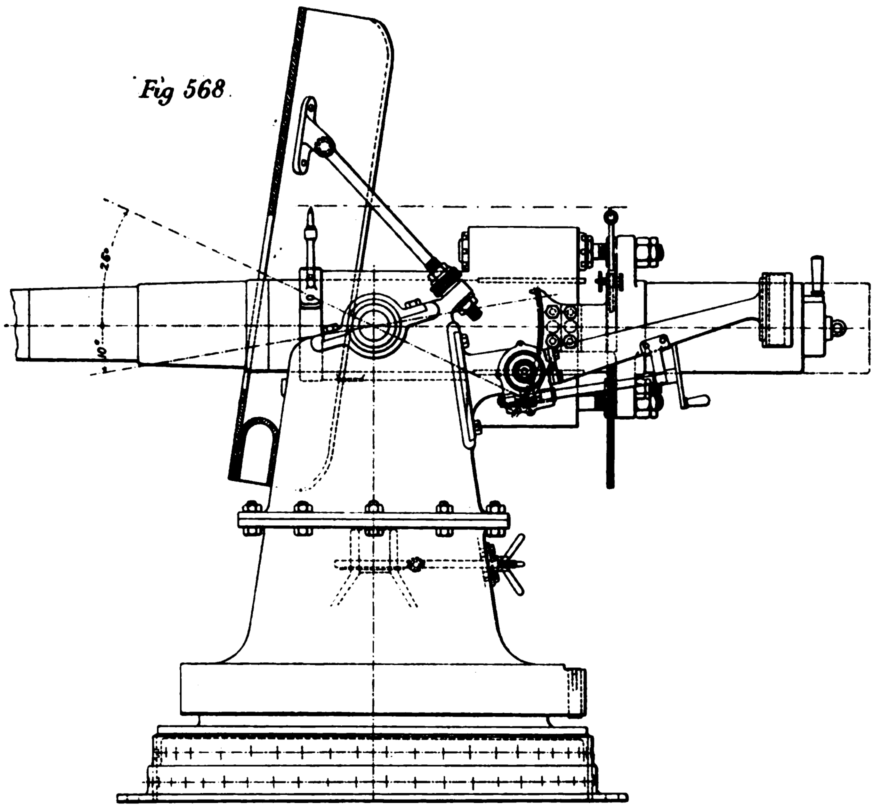


Fig 569.

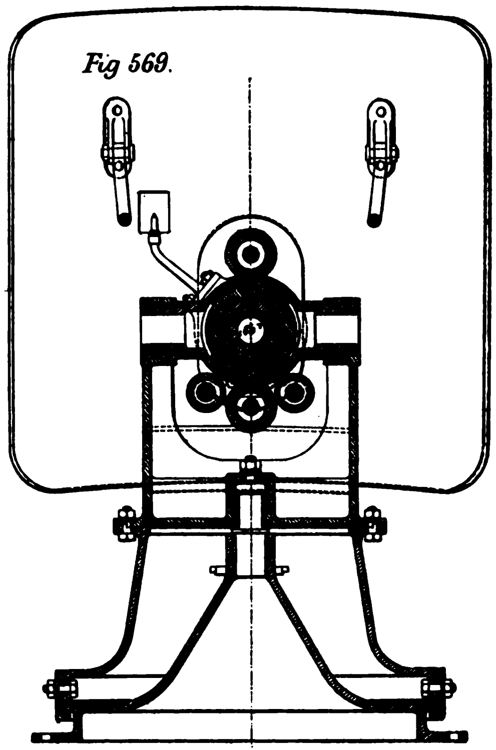


Fig 570.

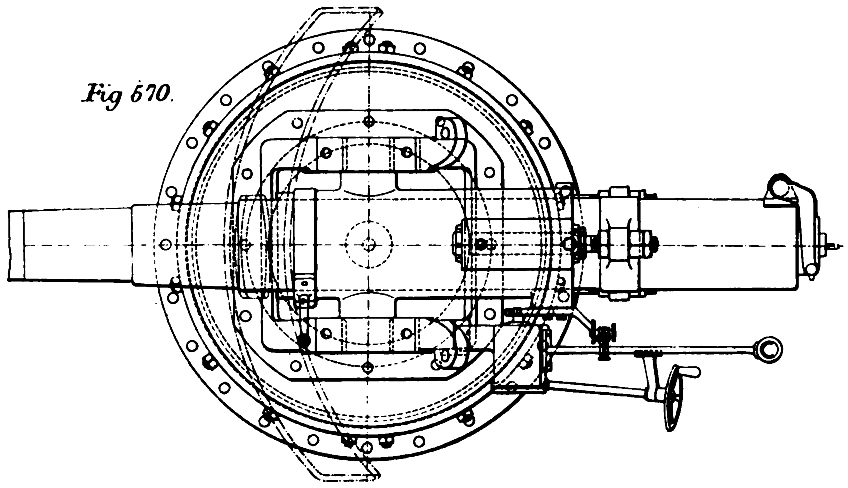
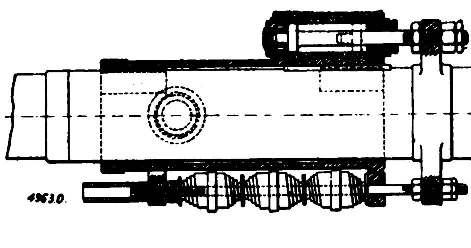


Fig 571.



horizontal shaft, provided with two pinions that engage the movable racks. When, therefore, the pinions are made to travel up or down the racks, the gun is given a corresponding inclination ; the gunner can produce these displacements by means of a gearing. The gun is trained horizontally by a lateral wheel that works a pinion through an endless screw, and a helicoidal wheel, the pinion gearing into the circular rack on the bolster. The sights are fitted on the left trunnion of the housing, and on the rear end of the corresponding slide ; the gunner can, therefore, keep his eye constantly to the firing line, including the period of recoil and of running out.

Figs. 568 to 571 are views of a mounting for a 65-millimetre 50-calibre quick-firing gun ; the following are some of the dimensions :

Weight of projectile ...	4 kilog.	(8.8 lb.)
" charge BM³ ...	1.660 "	(3.65 ")
Initial velocity	750 m.	(2460 ft.)
Weight of gun	510 kilog.	(1122 lb.)
Weight of mounting and shield	910 "	(2002 ")

The arrangements of this mounting are clearly shown in the illustrations ; they include brake cylinders and spring recuperators, the rods of both being attached to a crosshead ring fast on the gun.

The mounting is central pivoting, with hydraulic brake and reduced recoil, the running out being effected by the recuperator ; the angles of elevation vary from −10 deg. to +25 deg. The gun recoils in a cradle with trunnions, the brake cylinders being attached to the cradle. The transom frame turns round a central pivot that rests on a bearing fitted to the bolster, the base of which is large enough to insure suitable stability to the system. A holding ring that runs on the whole circumference of the transom frame prevents the shifting of the system during firing ; it is also fitted with a latch to fix the mounting. All the larger parts of the mounting are of cast-steel. The gun during the recoil slides on gun-metal shoes fitted inside the cradle, ribs being provided to prevent the system from turning. The brake cylinders, cast in one piece with the housing, are placed vertically, so as to reduce as much as possible the width of the mounting ; they are with gun-metal linings, in which are cut the grooves of different sections for the passage of the liquid. The piston plungers are attached by a bayonet joint to a ring shrunk on the gun. The recuperator for running out the gun consists of two series of spiral springs which bear on lugs on the housing, and are compressed by two screwed rods fixed to the gun ring. The springs are so set that they can run the gun out under the greatest angle of elevation. The gun is but little displaced during recoil, as the resistance of the brakes produces a resultant in the centre line of the gun which is in direct opposition to the pressure on the bottom of the bore. Leather plugs placed between the gun ring and the brake cylinders limit the running of the gun. The housing, transom-frame, and bolster are on the same pattern as those of the numerous other mountings built by Messrs. Schneider and Co. for the French Admiralty, as well as for foreign Governments.

The gun is trained vertically by a handwheel and gearing, which works, through a set of pinions, the rack fitted to the housing, the effort required being reduced to that which is necessary to overcome friction, as the whole of the oscillating weight is accurately balanced on the housing trunnions. The gunner trains the gun by horizontally pressing with his right shoulder on the butt ; and while he sights the target, he works the elevating handwheel with his left hand, and draws the firing line with his right. The sight and scale are fitted to that part of the housing which oscillates without recoiling ; the pointer can, therefore, when necessary, roughly sight the gun during loading, sighting it finally when he fires it.

To dismount the gun, all that is necessary is to detach the piston plungers from the brake cylinders, and to take the rods from the recuperators, the gun being then made to slide in the housing from the front to the rear. The ring holding the brake and the recuperator is then taken off by disengaging it from its lugs, by turning it a quarter round. All the parts of the mechanism, as well as the recuperator springs, are taken to pieces with the greatest facility.

A circular shield protects the gunners and the mounting against grape shot ; it is fixed to the transom frame by means of two stays and braces. To work the gun, the following *personnel* is required : One pointer who fires the gun, one gunner at the breech, and one to keep the gun supplied with ammunition.

In order to give a complete idea of the importance and number of tests of all kinds that were made during several years in the Creusot and Havre works and proving grounds, with a view to establish the bases for the construction of new quick-firing guns, it would be necessary to speak further

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and in detail of a numerous series of accessory gear relating to the various parts of the material, and which were manufactured and tried at the same time as the mountings, the principal types of which we have just described. Such a description, though interesting and instructive, as recording the progress of ordnance, would prove too lengthy for our present set of articles. These various experiments were witnessed at the time with great attention by commissions appointed by the French Admiralty, and by foreign Governments; and they resulted in important orders being given for Schneider-Canet quick-firing guns.

Following these experiments, two types of mountings were decided on for the 1888 ordnance. First, that with oscillating slides was chosen; this was fitted to a traversing platform made to slide also on balls or rollers, or to a pillar-shaped pivot. These types were, however, further improved upon, as experience was gained in practice, and the general arrangements, especially the elevating mechanism, were made more simple. The system which embodied a brake separate from the recuperator, and fitted to a frame provided with a guiding transom, was also maintained.

The Schneider-Canet system of gun mounting of 1888 may be taken as the basis of their most advanced practice; it comprises a large variety of guns and mountings of the usual calibres, which have been delivered by the Creusot and Havre Works, and placed in regular service in several fleets. The guns themselves are of a uniform type, and have already been described; the breech-blocks work by one action with the interposition of toothed pinions or racks.

The mountings are of two principal types: The first, developed from the model with oscillating slides, is characterised by a movable gun housing fitted with the trunnions, and consists mainly of two beams which form a sliding path with their top flange, and which are joined at the front and in the rear by two short rings which insure absolute stiffness to the system. The gun is not fitted with trunnions, but carries a jacket shrunk on it, provided with lateral shoes which slide on the upper and lower flanges of the gun-housing beams during recoil and running out. An hydraulic brake and a recuperator, in connection with each other, complete the system.

The second type derived from one of the models already described comprises a complete housing with trunnions, in which the gun is made to slide; it has an hydraulic brake and independent spring-recuperator.

A detailed description of a mounting of a few types will be given, together with data regarding the material of the usual calibres up to 24 centimetres (9.449 in.) inclusive.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

(FROM OUR NEW YORK CORRESPONDENT.)

(*Continued from page 9.*)

BOILER AND FURNACE EFFICIENCY.

"BOILER and Furnace Efficiency," by R. S. Hale and W. B. Russell, was the next paper read. The authors said:

The studies of boiler efficiency hitherto published have been mainly based either on theories that could not be satisfactorily checked by experiment, or else on experimental determinations of the efficiency without observing the facts necessary as a basis for a satisfactory theory. The reason for this is, that in most experiments only the efficiency of the boiler as a whole has been observed, while this depends on various factors, such as the efficiency of the furnace, of the heating surface, of the grate, &c.; and comparison of boiler efficiencies as a whole, without observing the furnace and other efficiencies separately, is only one degree better than would be a comparison of boilers based on coal used per horse-power hour indicated in an engine without determining the efficiency of the engine.

They then proceeded to analyse different tests, and to tabulate the results, showing where various losses had probably occurred. They summed up their conclusions as follows:

In designing or selecting a boiler, have the furnace roomy, and, if practicable, line it with brick in order to have a very high furnace temperature.

Pay especial attention to the furnace if poor coal is to be used. Get rid of air leaks after the gases have left the hot furnace. Proportion the boiler so that at least 15 lb. of coal per square foot of grate must be burned to develop its horse-power, and so to keep the rate of evaporation per square foot of heating surface low. This involves a moderately high ratio of heating to grate surface.

The horizontal return-tubular boilers appear, all things considered, to be the type of boiler for best economy of steam production, although the internally fired boilers are probably as good if the furnace is roomy and the firing careful. The Thornycroft boiler, which (from a combustion point of view) is of this type, shows the best result of all.

Certain of the water-tube boilers suffer from air leakage and from short circuiting of gases if underworked. Of course, the advantages of water-tube boilers often make their choice advisable, even at the possible expense of a slight loss in efficiency.

The Lancashire type suffers from air leakage, and the furnace is poor.

Stokers save nothing over hand-firing, either in better combustion or less air supply. This does not necessarily apply to all stokers; and it should be remembered that, even if it should finally prove to be true that stokers are no more efficient than hand-firing, yet saving in labour and smoke may pay good returns on their cost.

Down-draught grates show up well, both in good combustion and small air supply, but the number of tests is too few to allow final conclusions to be drawn.

The results show that present knowledge enables the boiler efficiency to be predicted reasonably well, provided the efficiency of combustion and the air supply are accurately known; and although these quantities themselves cannot as yet be accurately predicted, yet it is shown that the temperature of the furnace is at least one factor in the question of good combustion, and that rate of burning per square foot of grate affects the air supply.

The most pressing need, therefore, in the study of boiler efficiency is the further determination of the factors that govern the efficiency of combustion and the air supply. The latter can be studied by the means of taking gas analysis at the bridge wall for different methods or frequency of firing, thickness of fire, &c. The factors governing efficiency of combustion can only be determined by carefully conducted and complete tests with heat balance. In this connection it should be noted that one or two accurate tests in which all the qualities, such as thickness of fires, gas analysis, &c., are observed, are, for the purpose of increasing our knowledge of boiler efficiency, worth a thousand tests in which the efficiency or evaporation is measured alone.

Then followed a series of tables, which would be valuable if there was not a suspicion of inaccuracy due to insufficient data on which to base conclusions. There ensued a pretty vigorous discussion, since there were present representatives of many types of boilers. The authors received the various attacks calmly, and admitted the data was not all they desired; but claimed they had done the best they could with what they had to work from. Next to a good horse trade, there is probably nothing quite so interesting as a boiler discussion. The facility with which the advocate of any particular type will twist the data to reach a conclusion favourable to it, has no equal in any other line of manufacture. While it is true, "figures will not lie"; yet by skilful manipulation they may be made to show a maximum economy of truth if not a maximum efficiency in a boiler.

STEAM SEPARATORS.

"The Test of a Steam Separator," by F. L. Emery, was next considered. The separator was of the baffle-plate pattern, and "designed to serve as a live steam separator, as an exhaust steam separator or trap, and as an oil extractor."

The method of testing the separator consisted, in brief, of a determination of the character or quality of the steam before entering the separator, and also its quality after leaving it. Various pressures of steam and different velocities and amounts of steam running through the separator were noted, as also the quality of the entering steam was changed for various runs, as will appear from the readings and quality results of the wet steam calorimeter.

The apparatus was then described at length, and the results were: At high velocities of steam flow the separator will deliver steam at 97 per cent. dryness, and that the action is nearly constant at varying pressures of steam. The separator will also remove about 52 per cent. of oil in the steam. There seemed to be a doubt as to the value of the oil thus obtained for lubrication: indeed, it was pronounced of no value. Another speaker claimed to have obtained water clean enough to use in the boiler again, merely by the use of a large closed tank with baffle-plates, filled with broken brick, stone, or coke. He preferred the last because the residue could be burned with it. He used a surface condenser in connection with it, and claimed his results exceeded those obtained with any patent separator.

That afternoon the Society went to the White House, and were shown through it and the fine greenhouses attached. The ubiquitous photographer took a group, so that posterity may know something as to our appearance in the flesh. Many regrets were expressed that the President's health had compelled him to go to the Springs, and thus he had missed the chance to receive the makers of the Mechanical Engineers' era, as Colonel Bingham had put it. The party then went to Arlington to visit the graves of the soldiers, some 16,000 being buried in this beautiful cemetery, which lies on a hill overlooking the entire city. The number of the visitors was so great that the means of transportation were utterly inadequate, and many expressed their opinions of the electrics in terms quite forcible, and perhaps not altogether polite. Your correspondent had taken the precaution to bring from New York his bicycle, and can only say it is a beautiful ride and over very fair roads. Many monuments to distinguished soldiers are to be seen in this cemetery, but none is finer than that marking the resting-place of General Philip Sheridan. There is also a fine monument to the unknown dead, the bones of some 2100 being interred in one grave and marked by a granite stone of immense size suitably inscribed. General Crook's monument has a beautiful bronze panel, showing the scene of the surrender of the Apaches under Geronimo. There are many other fine monuments, and the whole cemetery is in beautiful order and the walks are tastefully arranged. The party lingered here till quite late, and seemed reluctant to leave so beautiful a spot.

BOILER EXPLOSIONS.

That evening work began again, and the first paper was one of prime importance, viz., "Investigations of Boiler Explosions," by G. C. Henning. The author started in a characteristic way, by stripping his subject of all air of mystery and getting right at the fundamental causes, which he declared to be very limited in number, viz.:

(*a*) *Excessive Pressure.*—This can be produced by wilfulness or by careless operation; it can be controlled by autographic recording gauges, alarm whistles, and competent management.

(*b*) *Defective Material.*—This can be readily avoided, and should never be used in any case; it is criminal to use it.

(*c*) *Low Water.*—This may be the result not only of carelessness, but of many accidental causes, such as derangement of pumps or injectors, stoppage of pipes, gauge glasses, valves, &c.; or even by suddenly augmented leakage, which cannot always be discovered promptly, or even immediately provided for after discovery.

(*d*) *Defective Workmanship.*—This exists more or less in all boilers, except those which are built without caulked seams and rivets, and punched holes, and all parts of which are prepared and finished by machine tools and consist mainly of tubes with screwed ends. Defective workmanship developes greater or less defects during service, and necessitates constant repair and patching, and may be cause of material weakness in course of time.

(*e*) *Local Defects.*—These may exist in all boilers initially or develop after a while in service.

In regard to excessive pressure, the author said:

Assuming that a boiler has been properly designed, there will be no excessive pressure in service except as previously stated. If all the possible safeguards have not been employed, and a record of pressures has not been made, it is still possible to obtain such record for the instant of explosion by making several tests of strips, especially when cut from material of different thicknesses taken from the boiler.

It is a well-known fact that all material used in construction is subjected to stress about one-third of its yield point, but never beyond one-half of this amount. Stress sufficient to cause rupture is always about five times the working stress. If then any part of the boiler had been worn thin by corrosion, such material would be overstressed and overstrained.

It is also a well-known fact that excess of stress beyond the yield point invariably raises it above its original value; and if, therefore, careful tests be made of the material, especially with an autographic recorder, the results will invariably show augmentation of yield point. Different thicknesses will show different augmentations, which must always be in direct proportion to the stress applied. If calculations show that the augmentations of yield point in thick and thin material were produced by the same internal pressure, then it is proof positive that excessive pressure existed at the instant of the explosion, and also its exact amount. Tests of stay-bolts will show the same thing. Elongation of the material is, however, reduced by excess of stress, and a second tension test of a piece of material previously ruptured will be very materially decreased. Stress beyond the yield point also changes the shape of the elastic curve in a very characteristic manner.

In regard to defective material, the author started with the assumption that the material was originally good, and all parts of the boiler were open to inspection; hence local corrosion would be seen, and could be watched. In service, however, material may deteriorate by the action of repetitive stress.

The yield point will again be changed as before, and the elongation similarly. However, different parts of the boiler would show different effects according to their

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VISIT TO CRAIGSIDE.

Saturday, July 22, was devoted entirely to a visit to Lard Armstrong's seat at Craigside.

THE DOCKING OF SHIPS.

In our last issue, in dealing with the discussion that took place in Dr. Elgar's paper on "The Distribution of Pressure over the Bottom of a Ship in Dry Dock and over the Dock Blocks," we made reference to a letter received by Mr. Holmes from Mr. Anthony J. Lyster, and which was read at the opening of the discussion. Mr. Lyster, as is well known, is the engineer to the Mersey Dock and Harbour Board, and was responsible for advising the Board in regard to the Fulda. We are now able to publish an abstract of this letter, which has an important bearing on the case. Mr. Lyster said :

From the experience which I have gained in the case of the Fulda, and from my own investigation of the matter, I feel pretty certain that many vessels must in the past have been dry-docked with very small margins of safety, and it is very desirable that an operation which may be attended with such unfortunate results should in all cases receive something more than the mere general rule-of-thumb consideration which it appears to have had hitherto. I have followed Dr. Elgar's mathematical investigation of the case, and it seems to me to be as far as it goes a simple and sound one. There is, however, one aspect of the case which for want of data to work upon Dr. Elgar had only been able to refer to generally, but which has a very important effect in increasing the pressure upon the foremost blocks; I refer to the flexibility of the ship.

The mathematical investigation of this would, I fancy, be almost impossible, even in a specific case, and with very ample data; but I may point out facts which will indicate the important effect which this consideration will have in increasing the pressures on the foremost blocks. The conditions of flexibility in the ship are totally different from those which apply when the vessel is water-borne and which may arise when in a heavy seaway, the forefoot, stern, or centre portions of her length are more or less unsupported. The amount of pressure upon those various points may, as in the case of the Fulda, vary very considerably for reasons disconnected entirely with her flexibility. The variations in the pressures have their effect upon the form of the ship in bending her, and if as in the case of the Fulda the variation of the pressure is due to the overhang, that variation will be aggravated at the point of maximum pressure and a serious statical condition be produced. The amount of that flexibility is not to be gauged by the bending of the ship longitudinally, but it will also be increased by the yielding of the line of the keel in the cross section; for instance, the effect of applying such an initial load as that mentioned by Dr. Elgar as coming on block 24 (the foremost block touching the keel), namely 178 tons on the centre of the floor, will be to bend up the floor on the line of the keel relatively to to the two sides. The amount of this transverse flexure must therefore of course be added to the longitudinal flexure of the ship, and the sum of the two represents the total flexibility which has to be taken into consideration in determining the increase of pressure due to this cause.

With a view to ascertaining the amount of this flexure as well as possible accidental irregularities of level in the keel, I have recently had very careful measurements taken of the condition of the line of the keel of some of the largest and strongest vessels in the port of Liverpool when in a graving dock where the permanent blocks were only 2 ft. 6 in. centre to centre, and parts of the vessel were supported as well by temporary intermediate blocks. In one case, at all events, I have found as much as an inch of variation in a length of 21 ft., and this somewhat behind the front bearing block, the overhang of the forefoot being very considerable, about one-fifth of the vessel's length. In this case the maximum initial load on any one of the foremost blocks did not probably exceed 65 tons, assuming, as in Dr. Elgar's Table, the ship rigid and the blocks perfectly elastic; but, of course, this load must have been seriously increased by this yielding of the ship. The observations were made with the greatest care, the measurements being made with a specially constructed staff fitted with a vernier scale, and the points to which the measurements were made were all subsequently levelled. That some such condition as this materially assisted in bringing about the disaster to the Fulda was, I think, clear from the fact that the greatest damage to the ship was done immediately over the foremost bearing blocks from No. 4 aft, where the floors were all bent up and the stanchions broken and bent.

The second case dealt with by Dr. Elgar seems to me to be the all-important one. One of his Tables shows the loads which come upon the various blocks under conditions of absolute rigidity of the vessel and perfect elasticity of blocks. Neither of those conditions applied to the case of the Fulda and probably would never apply in any other practical case. From what I have already said it will, I think, be apparent that the Fulda was probably sufficiently flexible to induce a very different statical condition from that dealt with in Dr. Elgar's Table.

As regards the blocks, we know that under pressure of such a narrow keel as the Fulda's, with the loads coming upon it, an intensity of stress must have been produced which was beyond the limits of elasticity and ultimate resistance of the soft wood packing and the greenheart caps. Under such conditions as these, the vessel would tend (leaving the flexibility out of the question for the moment) to take up a new line of keel on the blocks, the keel being depressed forward into the blocks until all elasticity was crushed out of the timber and the timber became to all purposes as incompressible as the cast iron.

During the latter phases of this change a gradual variation would be set up in the statical condition which would largely augment the load on the leading blocks, and correspondingly diminish that on the aftermost blocks until the condition of an incompressible fulcrum at block 24 was approached, under which all the load of the overhang plus such portion of the weight of the vessel aft of No. 24 block as was necessary to counterbalance that overhang would take effect upon block No. 24. Two causes, however, would prevent this ultimate condition being actually reached :

1. The fact that cast iron is not compressible, and,
2. That block No. 24 would not be merely able to sustain such a pressure as this load would bring upon it.

To determine under what load, and at what period of the variation of the statical condition referred to above, the block yielded, it would be necessary to make experiments with full-sized blocks, packings, and keel. To sum up the case, and to try and place before this Institution some practical conclusions which may be of value to those who have to conduct such operations, it seems to me that the most important circumstances to be considered are, the weight of the ship, the distribution of that weight over the ship, including the overhang, the width of her keel, and the length of her overhang particularly in regard to the total length of the ship.

In using Dr. Elgar's Table, to arrive, independent of the flexibility of the ship, at an approximation to the permissible initial loads, great care should be taken that that initial load does not exceed the limits of elasticity of any permanent wooden caps that may be provided with the blocks, and to avoid this as much as possible where sharp keels are used, hard wood packings should be introduced, and if these by themselves are insufficient, extra blocking is absolutely essential under the more heavily weighted portions of the ship. A very considerable margin should also be allowed in estimating the intensity of stress on the caps for the increase in the initial load through flexure of the keel. With ships of any considerable overhang, and particularly when that overhang forms a large proportion of their total length, the forefoot will probably be the position where the most pressure on the blocks will be found. This would be obvious from the statement that the pressure on the support of a cantilever of uniform weight, and counterbalanced by a like cantilever, is four times that on either of the two supports of a similar girder of equal length, supported at both ends.

To illustrate this point, it must be assumed that the blocks are incompressible, and that the weight per foot-run of the ship is the same throughout its length. Then, with an overhang of one quarter of the full length of the ship, the pressure on the foremost block would be within one-sixth of that on each of two, one at either end of the ship, and together supporting its whole weight. Of course this could never be the case in practice, because, among other reasons, the bow of the ship is lighter than some other parts of it.

ELECTRIC GENERATORS.

By H. F. PARSHALL, M. INST. C.E., and H. M. HOBART, S.B.

(Continued from page 844, vol. lxvii.)

COMMUTATORS AND BRUSH GEAR.

A NUMBER of illustrations of various types of commutators are given in Figs. 296 to 312, pages 96 and 97. Figs. 296 to 303 illustrate designs widely employed in traction motors, that of Figs. 302 and 303 being used on a 100 horse-power direct-connected motor, the three former in smaller-geared motors.

Figs. 304 to 306 give some early designs of Mr. Parshall's which have been much used with general success in many later machines, especially traction generators. Other useful modifications and alternative designs are shown in Figs. 307 to 312, the last one being employed in a 1600-kilowatt generator.

Commutator segments should preferably be drawn, although good results have also been attained with drop-forged segments; cast segments have been generally unsatisfactory. It is not on the score of its superior conductivity that wrought-copper segments are necessary, since the loss due to the resistance itself is negligible, but it is of primary importance that the material shall possess the greatest possible uniformity throughout, and freedom from any sort of flaw or inequality. Any such that may develop during the life of the segments will render the commutator unequal to further thoroughly satisfactory service until turned down or otherwise remedied, as the effect of uneven wear, once started, is cumulative. For similar reasons great care must be exercised in the selection of the mica for the insulation between segments; it should preferably be just soft enough to wear at the same rate as the copper, but should in no event wear away more slowly, as under such conditions the commutator will not continue to present a suitably smooth surface to the brush.

The writers have found the method of predetermining the commutator losses and heating, set forth in a preceding article (ENGINEERING, July 8, 1898, pages 38 and 39), to give very good results, and to amply cover practical determinations. But an intelligent handling of the subject of the relations existing between commutator speeds, brush pressure, and contact resistance, is facilitated by a study of the results of tests that have been made, showing the dependence of these values upon various conditions.

The most complete and careful tests on carbon brushes at present available appear to be those conducted by Mr. A. H. Moore, in 1898, and the results are graphically represented in Figs. 313 to 316, page 100. In Fig. 313 is given a sketch showing the disposition and nature of the parts. A rotating cylinder of 6.8 in. diameter, of cast copper, took the place of a commutator, and this introduced an element of doubt as to whether a segmental structure of hard-drawn copper segments and mica would have given the same results. But inasmuch as the constants derived from these tests, agree with those which have been found to lead to correct predictions of the working of new commutators, it may be safely concluded that this point of dissimilarity was of no special consequence. In all other respects the tests seem especially good. The set of tests also includes values for the resistances of the brush holders, but with good designs of brush holders the resistance should be negligible, hence it has been deemed advisable not to divert attention from the important results relating to contact resistance by the addition of these less useful observed values.

Mr. E. B. Raymond, has, in America, conducted tests on this same subject. Some of the results for carbon brushes are shown in the curves of Fig. 317, and it will be observed that, for all practical purposes, his results, like Mr. Moore's, lead to the general working constants given in the article referred to above.

Dr. E. Arnold, in the *Elektrotechnische Zeitschrift*, of 1899, described investigations on both copper and carbon brushes, from which have been derived the curves set forth in Fig. 318, showing the relative values for the contact resistances in the two cases. Dr. Arnold also points out that while the coefficient of friction for carbon brushes on copper commutators is in the neighbourhood of .3, he has found .2 to be a more suitable value for copper-gauze brushes. But in the absence of thorough tests in support of this, the writers would be inclined to continue using a coefficient of .3 for both carbon and copper brushes.

Of course, all values relating to this whole matter of commutator losses, must necessarily be, in practice, but little better than very roughly approximate, as they are so dependent upon the material, quality, and adjustment of the brushes, and the condition of their surfaces, as also upon the construction, condition, and material of the commutator and brush holders, and, fully as important as anything else, upon the electromagnetic properties of the design of the dynamo.

(To be continued.)

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXII.

NAVAL MOUNTINGS FOR QUICK-FIRING GUNS—*(continued).*

Mounting with Lateral Beams and with Brake and Recuperator Connected (Fig. 574).—A typical example of this mounting is that for 10-centimetre (3.937 in.) 55-calibre Schneider-Canet guns; it is of comparatively small dimensions compared with the *vis viva* of the gun ; the following are some particulars :

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Weight of gun	2200 kilog.	(4848 lb.)
" mounting ...	3740 "	(8242 ")
" shield ...	2450 "	(5400 ")
" projectile ...	14 "	(31 ")
" service charge (smokeless powder) ...	3.4 "	(7½ ")
Muzzle velocity	780 m.	(2559 ft.)
Elevation	+ 15 deg. – 10 deg.	
Training	360 deg.	

The bolster is circular, and is bolted direct on the deck or the firing platform. It is fitted around its circumference with a ring which holds the traversing platform clamps; its top surface forms a roller path; it is also fitted with the circular rack for the training of the gun. The traversing platform consists mainly of a lower bed in continuation of which are two brackets, made almost vertical and suitably stayed; the central part contains the vertical pivot ring. The lower surface of the bed is trough-shaped where it rests on the roller balls. The whole system is held down during firing by two clamps fixed—one in the front and one in the rear of the traversing platform, and which grasp the edge of the bolster. The rear clamp is fitted with a catch, which serves to fix the mounting in any firing position; it is, moreover, made of a suitable height to allow for the lowering of the breech end, and the recoil of the gun when firing takes place at an extreme angle of elevation. On the right-hand bracket is a pump for filling the brake cylinders, the firing mechanism being on the left hand. The traversing platform is provided at the top with the trunnion-plates in which the housing trunnions fit.

The movable housing consists mainly of two U-shaped beams; the left-hand one carries the sight support, the scale casing and the curved rack for elevating the gun. The two beams are joined in front and in the rear by two rings lined inside with gun-metal for bearings, in which the gun slides smoothly during recoil and running out. On the front ring are the stops against which the buffers strike. The gun is made with a jacket, in one piece, with which is cast the hydraulic recoil cylinder; the jacket has slides on each side, which clasp the top and bottom flanges of the beams along which they travel during recoil and running out. The gun, therefore, slides along the beams of the housing during firing, while the housing can only turn on its trunnions during the action of elevating or lowering the gun. On the top part of the jacket are the rings for lifting the gun in and out, and the slide lubricators. The brake cylinder placed below is provided with two projections which form abutments for the Belleville springs of the recuperator. In front of the cylinder is the piece which carries the guide of the recuperator columns. The hydraulic brake is on the Schneider-Canet type with central counter-rod; it is closed in the rear by a plunger, which bears constantly against the crosspiece which forms an abutment for the Belleville springs.

During recoil the brake piston remaining fixed, the gun draws the cylinder along with it; the liquid is compelled to pass through the annular vent made between the central counter-rod and the edges of the grooving in the piston by raising the valve. As the diameter of the counter-rod is smaller than that of the piston-rod, the liquid drives the movable end of the brake-cylinder before it as well as the rear crosspiece, thus comprising the Belleville springs of the recuperator. When the recoil is ended, the springs relax and drive back the crosspiece and the movable end of the cylinder, the liquid returning to the space it originally occupied by passing through the narrow vents made in the valve seat, the valve falling back on the seat immediately recoil ceases. The flow of the liquid thus takes place slowly, and the running out of the gun is effected progressively and without shocks.

The gunner, by bearing with his left shoulder against the butt rest, has the two handwheels within easy reach; he is then enabled to place the gun in all the positions required. The elevating mechanism consists of the handwheel with the shaft, which works, through an endless screw and a toothed wheel, a pinion that engages the circular rack fitted to the rear of the movable housing. The training of the gun is insured by a mechanism with toothed wheel and endless screw working a vertical pinion that engages a circular rack forming part of the fixed bolster. The gun can, therefore, be trained and elevated simultaneously as may be required.

The mounting can be fitted with a shield, shaped according to the requirements of the service. The shields are balanced on their supports so as not to interfere with the working of the mounting to which they are joined by elastic couplings.

Fig. 574 illustrates a 10-centimetre (3.937-in.) 55 calibre gun and mounting, a large number of which have been manufactured in the course of the last few years.

Mounting for 57-Millimetre (2.244-*In.*) 80-*Calibre Quick-Firing Guns* (Fig. 575).—These guns have already been referred to several times in preceding articles owing to their remarkable qualities as regards power, combined with the ease with which they are worked, a general characteristic of the Schneider-Canet ordnance. The following are some data:

Weight of gun	810 kilog.	(1785 lb.)
" mounting ...	700 "	(1542 ")
" projectile ...	2.7 "	(6 ")
" service charge (smokeless powder) ...	1.9 "	(4 ")
Muzzle velocity in service...	1000 m.	(3280 ft.)
Elevation	± 15 deg.	
Training	360 "	

The gun is 80 calibres in length, of the design generally followed by Messrs. Schneider and Co., for their quick-firing guns. This is not merely a proving yard gun, to be used only for ballistic experiments, but a serviceable weapon embodying all the necessary conditions required of war material and which forms a powerful unit in the armament of ships. The first gun of this type built has undergone, during several years, a great amount of service in the Hoc proving ground, and the inspection of the various parts never revealed any undue wear and tear. The breech-block is on the Schneider-Canet system, worked by one action of the lever; the gun is fired by percussion, either with the firing line or through the action of a lateral-rod combined with a mechanical disengaging device.

The mounting is of the type with lateral slides already described, and is remarkable for its small dimensions compared with the considerable power of the gun. The balancing of the various movable parts enables the gun to be trained by the gunner, who acts with his shoulder on the butt end. Elevation is effected by a handwheel, and the same class of mechanism as that for the 10-centimetre (3.937-in.) 50-calibre guns.

10-*Centimetre* (3.937-*In.*) 80-*Calibre Quick-Firing Guns* (Figs. 576 and 577).—This type reproduces the principal arrangements of the 10-centimetre (3.937 in.) 55-calibre guns already described. The first gun of this type was built at the same time as that of 57 millimetres (2.244 in.) 80 calibres in length. Both embody in every respect all the qualities required of war material. The mounting is of a very small size in comparison with the power of the gun, and the small reactions developed during firing allows of it being used for service on board light-draught ships, the decks of which are not suited for the carrying out of exceptional stiffening methods.

The first Schneider-Canet long guns which were put in service attracted much criticism; the flexion of the chase was considered as almost certain, and special steps were taken at the Hoc proving ground in order to ascertain exactly, by means of registering apparatus, the importance of the phenomena that were predicted. It was found that the vibrations at the chase of these long guns did not exceed in a marked degree those produced in the current types of guns of the period, and that therefore no trouble need be feared under this head in their service on board ship. Moreover, the tests of all descriptions that were carried out—tests to prove the resisting power of the guns, precision trials, quick-firing salutes &c., gave place to no incident whatever, and the French Navy deemed the results sufficiently conclusive to adopt the long Schneider-Canet guns in service:

Weight of gun	4050 kilog.	(8926 lb.)
" mounting ...	3750 "	(8265 ")
" projectile ...	13 "	(28½ ")
" service charge (smokeless powder) ...	6 "	(13¼ ")
Muzzle velocity in service...	1025 m.	(3362 ft.)
Elevation	+ 15 deg. – 10 deg.	
Training	360 deg.	

The firing tests carried out at the Hoc proving grounds, for ascertaining the precision of firing with a movable aim when firing at a fixed target, are interesting. The target carries two series of distinct objectives, namely, three white panels on the right and two on the left, at different heights. The quick-firing test is effected by firing alternately against a right-hand panel and a left one, the succession in the rounds being so set that it is necessary to change, after each round, the elevation and training of the gun. The gunner has, therefore, to face the same difficulties he would encounter in firing against a movable target requiring for each round the alteration in the angles of elevation and training.

Mounting for 12-Centimetre (4.724-*In.*) 45-*Calibre Guns* (Figs. 578 and 579).—Guns of this type have been manufactured for the French, Russian, Japanese, and Chilian Governments; apart from the sighting mechanisms, which are different, they embody the general characteristics of the gun already described.

Weight of gun	2970 kilog.	(6545 lb.)
" mounting ...	3750 "	(8265 ")
" shield ...	888 "	(1957 ")
" projectile ...	21 "	(46 ")
" service charge (smokeless powder) ...	4.8 "	(10½ ")
Muzzle velocity in service...	680 m.	(2230 ft.)
Elevation	+ 20 deg. – 7 deg.	
Training	360 deg.	

The gun is trained and elevated by the action of a single handwheel, a lever being provided for connecting and disconnecting the handwheel shaft with either one of the mechanisms alternately. The gunner, resting his shoulder on the butt-rest, has under his right hand the wheel handle and under his left the disconnecting lever. The handwheel is invariably fitted to a horizontal shaft which rests in bearings fixed to the left cheek of the mounting.

Fig. 576.

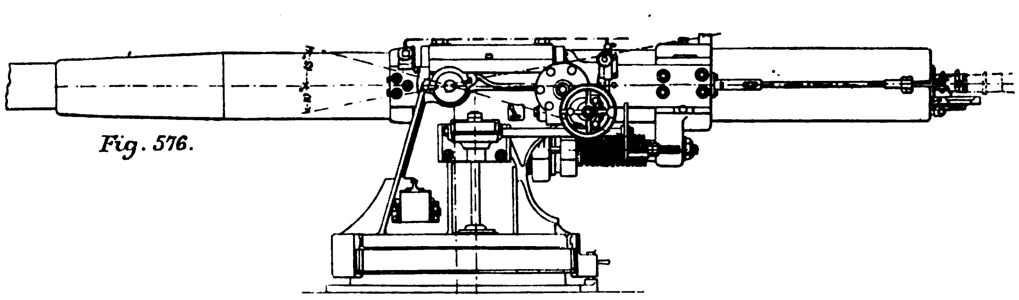
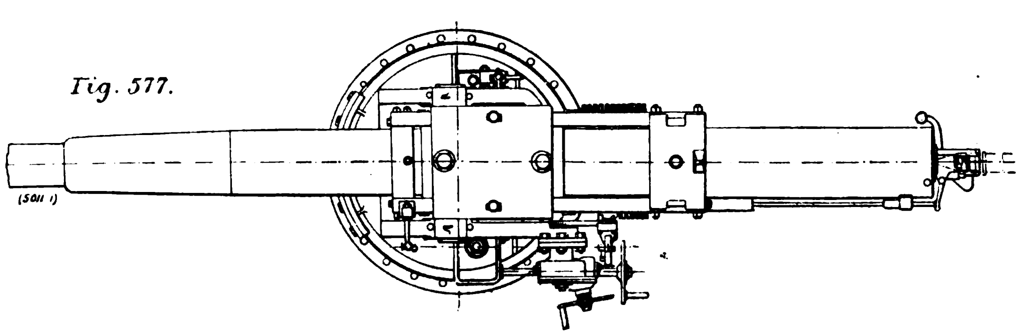


Fig. 577.



MOUNTING FOR 10-CENTIMETRE 80-CALIBRE QUICK-FIRING GUN.

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The disconnecting lever works backwards and forwards a coupling-block which can slide lengthwise on the shaft, but is compelled to revolve with it. The hollow jackets are fitted loose on the main shaft, and are provided each with an endless screw which works the pinions for elevating and training the gun. They are placed each side of the coupling-block, and are made with suitable grooves to engage it, and to revolve in one piece with the main shaft. It will be seen, therefore, that by acting on the handwheel and the disconnecting lever, the gunner can set the gun as required for firing, as both the hollow jackets are set in motion alternately to drive their corresponding gear.

This mechanism can easily be worked by electricity. The main gun-setting shaft is provided at its front part with a conical pinion, which can be made to engage another pinion fitted to the vertical shaft of a dynamo placed on the left cheek of the mounting, and worked either from a battery or with electric current taken from the main transmission of the ship. When it is required to work the gun by electricity, the two conical pinions are put into gear, and the handwheel is drawn back. The gunner has then only to work the disconnecting lever backwards and forwards to train and elevate the gun. When the gun is pointed, he fixes the coupling-block in an intermediate position, the main shaft turns free, the two jackets remaining loose.

Mounting for 15-*Centimetre* (5.905-*In.*) 45-*Calibre Quick-Firing Guns.*—This type is a reproduction of the preceding one, but of larger dimensions. It contains the same mechanism for closing the breech, firing and training by hand and by electricity.

Weight of gun ...	5740 kilog.	(12,651 lb.)
" mounting ...	5340 "	(11,769 ")
" shield ...	980 "	(2,160 ")
" projectile ...	40 "	(88 ")
" service charge (smokeless powder) ...	9.7 "	(21 ")
Muzzle velocity in service ...	680 m.	(2230 ft.)
Elevation ...	+ 20 deg. — 6 deg.	
Training ...	360 deg.	

Mounting for 16-*Centimetre* (6.299-*In.*) *Quick-Firing Guns.*—These reproduce all the characteristics of the 10-centimetre (3.937-in.) 50-calibre guns, but on a correspondingly larger scale. A great number of these guns have been built at Messrs. Schneider and Co.'s Havre Works.

Weight of gun ...	6730 kilog.	(14,833 lb.)
" mounting ...	7230 "	(15,935 ")
" projectile ...	45 "	(99 ")
Elevation ...	+ 15 deg. — 8 deg.	
Training ...	360 deg.	

Mounting for 24-*Centimetre* (9.449-*In.*) *Quick-Firing Guns* (Fig. 580.)—This type of mounting contains practically the same principal elements as those we have already described for medium-calibre guns. The example shown in Fig. 580 applies to 24-centimetre guns in turrets.

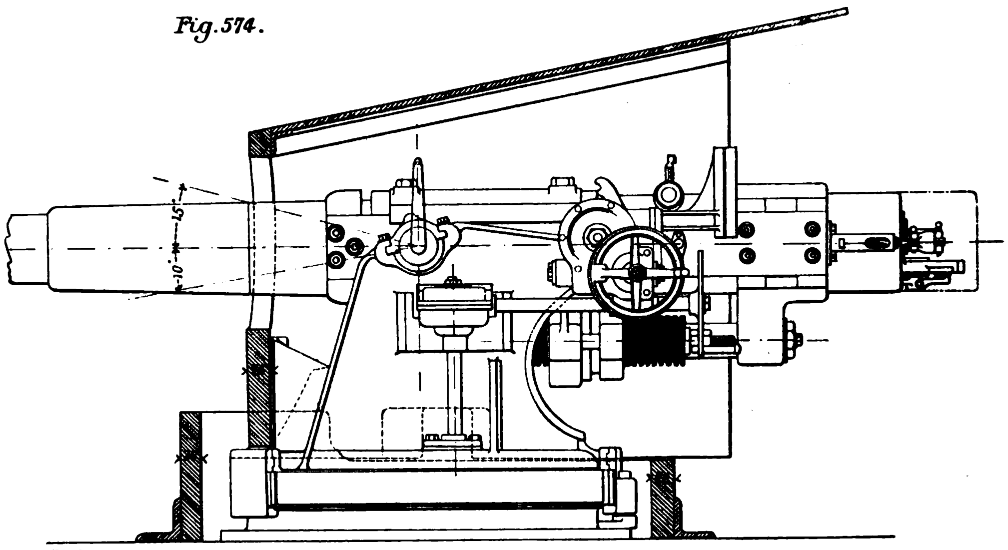
Weight of gun ...	23,000 kilog.	(50,692 lb.)
" slide and movable housing ...	6,500 "	(14,326 ")
Weight of projectile ...	170 "	(374 ")
" service charge (smokeless powder) ...	90 "	(198 ")
Muzzle velocity in service ...	680 m.	(2230 ft.)
Elevation ...	+ 15 deg. — 5 deg.	
Training ...	270 deg.	

The mounting consists of a gun housing carrying a slide with the elevating mechanism, a movable housing with hydraulic brake and a compressed air recuperator. On the gun is fitted a jacket with slide shoes, which run on the flanges of the lateral slides of the gun housing; the jacket contains also the two lateral recoil cylinders placed at the bottom, and is fitted besides with the buffers, lubricators, and controlling pistons. The carrying slide is formed of two vertical wrought-iron cheeks, fitted with trunnion plates and bolted on a revolving platform that forms part of the turret; they carry the transmission mechanism for elevating the gun. The movable housing consists of two lateral beams, joined together in the front and in the rear by stay rings. It is made to oscillate on two trunnions placed at the front. To the rear ring are fixed the rods of the hydraulic brake cylinders, and the trunnions of the elevating screw shells; the elevating screws are worked by conical pinions and endless screws from a horizontal shaft worked by hand or by electricity.

The compressed air recuperator consists of a gun-metal cylinder joined by a wrought-steel tube to a valve chest, which communicates with the hydraulic brake cylinders. A conical-shaped rod fitted to the valve chest and worked from the out-

QUICK-FIRING GUN MOUNTINGS.

Fig.574.



MOUNTING FOR 10-CENTIMETRE QUICK-FIRING GUN.

Fig.578

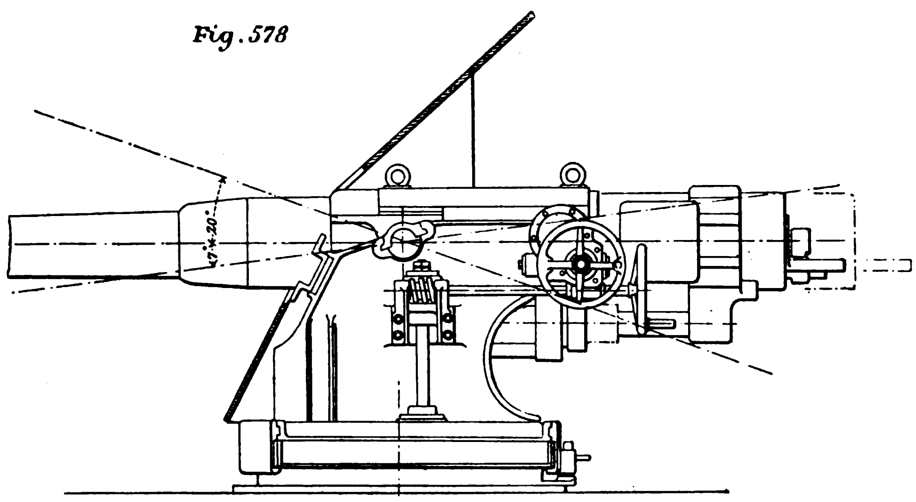
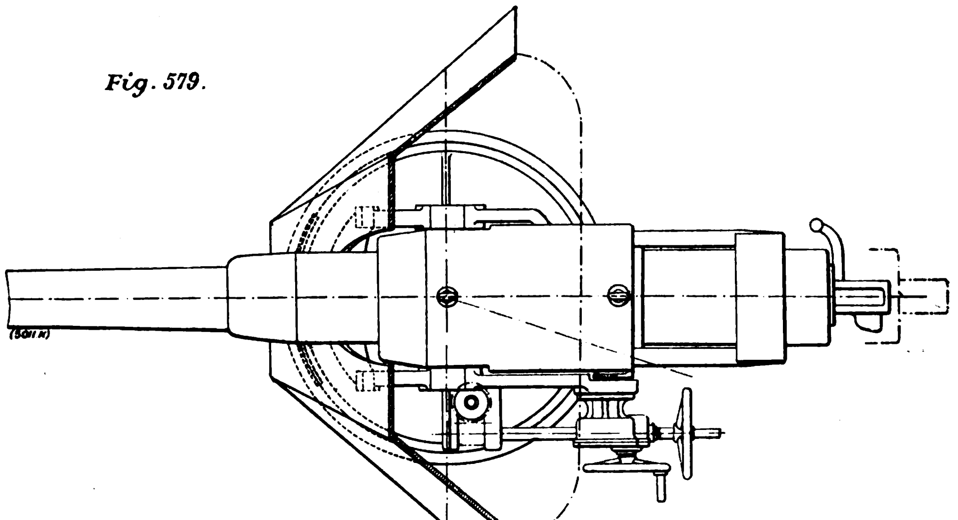


Fig. 579.



MOUNTING FOR 12-CENTIMETRE 45-CALIBRE QUICK-FIRING GUN.

side enables the communication between the valve chest and the recuperator to be interrupted at will.

During recoil the plunger pistons, by sliding in their cylinder, displace a certain quantity of liquid which lifts the valve fitted to the communication tube, and acts on the separator piston of the recuperator cylinder by compressing the air it contains. When recoil is spent, the valve falls back on its seat, and the liquid driven by the water can only fill the space it occupied previously, by passing through a narrow vent made in the valve; the gun thus runs out again progressively, and the buffers meet without shocks. This takes place automatically throughout and under the best conditions of rapidity.

This closes the description of the Schneider-Canet longitudinal slide mountings; a larger number of examples might be mentioned; the types we have chosen will, however, suffice to illustrate this class of mountings.

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MOUNTINGS FOR SCHNEIDER-CANET QUICK-FIRING GUNS.

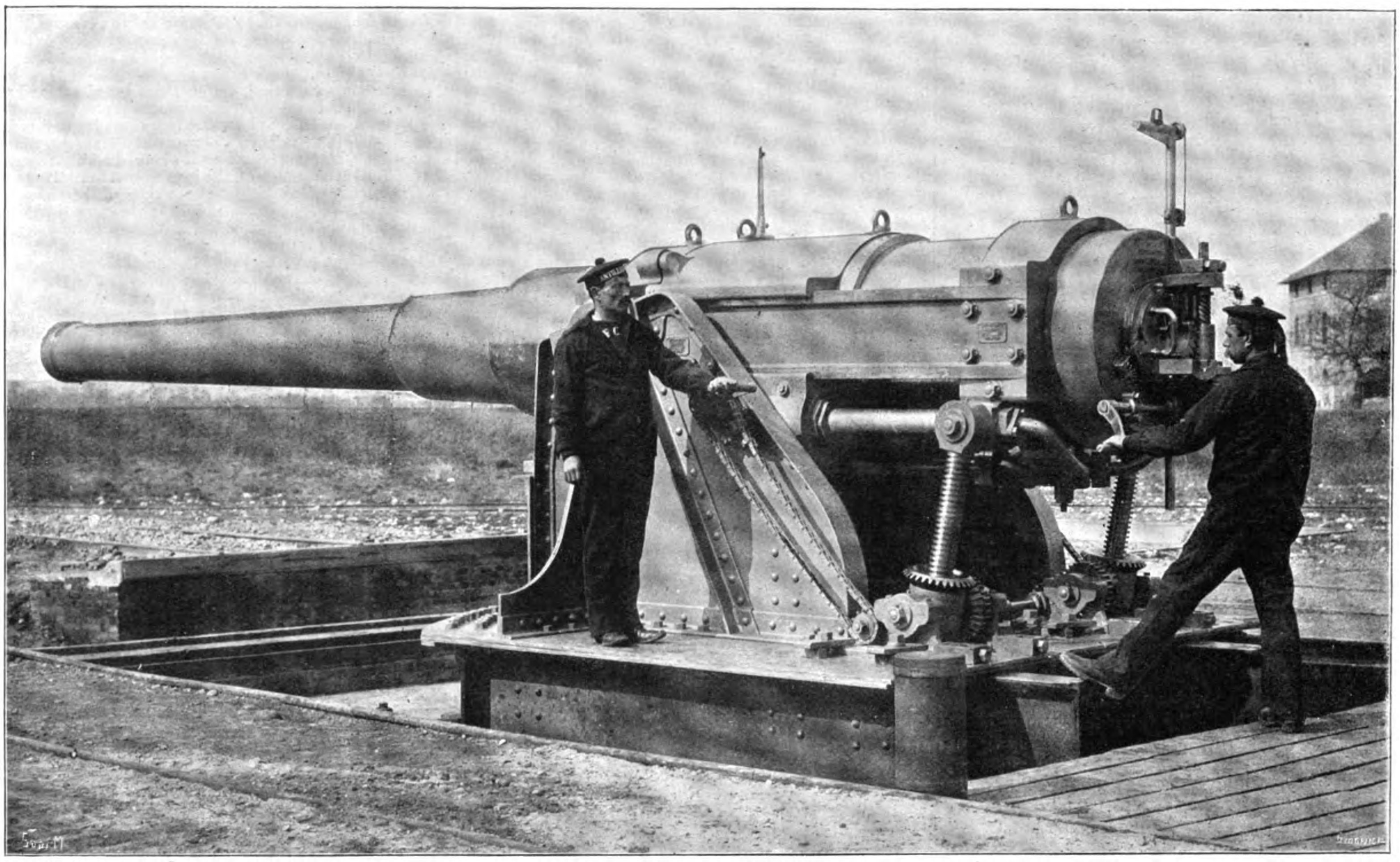

FIG. 580. MOUNTING FOR 24-CENTIMETRE 25-TON QUICK-FIRING GUN.

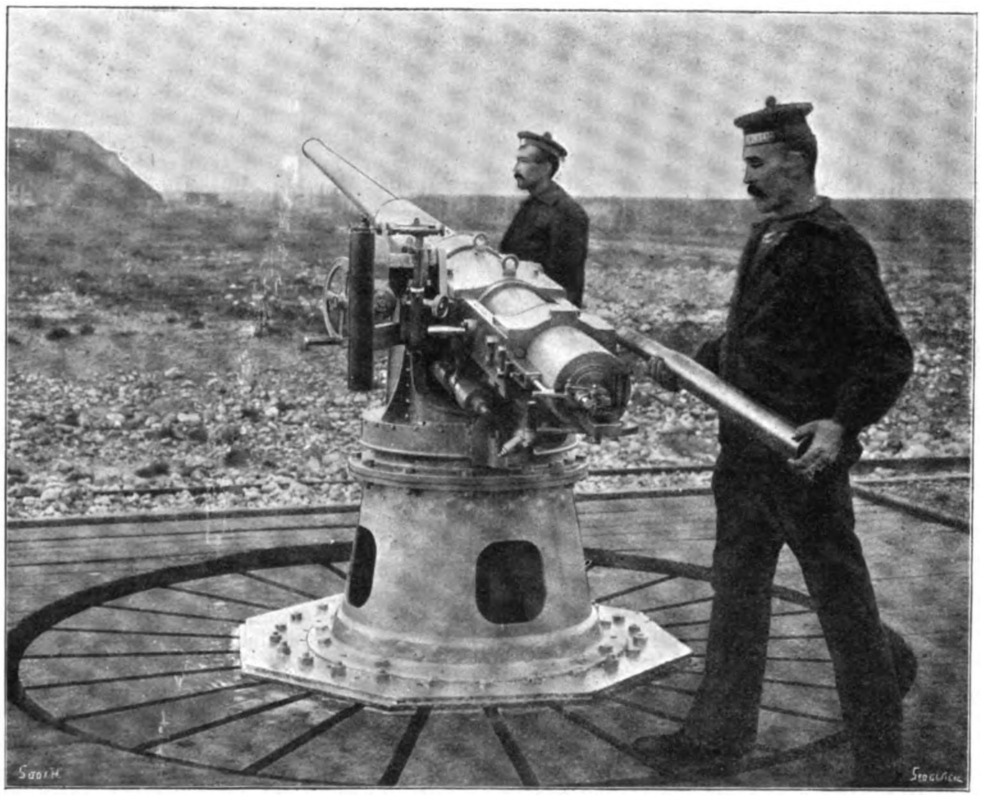

FIG. 575. MOUNTING FOR 57-MILLIMETRE QUICK-FIRING GUN.

To complete our review of quick-firing Schneider-Canet mountings, developed from the 1888 pattern, it is necessary to add that from their first appearance in service, the guns and carriages gave proofs of remarkable qualities as regards quick firing and perfect working of the various parts. They were adopted for regular service by various Governments for the arming of fleets and for coast defence works. At the present time orders are in course of completion in Messrs. Schneider and Co.'s works for mounting differing from the earlier types in matters of detail only.

It must be remarked, however, that the 1888 pattern, while fulfilling the conditions now demanded of quick-firing naval ordnance in current service, requires a slow and complicated process of manufacture which it is almost impossible to hurry, whatever be the power and completeness of the plant used. Besides, as ships are now built in a much shorter time than was the case ten years ago, their armament is wanted much more promptly.

To meet this particular difficulty, Messrs. Schneider and Co., shortly after the designing of the 1888 pattern, were led to consider in what manner they could modify their first designs, in order to reduce the time taken in building up the ordnance to a minimum. This has led to a simplified type of mounting which has been supplied with the most recent armaments they have executed, or have now in course of completion at their works.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

(FROM OUR NEW YORK CORRESPONDENT.)

(*Continued from page* 69.)

ROLLING MILL FLYWHEELS.

THE next paper was "Rolling Mill Flywheels," by John Fritz. This was a concise account of how flywheels had developed within the writer's knowledge. All the earlier wheels had wooden arms, and the author showed (see Fig. 8, page 108) how they were fitted in; the arms were made of hard wood, preferably locust or white oak, and about 6 in. to 8 in. in thickness. In the diagram the plan of securing the rims together is shown. The segments were in halves, and secured with gibs and keys, and put together with the lumps and swells chipped off with a two-handed chisel and sledge, which resulted in a weak wheel; but being made of cold-blast charcoal iron, accidents were not very frequent. Later, millwright and carpenter were displaced by the machinist, and the wheels were better fitted up, but not much safer, for iron was used made by

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It is a humdrum virtue, perhaps, but most useful. . . . It was Nelson's dogged perseverance, his unwearying attention to detail, especially displayed when cruising off Toulon, that put those 'storm-tossed ships' into the state which gave them the crowning victory of Trafalgar." The boiler question naturally occupies considerable space in the year's engineering review, the author quoting passages from Rear-Admiral Melville's report to the Secretary of the United States Navy, in which it is stated that the water-tube boiler will be used in future in cruisers and battleships. There are also notes on fuel economy and engine efficiency; the difficulty of reconciling the opposing demands of the engines and the boilers respectively in regard to economy in relation to speed being discussed. The effect of auxiliary machinery is treated at some length, the system of electric driving with a central station being referred to. Triple screws is another subject dealt with, a little inadequately, perhaps, on account of space limitations. It would have been more satisfactory had the author referred at greater length to the discussion on Admiral Melville's paper contributed to the last meeting of the Institution of Naval Architects. The balancing of engines, nickel steel, and steam turbines for marine propulsion are the remaining questions touched upon in this chapter.

The second division of the book, in which is contained the tables of British and foreign war vessels, does not lend itself to detailed criticism. The "Naval Annual" since its first introduction, has held the position as the chief authority on the composition of the fleets of the world. There has been no falling off in this part of the work; in fact, it has been improved as time has gone by. The labour involved in keeping these lists of ships up to date must be very great, and our experience gained by the constant use of the "Annual" tells us that the details are set forth with remarkable general accuracy. The outline plans of British and foreign ships afford also a most valuable source of information, and a great improvement has been made in the illustrations of late years. Part III., on "Armour and Ordnance," is as well treated as usual by Captain Orde Browne, and that is giving the section very high praise. The trials of armour-plates and projectiles that have taken place during the year are described, and illustrations of plates tested are given. Engineering drawings and photographic reproductions of Vickers' breech mechanism are also published in this section of the work.

BOOKS RECEIVED.

Applied Geology. By J. V. ELSDEN, B.Sc. (Lond.), F.G.S. Part II. London: "The Quarry" Publishing Company, Limited.

The Screw Propeller. By JOHN KEMP, Wh. Sc. Glasgow: Published by the Author. [Price 3s. 6d.]

Sewage Analysis. A Practical Treatise on the Examination of Sewage and Effluents from Sewage. By J. ALFRED WAUKLYN and WILLIAM JOHN COOPER. London: Kegan Paul, Trench, Trübner, and Co., Limited. [Price 7s. 6d.]

The Cupola Furnace: A Practical Treatise on the Construction and Management of Foundry Cupolas. By EDWARD KIRK. Illustrated by 78 engravings. Philadelphia: Henry Carey, Baird, and Co.; London: E. and F. N. Spon, Limited. [Price 14s.]

Telephones, their Construction and Fitting. By F. C. ALLSOP. Fifth Edition. London: E. and F. N. Spon, Limited; New York: Spon and Chamberlain. [Price 3s. 6d.]

A Russian Province of the North. By ALEXANDER PLATONOVICH ENGELHARDT. Translated from the Russian by HENRY COOKE. Westminster: Archibald Constable and Co. [Price 18s.]

The Slide Valve Simply Explained. By WILLIAM J. FENNARD, A.M.I Mech. E. London: Dewsbara and Ward. [Price 6d.]

A Select Bibliography of Chemistry, 1492-1897. By HENRY CARRINGTON BOLTON. First Supplement. Washington: The Smithsonian Institution.

Steam-Boiler Practice in its Relation to Fuels and their Combustion. By WALTER B. SNOW, S.B. New York: John Wiley and Sons; London: Chapman and Hall, Limited. [Price 3 dols.]

Boilers and Furnaces, Considered in their Relation to Steam Engineering. By WILLIAM M. BARR. Philadelphia and London: J. B. Lippincott Company. [Price 18s.]

First Steps in International Law. Prepared for the use of Students. By SIR SHERSTON BAKER, Bart. London: Kegan Paul, Trench, Trübner, and Co., Limited. [Price 12s.]

Sewer Design. By H. N. OGDEN, C.E. New York: John Wiley and Sons; London: Chapman and Hall, Limited. [Price 2 dols.]

Society of Engineers. Transactions for 1898 and General Index, 1857 to 1898. Edited by G. A. PRYCE CUXSON, Secretary. London: E. and F. N. Spon, Limited; New York: Spon and Chamberlain.

Die Circulation in Wasserröhrenkesseln. Von FRITZ KRAUSS. Vienna: Published by the Author.

Anuario de la Mineria, Metalurgia y Electricidad de España. Bajo la direccion de DON ADRIANO CONTRERAS. Año Sexta, 1899. Madrid i Enrique Teodoro.

The Steam Engine and Gas and Oil Engines. By JOHN PERRY, D.Sc, F.R.S. London: Macmillan and Co., Limited; New York: The Macmillan Company. [Price 7s. 6d. net.]

U. S. Commission of Fish and Fisheries. Report of the Commissioner for the year ending June 30, 1898. Washington: Government Printing Office.

Eighteenth Annual Report of the United States Geological Survey to the Secretary of the Interior, 1896-7. CHARLES D. WALCOT, Director. In five parts. Part II. *Papers chiefly of a theoretic nature.* Part V. (two volumes) *Mineral Resources of the United States*, 1896. By DAVID T. DAY, Chief of Division. Washington: Government Printing Office.

New Zealand. Papers and Reports relating to Minerals and Mining, 1898. Wellington, N.Z: John Mackay, Government Printer.

Tables for Quantitative Metallurgical Analysis for Laboratory Use. By J. JAMES MORGAN, F.C.S. London: Griffin and Co., Limited. [Price 6s.]

Transport-und Lagerungs-Einrichtungen für Getreide und Kohle. Von M. BUHLE. Berlin; Georg Siemens. [Price 10 marks.]

Know Your Own Ship. By THOMAS WALTON. Fourth edition, greatly enlarged. London: Charles Griffin and Co., Limited. [Price 7s. 6d.]

Examinations in Sanitary Science. By ERNEST R. MATTHEWS. London: St. Bride's Press, Limited. [Price 6d.]

Die Kraftmaschinen des Kleingewerbes. Von J. O. KNOKE. Berlin: Julius Springer. [Price 12 marks.]

The Merchant's Handbook of Money, Weights, and Measures, with their British Equivalents. By W. A. BROWNE, M.A., LL.D. Fifth Edition. London: Edward Stanford.

Leçons sur l'Electricité professées a l'Institut Electrotechnique Montefiore annexé a l'Université de Liége. Par ERIC GERARD. Tome Premier. Sixième Edition. Paris: Gauthier-Villars et Fils. [Price 12 francs.]

Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Sixteenth Annual Issue. London: Charles Griffin and Co., Limited. [Price 7s. 6d.]

The Art of Advertising. Its Theory and Practice fully Described. By WILLIAM STEAD, Jun. London: T. B. Browne, Limited. [Price 3s. 6d., post free.]

Tables and Data for the Use of Students in Engineering Laboratories; also for Class and Home Work Exercises. By W. W. F. PULLEN. Manchester: The Scientific Publishing Company. [Price 4s. net.]

The Students' Guide to the Practice of Measuring and Valuing Artificers' Work. Originally edited by EDWARD DOBSON. *With Additions on Mensuration and Construction, and a Chapter on Dilapidations, Repairs, and Contracts.* By E. WYNDHAM TARN, M.A. Seventh Edition, revised. London: Crosby Lockwood and Son. [Price 7s. 6d.]

The Elements of Euclid. With Notes, an Appendix, and Exercises. By I. TODHUNTER, D.Sc., F.R.S. New Edition, revised and enlarged by S. L. LONEY, M.A. London: Macmillan and Co., Limited; New York: The Macmillan Company. [Price 4s. 6d.]

The Management of Small Engineering Workshops. By ARTHUR H. BARKER, B.A., B.Sc., Wh. Sc. Manchester: The Technical Publishing Company, Limited. [Price 7s. 6d. net.]

The Institution of Junior Engineers. Record of Transactions. Vol. VIII. *Seventeenth Session*, 1897-8. Edited by WALTER T. DUNN. London: Published by the Institution. [Price 10s. 6d.]

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXIII.

NAVAL MOUNTINGS FOR QUICK-FIRING GUNS—(*continued*).

Recent Types of Quick-Firing Schneider-Canet Guns.—These are based on the 1888 pattern, and also, for certain parts, on the earlier types previously described. The gun itself, as a rule, is the same, with the exception that in certain cases the one-motion cylindrical breech-block has been replaced by the concentric-threaded type. The mounting reproduces certain primary arrangements of the 1888 pattern, and, to a certain extent also, the design of slide and bolster of the 65-millimetre (2.559-in.) 50-calibre gun mounting, mentioned in our first descriptions of quick-firing Schneider-Canet guns. We propose, as we have already done for the 1888 pattern, to give a complete description of each type of mounting.

47-Millimetre (1.850-In.) 60-Calibre High-Power Quick-Firing Guns (Figs. 581 to 583, pages 168 and 170):

Weight of gun ...	...	270 kilog. (595 lb.)
Length in calibres ...	...	60
Weight of mounting	...	450 kilog. (992 lb.)
" shield ...	...	50 " (110 ")
Elevation	...	+ 15 deg. – 15 deg.
Weight of projectile	...	1.5 kilog. (3.30 lb.)
Muzzle velocity in service ...		880 m. (2887 ft.)

The gun is of steel throughout, and consists of four parts: *a*. The inside tube that runs the whole length of the bore and bears in the rear against a projection of the jacket. *b*. The jacket in which is cut the breech seating, and which is provided in the rear with a coil made with lugs for the fixing of the brake and recuperator-rods. *c*. The front coil which joins the gun tube to the jacket. *d*. The breech mechanism of the concentric-threaded type with extra quick-opening action, already described.

The mounting consists of the bolster bolted on the deck; the movable slide that rests on the bolster with the interposition of a pivot; the oscillating housing or jacket, which carries the gun and rests in the slide. The slide, housing, and gun, turn in two guiding collars with a vertical axis, for training the gun. The housing and gun oscillate round the housing trunnions for obtaining the required elevation.

The bolster is in the shape of a truncated cone and consists of the outside envelope of wrought steel, fitted at its lower part with an angle forming a flange by which the cone is bolted to the firing platform; of the inside gun-metal body, on which are fitted: (*a*) The top plate which carries part of the weight of the mechanism; and (*b*) the two guide collars of the slide pivot, joined together by a piece in the shape of a truncated cone, provided with stiffening ribs.

The slide is in one piece and rests on the bolster. It consists of: (*a*) Two parallel cheeks with trunnion plates in which fit the trunnions of the gun housing; on one side is a projection in which engages a square-headed bolt that serves to fix the trunnion at any required elevation. (*b*) A circular disc which joins the two cheeks at their lower part and carries the buffers that limit the degree of elevation of the gun. (*c*) The central pivot, formed of two cylindrical parts, joined together by a truncated cone. At the lower part of the pivot is a bolt provided with a catch. When the slide is in its place, a nut is screwed on the bolt, which bears on the bottom of the pivot and prevents all raising during firing. Besides this, a hand screw goes through the shell of the bolster, and by bearing against the body of the pivot allows of fixing the gun in any position.

The housing is cylindrical, it surrounds the gun and forms a slide during recoil and running out. It consists of: (*a*) A jacket with trunnions and fitted at the ends with gun-metal rings to insure a perfect guiding. (*b*) A recoil cylinder in one piece with the jacket, and on one of the ends of which is screwed the central counter-rod. On the left side of the housing are two bearings on which are bolted the flanges that hold the recuperator and the butt end for the training of the gun. The hydraulic recoil cylinder is on the Schneider-Canet system, with central counter-rod; its rod is held by a nut in the lower projection of the recoil rear jacket. The recuperator consists of a cylindrical chest containing a series of spiral springs; its governing rod is fixed to the second projection of the recoil rear jacket, and is provided with a bearing ring which weighs on the set of springs. The working of the recoil cylinder is therefore quite independent of that of the recuperator, as these elements are without inside communication from one to the other, they act therefore separately during recoil, the recuperator alone effecting the running out of the gun.

The various parts of the mounting being of comparatively small weight, and the shifting of the movable parts requiring but little effort, training and elevation are secured by the gunner bearing with his shoulder on the butt. By taking hold of a suitable handle in one piece with the butt, the gunner has no difficulty in sighting the target accurately.

When a quick-firing salute is to be effected without any modification in the sighting of the gun, it suffices to set the screw on the right-hand trunnion and that which goes through the shell of the bolster, in order to fix the gun in the required position. The scale is carried in a slide which forms part of the jacket, and the sight is on the left trunnion. A suitable shield serves to protect the gunners and the working parts of the gun.

These guns are characterised by their very great power compared with their calibre and by the flatness of the trajectories, which renders the firing point blank up to a distance of 1000 metres quite practicable. They are, therefore, most suitable for naval service on board ships of limited tonnage designed for pursuing similar ships scantily protected but capable of developing a high speed. They can

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MESSRS. SCHNEIDER AND CO.'S MOUNTINGS FOR QUICK-FIRING GUNS.

(*For Description, see Page 167.*)

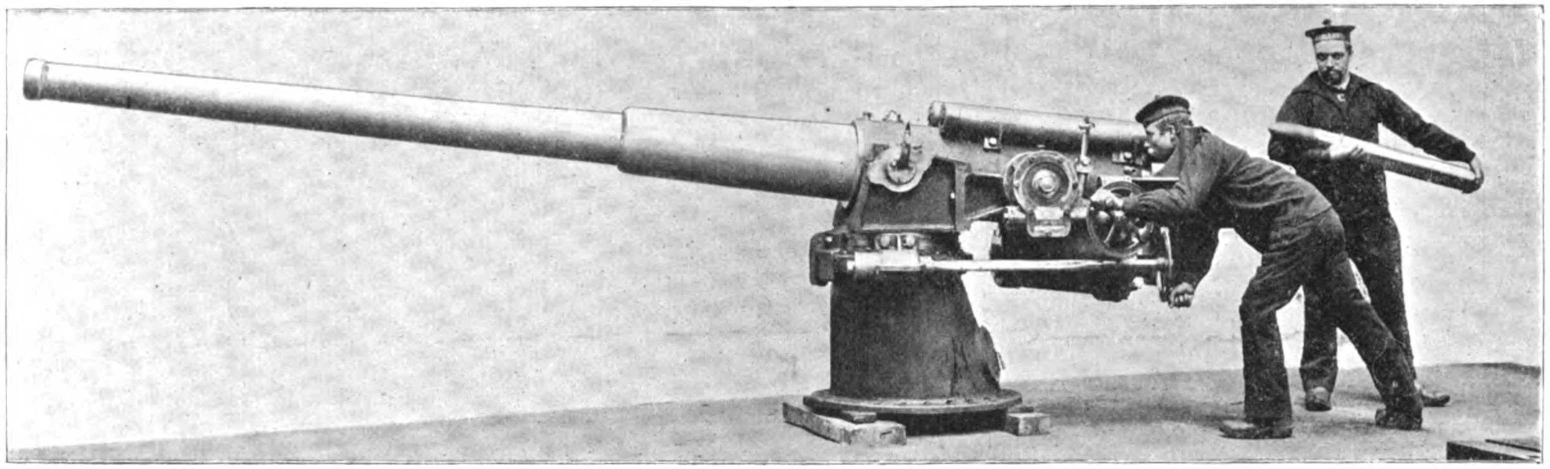

Fig. 588. Mounting for 10-Centimetre Quick-Firing Gun.

Fig. 583. Mounting for 47-Millimetre Quick-Firing Gun.

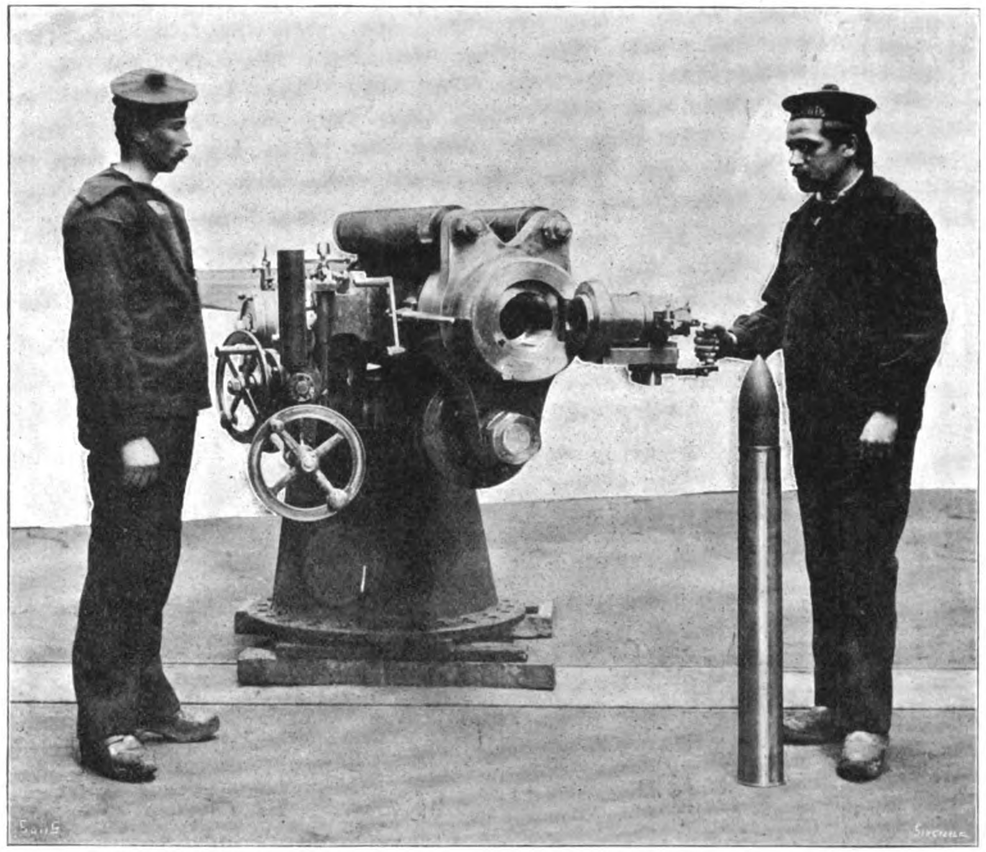

Fig. 589. Mounting for 10-Centimetre Quick-Firing Gun.

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MOUNTINGS FOR QUICK-FIRING GUNS.

Fig. 584

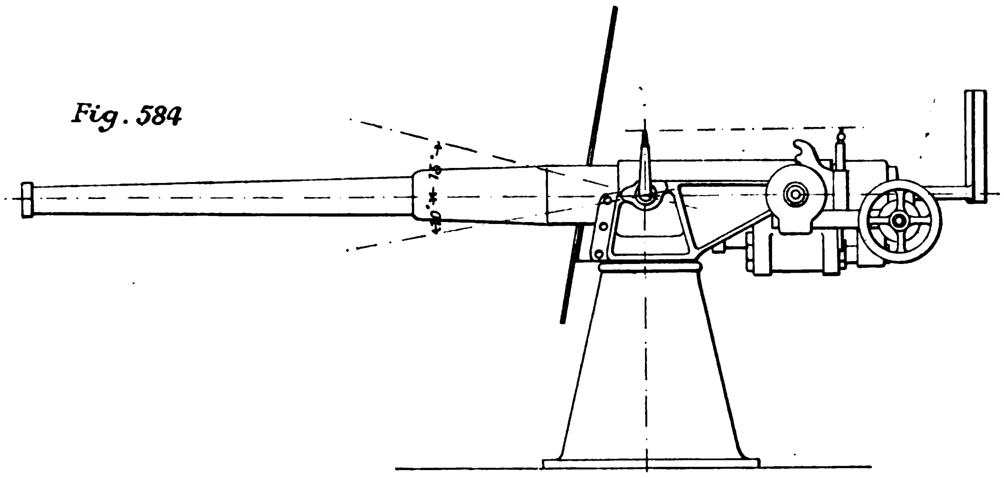
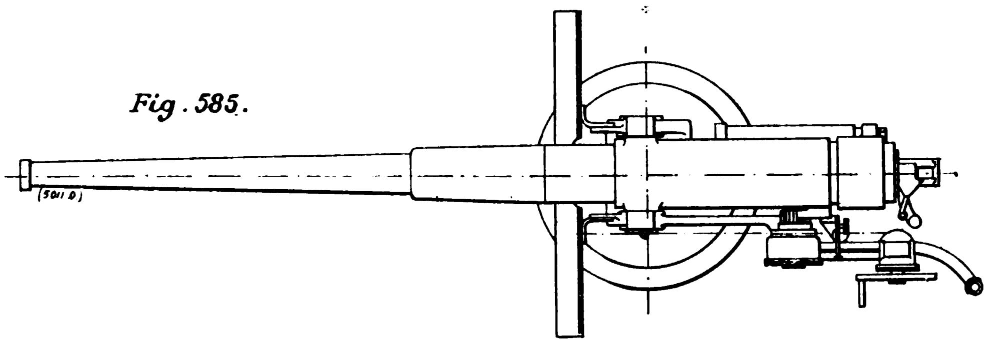


Fig. 585.



MOUNTING FOR 65-MILLIMETRE QUICK-FIRING GUN.

Fig. 586

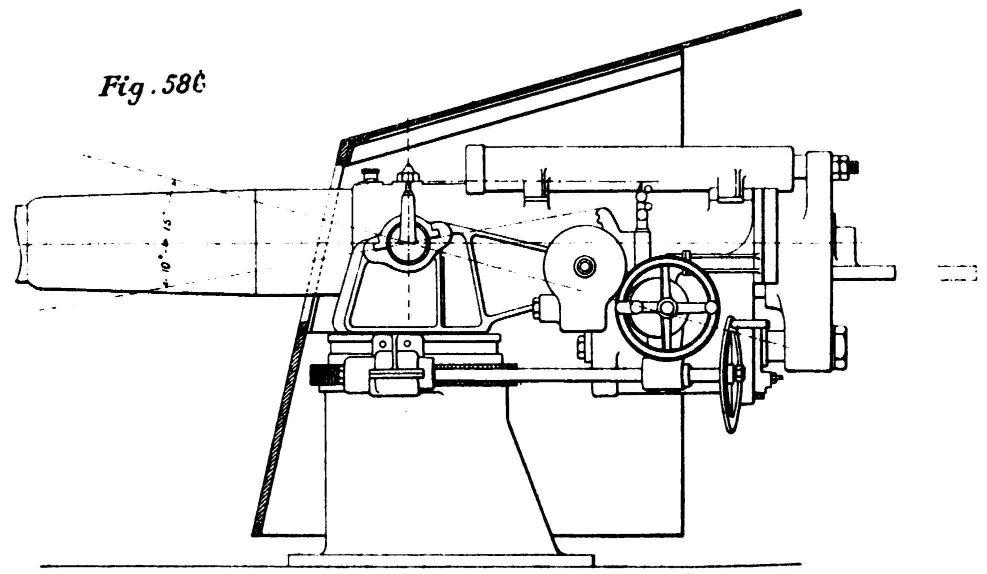
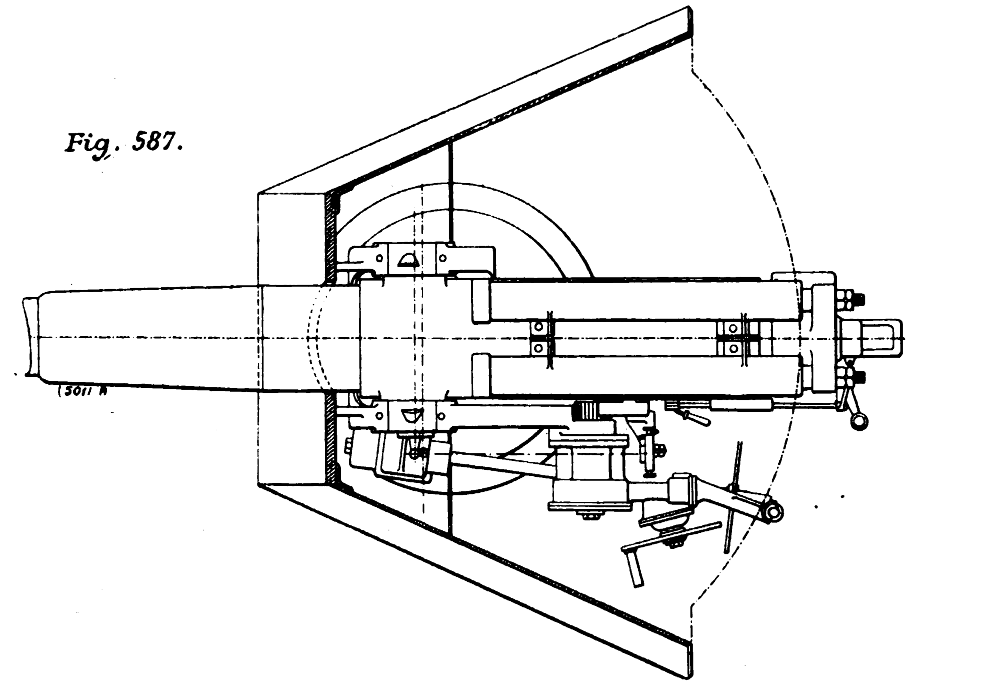


Fig. 587.



MOUNTING FOR 10-CENTIMETRE QUICK-FIRING GUN.

be worked ultra-rapidly, the breech-block being almost instantaneous in its action.

65-Millimetre (2.559-*In.*) *50-Calibre Guns* (Figs. 584 and 585, page 169). These guns, as a whole, embody the same general arrangements as those of 47-millimetre 60 calibres in length, just described. They differ, however, in the addition of an elevating mechanism and in the details of the slide pivot.

Weight of gun	550 kilog. (1212 lb.)
Length in calibres	50
Weight of mounting ...	600 kilog. (1322 lb.)
,, shield	180 ,, (396 ,,)
Maximum angles of elevation	+ 15 deg. – 10 deg.
Weight of projectile ...	4 kilog. (8¾ lb.)
Muzzle velocity in service...	470 m. (2428 ft.)

The elevating mechanism is on the left side of the slide; it consists of a shaft fitted with a toothed pinion and worked by a handwheel; this shaft works a second spindle parallel with the mounting bracket and fitted with an endless screw that engages a helicoidal wheel mounted on the same axis as the cylindrical pinion that engages the toothed sector fitted to the jacket, and transmits to the gun the required oscillations. As regards the inside pivot arrangements, these guns are very similar to those of 10, 12, and 15 centimetres described hereafter.

10-Centimetre (3.937-*In.*) *45-Calibre Quick-Firing Guns* (Figs. 586 to 589, pages 168 and 169).—Guns of this type have been manufactured lately by Messrs. Schneider and Co. in large numbers.

The mounting is generally similar to that for the 47 and 65-millimetre guns already described, but it embodies a special mechanism for the training of the gun. In this and the larger calibres, the inertia of the movable parts is too great for it to be possible to insure their working with the required rapidity by simply acting on the butt end of the gun.

The bolster is of cast steel, in one piece, its lower flange being bolted on the deck. Its central part forms the seating of the fixed pivot; this is of steel, and its height can be varied at will, owing to the outside threads cut on it. This pivot bears part of the weight of the slide, and insures besides the perfect centreing of the system. On the top part of the bolster is a horizontal ring which is continued on the inside by a vertical cylindrical bearing; this is provided with a gun-metal lining. The whole arrangement is suitably stiffened. The slide is of the same shape as those of the 47-millimetre and 65-millimetre mountings; its bottom part ends in a step-bearing lined with gun-metal which clasps the fixed pivot of the bolster. The brake, with central counter-rod, is placed under the gun housing; on the top part of the latter are the two cylindrical envelopes that contain the recuperator set of springs. The mechanism for training the gun consists of: (*a*) A horizontal shaft slightly inclined with regard to the axis of the slide; it is provided with an endless screw worked through a set of conical pinions, one pinion being keyed on the handwheel shaft, (*b*) A circular rack which runs round the bolster; an elastic coupling is used to control the speed of the various parts in the training operations. The endless screw and the circular rack are surrounded by an airtight envelope, easily removable, to preserve them. The elevating mechanism, apart from the dimensions, is the same as that for the 65-millimetre guns. All the movable parts are fitted with an airtight cover provided with a lubricator. The gun housing is fitted with a butt-end against which rests the gunner during the service.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

(FROM OUR NEW YORK CORRESPONDENT.)

(*Concluded from page* 140.)

THE somewhat extended notice of this meeting may be concluded with short notices of a few other papers that were read. Two of these were entitled "Power Plant of Columbia University," by E. A. Darling, and "Central Heating Plant of the University of Madison, Wisconsin," by Professor Storm Bull. They were both elaborate and well illustrated, but neither could be treated with justice in these columns. Anyone who has a similar problem to solve will find both of them quite interesting. The first paper extended through fifty-eight 8vo pages, and the second through twenty-four. "The Plunger Elevator," by Professor G. J. Alden, described this type of elevator, which he considered adapted to

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high buildings. He stated it had attained a speed of 600 ft. per minute. He believed it economical, safe, and requiring but little for repairs. "Elevators," by Charles R. Pratt, followed this paper, and the leading types were described and illustrated. Naturally, as chief engineer of the Sprague Electric Elevator, the author had an excellent opinion of that firm. This paper extended through sixty pages, and can be heartily commended as a full discussion of the subject.

The Allen Valve.

"The Allen Valve for Locomotives" was then read by Mr. C. H. Quereau. He stated:

There are decided differences of opinion among railroad mechanical men as to the value of the Allen or double-ported valve, a diagram of which is given in Figs. 22 and 23. Those who favour its use claim that it secures a greater mean effective pressure than the plain valve by giving a more prompt and full admission, thus increasing the power of locomotives on which it is used. Those who oppose its use claim there is no difficulty in getting all the steam into the cylinders that is needed without the

Fig. 22.

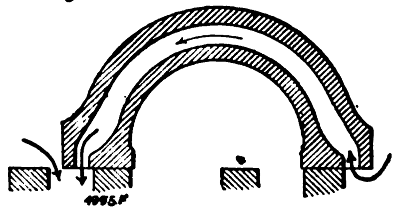
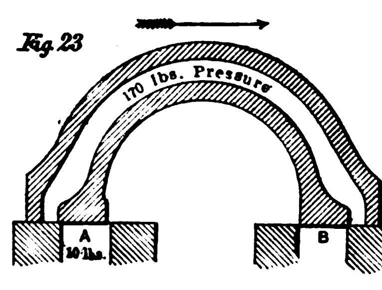
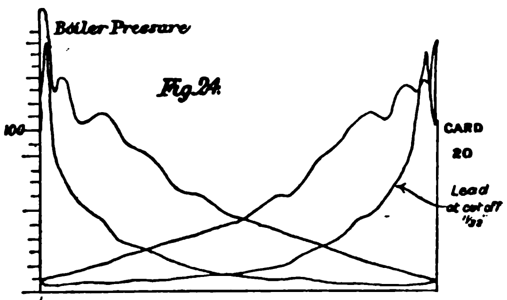
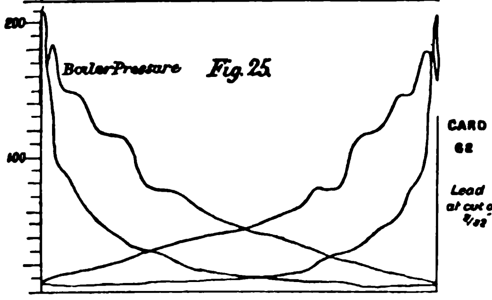
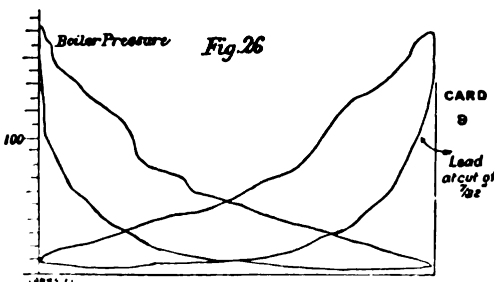


Fig. 23.









Allen port, the main difficulty being to reduce back pressure and compression; that if the Allen valve gives a freer admission, its use necessarily increases the difficulty of getting the steam out of the cylinders, increasing back pressure and compression, and causing the engines to pound badly.

Strictly speaking, compression is the period of the stroke from exhaust closure to lead opening. The term "excessive compression" is commonly used to denote a suddenly rising pressure at the end of the return stroke, which takes the form of a loop on the indicator card, and is usually wrongly assumed to be caused by the compression of steam remaining in the cylinder at the time of exhaust closure. If exhaust closure takes place at half-stroke with 3 lb. back pressure and 8 per cent. cylinder clearance, the pressure in the cylinder at the end of the stroke will reach only 113 lb. If the back pressure is 12 lb. and the compression begins at 15 in., the full stroke being 24 in., the highest pressure attained at the end of the stroke will be but 137 lb. With the usual locomotive valve gear and the valve line and line inside, compression begins at about 15 in. of the return stroke. These facts remain true whether the valve is of the common type or an Allen valve. From the foregoing it is quite evident that the Allen valve cannot produce a compression equal to the boiler pressures commonly used, and we must look elsewhere for the cause of the so-called excessive compression complained of. That this cause is excessive lead I believe will be clearly shown by the cards in Fig. 24 to 26, which were all taken from the same engine, having Allen valves, under practically the same conditions, except a difference in lead, and which clearly prove that the Allen valve can be so set as not to produce excessive compression. (The engine from which these cards were taken had drivers 68 in. in diameter, valves with 5-in. travel in full gear, $\frac{7}{8}$-in. outside lap, and Allen ports $\frac{1}{2}$ in. by $17\frac{1}{4}$ in. inside clearance, $\frac{1}{16}$ in. on either end, cylinders 19 in. by 24 in., and steam pressure 165 lb.)

In view of the preceding, it seems to me clear that those who criticise the Allen valve have made the mistake of assuming that the excessive compression frequently found to accompany its use is due to so free an admission of steam from the beginning of the stroke up to the cut-off as to produce abnormal back pressure and compression, while the facts in the case are that the objectionable results are caused by too much lead, which can be easily remedied, without losing the advantage claimed for this valve. That the objectionable feature of undue compression can be obviated seems evident from card 9, Fig. 26.

On this card the average back pressure from the beginning of the return stroke up to the point of exhaust closure is 7 lb. Taking into consideration the fact that the drivers were making 267.6 revolutions per minute when the card was taken, and that these are representative cards among hundreds taken under similar conditions, it seems evident that the Allen valve cannot justly be considered as producing more back pressure than the plain valve.

From the foregoing I feel warranted in drawing the conclusion that the Allen valve, when properly set, does not produce more back pressure or compression than a plain valve under similar conditions.

It is sometimes objected that the Allen port necessitates a weak design, or the valves must be made very heavy. For about ten years the Chicago, Burlington, and Quincy Railroad has been using, very successfully, on 19 in. by 24 in. engines, having steam ports $1\frac{1}{4}$ in. by $17\frac{1}{4}$ in., Allen valves weighing only 112 lb. without packing strips.

MOUNTING FOR 47-MILLIMETRE QUICK-FIRING GUN.

(*For Description, see Page* 167.)

Fig. 581

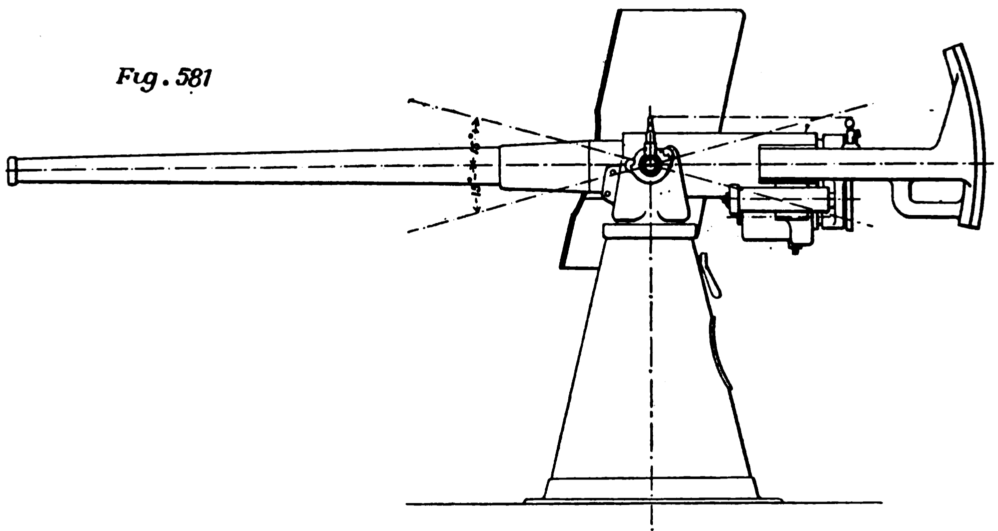
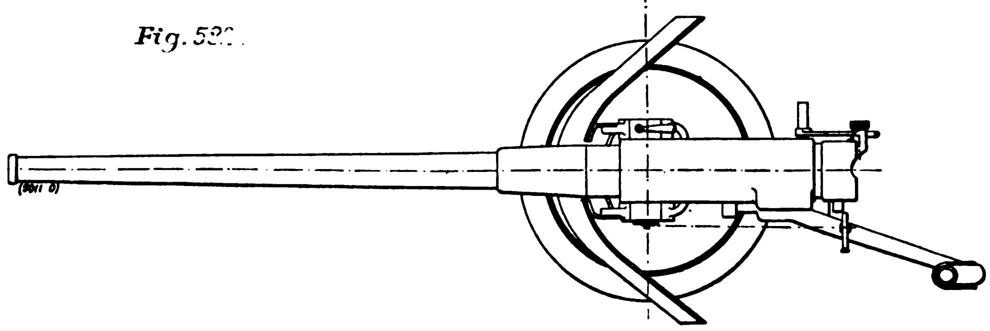


Fig. 582.



A New System of Valves for Engines.

Following this was, "A New System of Valves for Steam Engines, Air Engines, and Compressors," by F. W. Gordon.

These valves were described and illustrated by drawings. The author said:

These valves being placed in the heads of the cylinder, and the valve cylinder's bore being parallel with the bore of the main cylinder, the inner flush ends of the valves are parallel with the inside of head. The distance from the cylinder to the port is shorter than usual, reducing the resistance and change of temperature incident to long ports.

When the engine is compound the employment of the valves in the heads is conducive to direct and free passage between the cylinders, so that practically exhaust pressure in a high-pressure cylinder may be the initial pressure in a low-pressure cylinder. When the piston is at dead point, and the valves have the desired lead, and the ends of the valves nearly flush with the inside of the cylinder head, then, as the piston recedes from that end, one of the valves follows the piston and the other recedes from it. It will be seen, then, that no amount of increased travel of the valves materially increases the clearance, hence the system is especially adapted to shaft governing, where in shorter cut-offs the reduction of a small valve travel will affect the portage and cause wire-drawing.

For air compressors, which include blowing engines used at blast-furnaces, gas or any other elastic fluid compressor, the inlet valves are constructed so as to be similar to one pair of a steam engine's valves. The delivery or discharge valves may be similarly constructed, or modified.

Fire Hydrants.

One very elaborate paper, covering 107 pages, was not reached for lack of time, and had, therefore to be taken as read. It was called, "Experiments on Various Types of Fire Hydrants," by Chas. L. Newcomb. The records given were quite exhaustive, and treated of frictional resistances of various hydrants, and the results were carefully tabulated, some 52 pages consisting entirely of tables. The author stated:

The object of these tests was a complete investigation of the fire hydrants now commonly used, and the work was divided under the following heads:

1. The loss of pressure due to the friction of water in the hydrant, the total loss being subdivided into barrel loss and nozzle loss.

2. The discharging capacity of open hydrant butts at different pressures.

3. The water-hammer caused by quickly closing the main gate.

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our great scientists in a pleasant way, while giving a clear and able survey of the progress of physics, and he displays great tact when alluding to personal controversies. He agrees with Ostwald in regretting the absence of the historical sense and the want of knowledge of the great researches upon which the edifice of science rests, as a defect of the present system of scientific education; and he is right. We have noticed only one misprint, Lagenbeck instead of Langenbeck. The book is carefully revised, and nicely got up.

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXIV.

NAVAL MOUNTINGS FOR QUICK-FIRING GUNS—(*concluded*).

12-*Centimetre* (4.742-*In.*) 45-*Calibre Quick-Firing Guns* (Fig. 590).—These guns and mountings embody the general arrangements of the 10-centimetre types we have already described. The gun is of the type adopted by the Portuguese Government for the armament of their new cruisers, the length being 45 calibres. These guns have, however, been manufactured up to 80 calibres in length, the power thus obtained being considerable for the bore.

Weight of gun	2800 kilog. (6171 lb.)
,, mounting ...	2750 ,, (6061 ,,)
,, shield	900 ,, (1983 ,,)
Elevation	+ 15 deg. – 10 deg.
Weight of projectile ...	21.5 kilog. (47½ lb.)
Muzzle velocity in service...	720 m. (2362 ft.)

12-*Centimetre* (4.724-*In.*) 50-*Calibre Quick-Firing Guns.*

Weight of gun	3300 kilog. (7273 lb.)
,, projectile ...	22 ,, (48½ ,,)
,, charge (smokeless powder)	8250 ,, (18⅛ ,,)
Muzzle velocity	810 m. (2657 ft.)
Weight of mounting ...	2.850 kilog. (6282 lb.)
,, shield	3850 ,, (8485 ,,)
Elevation	+ 20 deg. – 5 deg.

The mounting is central pivoting, with limited recoil and automatic return. It consists mainly of an oscillating housing, two slides or recoil cylinders, a pivot transom, and a bolster. This type of mounting fulfils the following conditions:

It allows the gun a very limited recoil, and insures quick and automatic return; it does away with the percussion efforts, whatever be the position of the gun, which recoils along its axis, and meeting the action of the brake direct. The effects due to firing are divided over a large number of points, thus reducing the wear and tear on the various parts. It allows the gunner to elevate and train and fire the gun direct, without having to interfere in any way with the loading.

The gun is constantly maintained in battery by the action of the running-out springs; the recoil cylinders are kept filled with incongealable liquid, and the joints, which are very few in number, are so arranged that they keep tight. The mounting is, therefore, always ready for firing.

The mounting body is of cast steel; it consists of a housing in two parts firmly bolted together in the middle, and provided with trunnions which fit in the sides of the slide and which carry the gun, the slides, and the gun carriage proper. The two slide-shoes, of forged steel, are placed symmetrically, and are uniform in their working. Each one fits in the grooves made in the gun, and are provided in front and in the rear with cylindrical seatings of equal diameter and length, which constitute the recoil cylinders.

When the gun, during recoil, drives the slide-shoes, or, in other words, the recoil cylinders—the pistons remaining fixed—the liquid which is in front of the pistons is driven violently back, and flows through the grooves of various sections cut in the cylinders. The section of these grooves is so designed as to offer a constant resistance on the whole length of the recoil, which extends over 200 millimetres (7⅞ in.) maximum. Return is effected automatically by a recuperator formed of two sets of direct-acting springs.

To elevate the gun a handwheel is provided, which works through an endless screw gearing, a pinion that engages a circular rack fitted on the left side of the gun carriage. The endless screw wheel is fitted by friction, to allow, if necessary, of a slight displacement during firing. The gun is trained by means of a handwheel that works, through an endless screw and a helicoidal wheel, a vertical pinion which engages a circular rack surrounding the bolster.

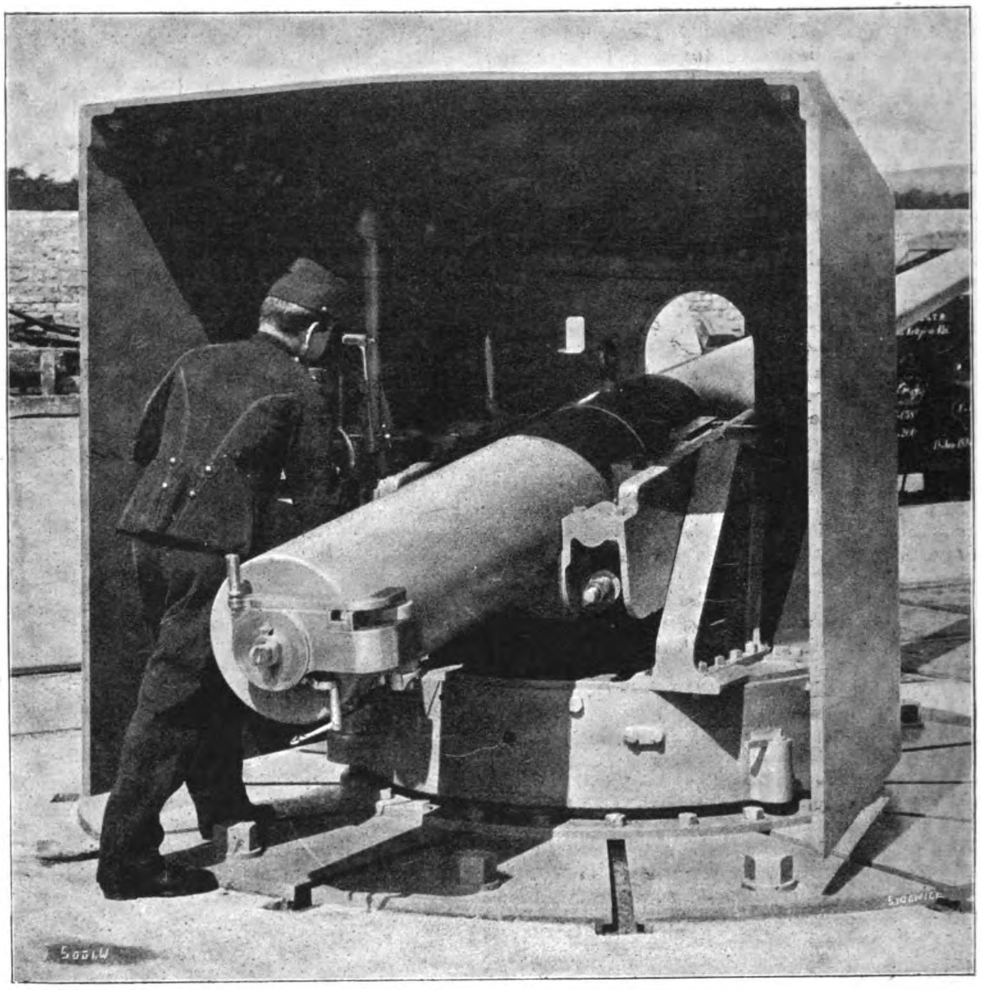


FIG. 590. 12-CENTIMETRE 45-CALIBRE QUICK-FIRING GUN AND CARRIAGE.

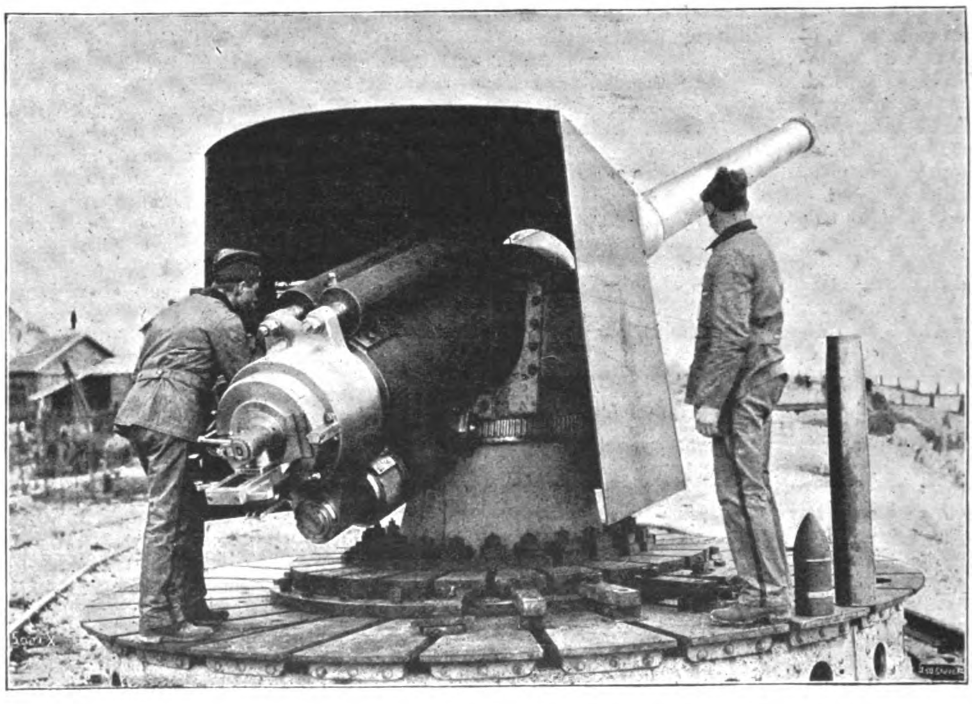


FIG. 591. MOUNTING FOR 14-CENTIMETRE QUICK-FIRING GUN.

14-*Centimetre* (5.511-*In.*) 45-*Calibre Guns* (Figs. 591 to 593).—These form part of the recent types built by Messrs. Schneider and Co., and adopted, among other Governments, for the Spanish Navy. Owing to delay, these guns were not used in active service, and they will form an excellent basis for the reconstruction of the Spanish Fleet. They contain the main characteristics of the preceeding calibres; Fig. 591 shows one of these guns and carriages, of which particulars are added:

Weight of gun	4800 kilog. (10,579 lb.)
,, mounting ...	4100 ,, (9,036 ,,)
Weight of shield	1200 kilog. (2,644 lb.)
Elevation	+ 20 deg. – 5 deg.
Weight of projectile ...	40 kilog. (88 lb.)
Muzzle velocity in service...	700 m. (2296 ft.)

15-*Centimetre* (5.905-*In.*) 45-*Calibre Quick-Firing Gun.*—These guns and mountings have been adopted, among others, by the Portuguese Government for the armament of cruisers of recent construction. They contain all the improvements carried out for the Schneider-Canet quick-firing naval guns and allow of an ultra-rapid firing. The various manœuvres and the firing are effected by

MESSRS. SCHNEIDER AND CO.'S MOUNTINGS FOR QUICK-FIRING GUNS.

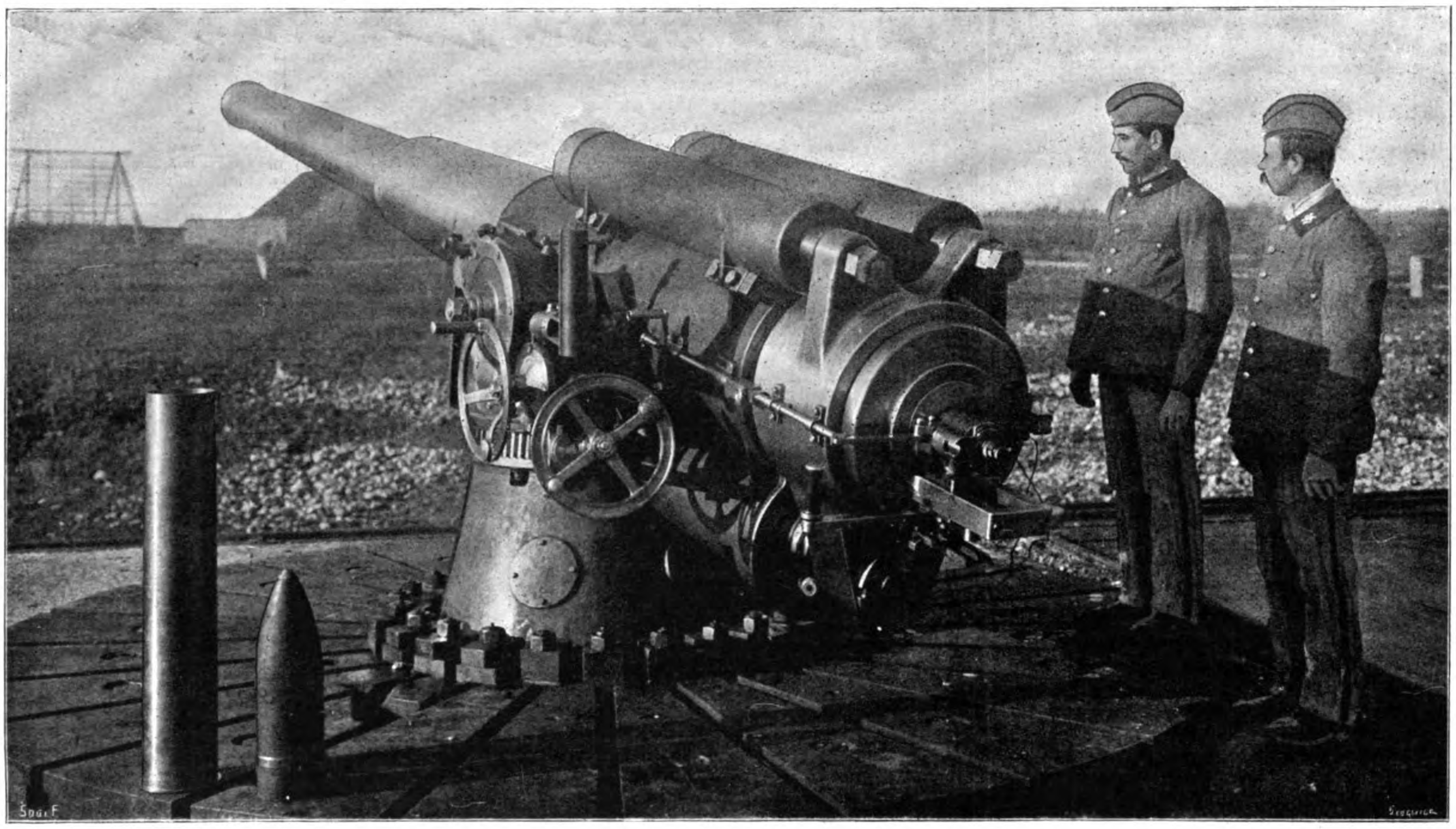


FIG. 594. CENTRAL PIVOTING MOUNTING FOR 15-CENTIMETRE 50-CALIBRE QUICK-FIRING GUN.

FIG. 592.

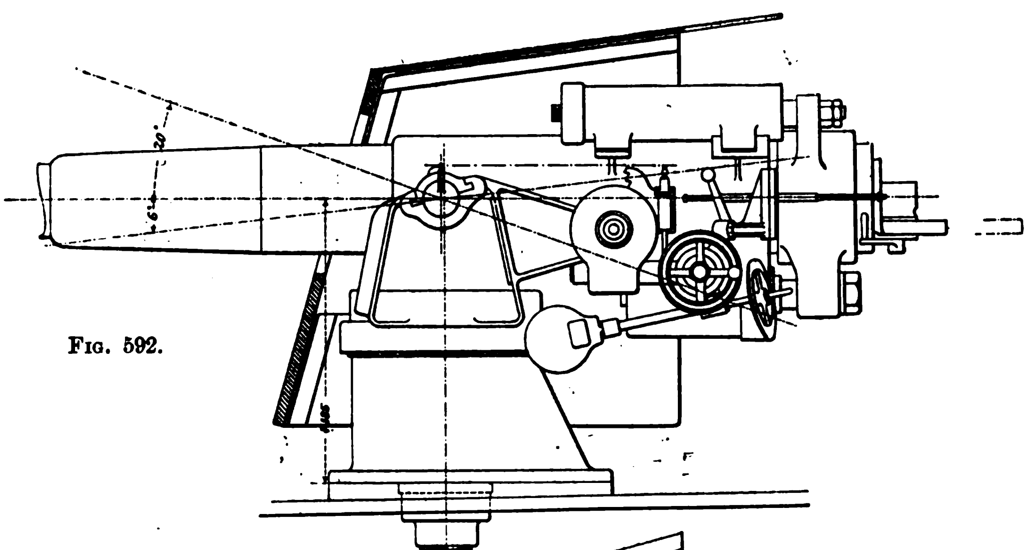
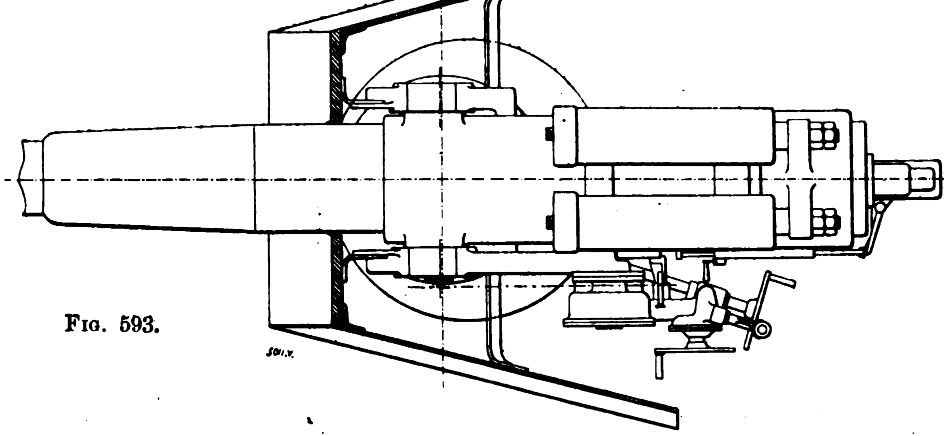


FIG. 593.



MOUNTING FOR 14-CENTIMETRE 45-CALIBRE QUICK-FIRING GUN.

one single gunner, who has within easy reach all the various parts of the mechanism. The line of sight is lighted by electricity for night service, and the fuse can be fired either by percussion or by electricity. The guns were built according to a specification which provided that they had to fire a projectile isolated from the cartridge-case, in order to facilitate loading and handling in the magazines.

Weight of gun	5700 kilog. (12,562 lb.)
,, mounting ...	4500 ,, (9,918 ,,)
,, shield	1200 ,, (2,644 ,,)
Elevation	+ 15 deg. – 10 deg.
Weight of projectile ...	40 kilog. (88 lb.)
Muzzle velocity in service ...	720 m. (2362 ft.)

15-*Centimetre* (5.905-*In.*) 50-*Calibre Quick-Firing Guns* (Fig. 594):

Weight of gun	6250 kilog. (13,775 lb.)
,, central pivoting mounting, with shield ...	7990 ,, (17,610 ,,)
Weight of muzzle pivoting mounting	5650 ,, (12,452 ,,)
Elevation	+ 18 deg. – 5 deg.
Weight of light armour-piercing projectile ...	40 kilog. (88 lb.)
Weight of charge, smokeless powder	13 ,, (28½ ,,)
Muzzle velocity	820 m. (2690 ft.)
Weight of heavy armour-piercing projectile ...	50 kilog. (110 lb.)
Weight of charge, smokeless powder	12¼ ,, (27 ,,)
Muzzle velocity	730 m. (2395 ft.)

The gun slides in a housing which is of uniform type, whatever be the style of mounting used. It consists of a cylindrical body fitted with the trunnions and the recoil cylinders; the latter afford a constant resistance owing to the variations in the dimensions of the vents. Each cylinder is formed of a chest with two reglets of varying section, a plug, and a gland. The pistons are provided in front with a projection that forms a hydraulic buffer for automatic return and end in the rear in a screwed part for fitting to the gun. The spring recuperator is independent of the brake, and consists of two series of spiral springs which bear on the housing and work by traction on the rods fixed to the gun.

The central pivoting mounting consists of a movable part, slide and transom, made to turn by the interposition of rollers, on the bolster fitted to the deck. A wrought-steel shield is fixed to the movable part with elastic couplings. The gunner bears on the butt, and points the gun by acting on two handwheels, the right-hand one for elevating, and the left-hand one for training the gun.

The muzzle pivoting mounting consists of a movable part, slide and transom, made to turn round a front roller path fitted to the bolster and round a racer in the rear, fitted to the deck. The gun is also elevated and trained by means of two handwheels.

The gun is set by a scale and a foresight fitted to the housing, and is unaffected by the recoil. The muzzle pivoting mounting is with two lines of sight, one on the right and one on the left.

For night service a breech-sight is added to the scale, and on the foresight a point, both being provided with a small incandescent lamp. The rays of light in the scale fall on a small silver foil, while the lamp, combined with the foresight, lights a crystal cone fitted to the end of the point. The amount of light is regulated by rheostats placed on the accumulator chests; the lamp connected with the scale may be detached to be in the same way as a hand-lamp.

The foregoing descriptions of the mountings for medium-calibre quick-firing guns recently manufactured by Messrs. Schneider and Co., will give an idea of the importance of this class.

THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

(FROM OUR NEW YORK CORRESPONDENT.)

THE thirty-first annual meeting of the American Society of Civil Engineers was held recently at Cape May. It may not be generally known to the readers of ENGINEERING exactly where Cape May is. Suffice it to say this cape was one of the points selected for bombardment by the Spanish fleet; although just why this should have been chosen seems mysterious. But then all the actions of this fleet were mysterious. There is a splendid place for practice-firing at Cape May, and that was what the fleet needed most; moreover, the immense stretches of sand enable the gunners to fire continuously without any danger to the inhabitants, the latter being largely land crabs and mud turtles, unless a land breeze is prevailing, and then the Jersey mosquito gets in his fine work, and for the time being makes life miserable. Cape May is a long projection of sand which forms the southerly point of New Jersey, and marks one side of the entrance to Delaware Bay. It is past this point that all traffic for Philadelphia passes from the ocean. That city has laboured with most commendable zeal to establish an ocean trade which should rival that of Liverpool, but being 120 miles up the bay, and the channel being shallow and somewhat intricate, the first steamer coming directly from Liverpool, stuck fast for many hours, and the staid Quakers who were awaiting her arrival at Philadelphia to celebrate in proper shape, were reluctantly compelled to adjourn for lack of something to celebrate. The United States Government has spent considerable money in improving the navigation of Delaware Bay, and a fine breakwater has been built, a description of which will be given hereafter, as the account of it formed one of the entertainments of this session.

Through the courtesy of the Pennsylvania Railroad, which is never lacking when a scientific body desires to assemble, a beautiful train was provided at Jersey City, and run on a special time card to Cape May for the accommodation of the New York and eastern members, while those from the south and west had another special train from Philadelphia. The rate of speed of the New York train was very great, frequently attaining from 65 to 70 miles per hour, and the party were all landed in Cape May a little ahead of the schedule time, not at all fatigued with the journey, for the roadbed of the Pennsylvania Railway is constructed with a special view to comfort and ease in transportation. The passengers were, however, quite dusty and hungry, and having been told of the comforts of the Stockton House, naturally were eager to enjoy them. At this point the only drawback to a perfect Convention occurred. The writer has travelled pretty extensively in this country and in Europe, and thought he had experienced every phase of hotel life, good and bad; but it was reserved for Cape May to show him there was here a depth of absolutely bad management never experienced even in Alaska. Many others were treated in the same way as your correspondent, and among them an English gentleman of culture, who had brought his wife for her first visit to America. This was most mortifying to us Americans, but when we came to an ill-served meal, where we had to almost fight for any attention, a number of us felt a climax had been reached, and shook off the dust from our feet and clothes as well, and departed to seek other quarters.

We now come to the Convention itself. There was a very large gathering, and the members in attendance came from almost every part of the country; in fact, this was the most thoroughly representative gathering the Society has ever held. The formal session commenced the next morning with the Presidential Address of Mr. Desmond Fitzgerald, of Boston, Mass. He commenced by calling attention to some of the earlier public works of American engineers, dividing engineering in America into four periods, 1785-1800, 1810-1830, 1830-1848, and from then to the present. The first man noticed was John Belledine of Virginia, who published in 1773 plans for connecting the Potomac River with the Monongahela, and the James River with the Kanawha, proposing to construct canals and locks for the purpose. Later, George Washington planned to connect the Atlantic coast with the Alleghenies, and after the Revolutionary War actually obtained a charter and organised a company to connect Chesapeake Bay with the Ohio River. Locks were built around the Great Falls, and, finally, in 1823 the Chesapeake and Ohio Canal was constructed. In 1786 a canal seven miles long was built around the falls of the James River, near Richmond, Va., and the charter for the Dismal Swamp Canal was obtained in 1787, and considerable work was done before the close of the century, although the complete connection of Chesapeake Bay and Albermarle Sound was not effected till after 1812. In 1784 South Carolina started to construct the Sautee Canal 22 miles long to connect the Sautee River, with the tidal water of the Cooper River, and thus into Charleston Harbour. There was a rise of 103 ft., which was overcome by eight single and two double lift locks, varying from 5 ft. to 10 ft., having wooden gates built into masonry. The boats were 54 ft. long, 9 ft. beam, and 2½ ft. of draught. The canal was 35 ft. wide at the top, 20 ft. at the bottom, and contained 4 ft. of water. It had 25 flood gates, several overfalls, and abutments and walls for bridges. For 13 miles the excavation was 15 ft. It seemed that as far back as 1690 William Penn had a plan to connect the Schuylkill River, which flows past Philadelphia, with the Susquehanna, and in 1789 the project took shape. William Weston, an English engineer, came over to examine the route in 1793. He reported against utilising the beds of the creeks, and recommended a canal 70 miles long. In 1811 the two companies holding charters for this and for a canal to connect the Delaware and Schuylkill, were consolidated, and in 1827, after a lapse of 65 years from the time of survey, the works were completed. The Schuylkill Navigation Company was chartered in 1815, and 108 miles of canal were constructed, in which were 31 dams and 120 locks, representing 620 ft. The engineer was Thomas Oakes. He was succeeded by George Duncan, who built the old tunnel at Pottsville, and the Tumbling Rim reservoir system, consisting of earth dams, 48 ft. and 60 ft. high. He also constructed the dams around Reading, which are in use at present, and said to be excellent. New York State started in 1791 to open water communication between New York City and the Great Lakes, and in 1796 boats of 15 tons burden passed from Schnectady to Seneca Falls. Massachusetts had less share in these earlier works, and in 1794 had surveys made for the Middlesex Canal to connect the Merrimac River with Boston, a distance of about 27 miles. This was completed in 1802, was 30 ft. wide, 4 ft. deep, had 7 aqueducts, 20 locks, and 50 bridges. It was fed by the Concord River, 37 ft. above the Merrimac, and 107 ft. above tide water. The success of this led to the contemplation of steps to insure 80 miles of navigation up the river, and eventually a connection with the St. Lawrence. This might have taken place had not railways supplanted the canal. Mr. Fitzgerald gave at this point two extracts relating to canal travel, which are given below; the first was issued in 1794.

Two boats for the present will start from Cincinnati to Pittsburg and return to Cincinnati in the following manner, viz.: First boat will leave Cincinnati this morning at 8 o'clock and return to Cincinnati so as to be ready to sail again in four weeks from this date. Second boat will leave Cincinnati on Saturday, the 30th inst., and return as above; and so regularly, each boat performing the voyage to and from Cincinnati to Pittsburg once in every four weeks. The proprietor of these boats having maturely considered the many inconveniences and dangers incident to the common method hitherto adopted of navigating the Ohio, and being influenced by a love of philanthropy and a desire of being serviceable to the public, has taken great pains to render the accommodations on board the boats as agreeable and convenient as they could possibly be made. No danger need be apprehended from the enemy, as every person on board will be under cover made proof to rifle balls, and convenient port holes for firing out. Each of the boats is armed with six pieces, carrying a pound ball; also, a good number of muskets, and amply supplied with ammunition, strongly manned with choice men, and the master of approved knowledge.

The second was issued in 1838, and was by David Stevenson, of England, who evidently did not enjoy our methods:

The canal travelling in many parts of America is conducted with so little regard for the comfort of passengers as to render it a very objectionable conveyance. The Americans place themselves entirely in the power and at the command of the captains of the canal boats, who often use little discretion or civility in giving their orders, and strangers who are unaccustomed to such usage, and would willingly rebel against their tyranny, are in such cases compelled to be guided by the majority of voices, and quietly to submit to all that takes place, however disagreeable it may be. About eight o'clock in the evening every one is turned out of the cabin by the captain and his crew, who are occupied for some time after the cabin is cleared in suspending two rows of cots or hammocks from the ceiling, arranged in three tiers one above another. At nine the whole company is ordered below, when the captain calls the names of passengers from the way-bill, and at the same time assigns to each his bed, which must immediately be taken possession of by its rightful owner on pain of his being obliged to occupy a place on the floor, should the number of passengers exceed the number of beds, a circumstance of very common occurrence in that locomotive land. I have spent several successive nights in this way, in a cabin only 40 ft. long by 11 ft. broad, with no less than forty passengers; while the deafening chorus produced by the croaking of the numberless bull-frogs that frequent the American swamps was so great as to render it often difficult to make one's self heard in conversation, and, of course, nearly impossible to sleep. The distribution of the beds appears to be generally regulated by the size of the passengers; those that are heaviest being placed in the berths next to the floor. The object of this arrangement is partly to ballast the boat properly, and partly, in the event of a breakdown, to render the consequence less disagreeable and dangerous to the unhappy beings in the lower pens. At five o'clock in the morning, all hands are turned out in the same abrupt and discourteous style, and forced to remain on deck in the cold morning air while the hammocks are removed and breakfast in preparation. This interval is occupied in the duties of the toilette, which is not the least amusing part of the arrangement. A tin vessel is placed at the stern of the boat, which every one washes and fills for his own use from the water of the canal, with a gigantic spoon formed of the same metal; a towel, a brush, and a comb, intended for the general service, hang at the cabin door, the use of which, however, is fortunately quite optional. The breakfast is served betweeen six and seven o'clock, dinner at eleven, and tea at five.

Mr. Fitzgerald then spoke of the Erie Canal, which, he said, created the new profession of the civil engineer. The preliminary surveys were made in 1808, but construction did not commence till 1817. It was completed and opened in 1825. The total length from Albany to Buffalo was 363 miles. (This canal, it may be noted, connects the Great Lakes with the ocean by means of the Hudson River and New York Bay.) The canal was 40 ft. wide at the top, 28 ft. wide at the bottom, and was 4 ft. deep. There were eighty-four locks on the main line, each 15 ft. by 90 ft. The total lockage was 688 ft. On the canal were eighteen aqueducts, some of them fine stone structures, notably that over the Genesee River, which was 804 ft. long and contained eleven arches. Among the aqueducts across the Mohawk there was one with a length of 1188 ft. One of the embankments was 72 ft. in height. The cost was upwards of 10,000,000 dols. By the completion of the Erie Canal, the time between Buffalo and Albany was reduced from twenty to ten days. The work was divided into three divisions, in charge of James Geddes, Benjamin Wright, and Charles Brodhead. The first two named were judges, and two of their associates —Bates and Roberts—were also judges. A short description was then given of each, which is quite interesting reading:

Benjamin Wright was born in Connecticut on October 10, 1770. At an early age he began the work of surveying farms at Fort Stanwix, on what was then the border of civilisation. Before the year 1800 it is said he had laid

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HORIZONTAL MOUNTING FOR 14-CENTIMETRE GUN.

Fig. 598.

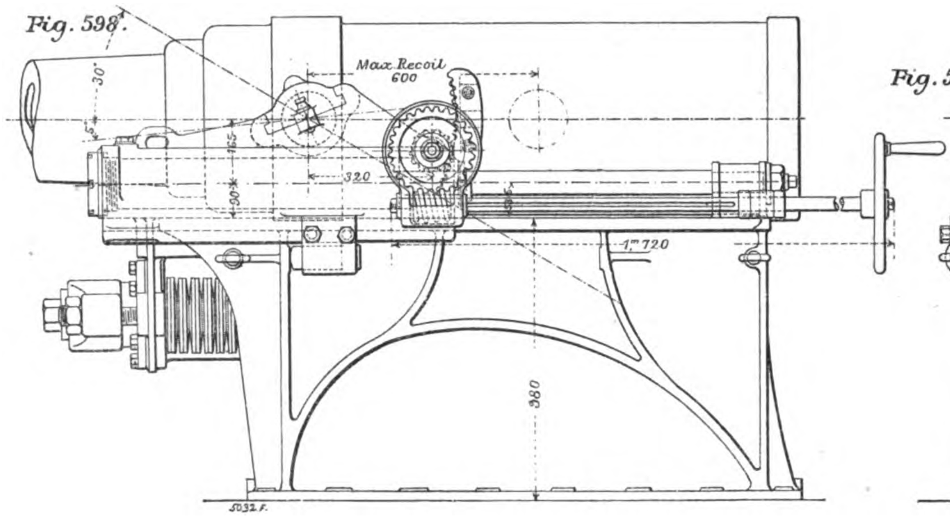
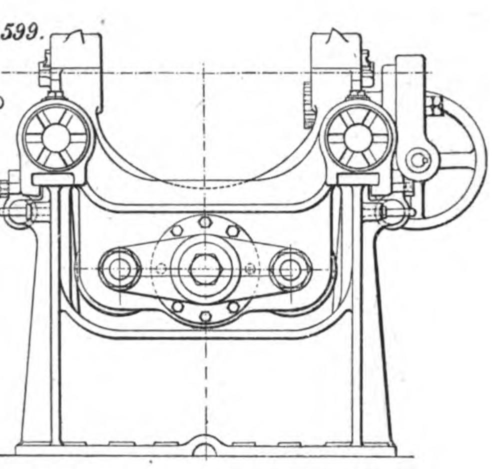


Fig. 599.



sary to say that it was admirably carried out by Mr. Brough and his assistants. It may be taken as typical of the admirable manner in which the duties of the permanent staff of the Iron and Steel Institute are carried out, that the first volume of the Transactions for the present year was in the hands of members before the Manchester meeting was over. Members who know how ably and completely the Transactions of this Institute are edited will more fully appreciate the significance of this fact.

The summer meeting of next year will doubtless be held in Paris.

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXV.

MORTARS AND HOWITZERS FOR NAVAL SERVICE.

THE details of modern naval armaments frequently comprise a certain number of guns of the howitzer and mortar types, for firing projectiles charged with high explosives under great angles. Such pieces are specially designed for the attack of armoured decks which, while forming one of the vulnerable parts of modern men-of-war, usually escape owing to the flat trajectories of quick-firing guns. On the other hand, trials have been made for arming light-draught ships with a single quick-firing gun of medium calibre and high power. In both cases special arrangements are necessary, so that the shock resulting from firing these guns may not be a cause of injury to the decks and their framing. It might be possible, it is true, by placing suitable stiffening pieces directly below the gun, to employ mountings of the usual type for this service; but this would not meet, in many cases, a large number of conditions that have to be taken into account when designing the internal arrangements of warships. It was, therefore, most important to be able to rely on a type of armament successfully designed to meet these particular requirements.

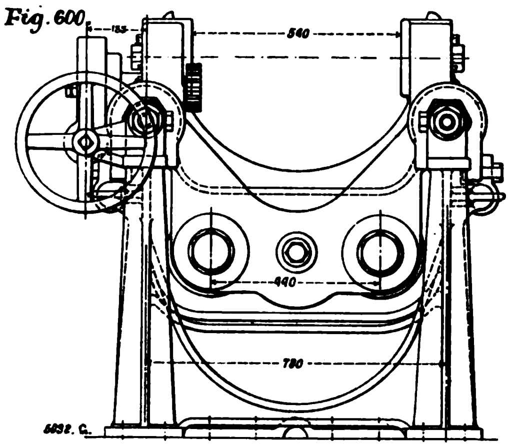
The problem presented itself several years ago, in connection with the Schneider-Canet guns, and was solved by placing in service a series of various types, each one corresponding to a distinct purpose. Their main characteristic is the reduction, by means of special arrangements, of the percussion produced by firing, the shock being reduced to a proportion consistent with the normal resistance of the decks to which the armament is attached.

These mortars and howitzers, as regards their design and their breech-closing arrangements, form part of the Schneider-Canet current series. The mountings can be divided into two main classes:

1. *Beam Mountings.*—In this type, an oscillating slide is used, which is made to turn round horizontal trunnions; as it recoils during firing, it operates an hydraulic brake and recuperator, which run out the piece to its original position. This type will be described in a separate chapter, which deals with disappearing gun carriages.

2. *Circular Slide Mountings.*—These are made with a traversing platform embodying circular vertical slides, the centre of which coincides with the axis of the trunnion. By this arrangement, whatever be the angles of elevation, the axis of the hydraulic cylinders follows the direction of the firing line, thus reducing the effort of percussion. A complete description of a mounting of this type has been given in a preceding article, in connection with an ordinary 14-centimetre gun. Fig. 595, page 228, shows a 22-centimetre (8.661-in.) howitzer on a mounting with circular traversing platform.

Fig. 600.



Weight of howitzer ...	3,500 kilog.	(7,714 lb.)
,, mounting ...	11,600 ,,	(25,566 ,,)
,, projectile ...	116 ,,	(255 ,,)
Muzzle velocity in service	300 m.	(984 ft.)
Elevation	− 5 deg. + 60 deg.	
Training	360 deg.	

15-Centimetre Quick-Firing Mortar (Figs. 596 and 597).—The principal parts of this are the following: The mortar, with its breech-closing arrangement; the housing; the slide and the bolster.

The mortar is furnished with a breech mechanism of the two-action type. To the rear is screwed a recoil jacket to which is fixed the head of the hydraulic recoil piston. The housing is provided with trunnions, and consists of a cylindrical body in which the mortar slides, and of an hydraulic recoil cylinder with constant resistance. The piston is held by the recoil jacket, and a counter-rod is provided of a slightly larger diameter, which, by penetrating in the cylinder during recoil, forces part of the liquid to flow into the recuperator. This is placed outside the right bracket of the slide, and consists of a vertical cylinder in which moves a double diaphragm, combined with a set of springs. Communication is established between the recoil cylinder and the recuperator, by a pipe which passes through the centre of the right trunnion of the housing; a loaded valve placed on the circuit followed by the liquid, is raised during recoil and falls back on its seat when the recoil is spent. The liquid can only return by flowing through small vents cut in the valve seat; the mortar then runs out slowly under the relaxing of the recuperator springs. On the left side of the recoil cylinder is the circular rack for elevating the mortar.

The slide consists of two brackets, made with stiffening ribs, and strongly stayed together. Its lower part forms a circular plate round which is the racer that carries the balls for facilitating the rotary movement; in its centre, the plate is in the shape of a vertical cylinder which fits on the fixed pivot of the bolster. The slide is, moreover, provided with the necessary lugs and projections for the fixing of the setting mechanisms. Two clasps, one in front and one in the rear, prevent all raising of the system.

The bolster on which the slide rests with the interposition of the set of balls, is fitted with a circular rack for training the mortar, and with a ring plate in the holes of which the foundation bolts are placed. Its central part forms the fixed pivot.

The required elevation is obtained by operating the handwheel placed on the left of the slide. This works, through two conical pinions, an endless screw and a set of differential gearing, the right-hand pinion which engages the fixed toothed sector, which is on the left side of the housing.

The mortar is trained by turning a second handwheel placed slightly to the rear of the preceding one. It works through an endless screw and a helicoidal wheel, a vertical pinion gearing with the circular rack on the bolster.

To train the mortar by means of these two handwheels, the gunner rests his shoulder on the butt-end, which is so placed that he can immediately cast his eye on the line of sight.

This mounting takes up but little room, and is suitable for large-calibre guns, without any extra provision for stiffening the decks of ships being required.

15-Centimetre (5.905 In.) Quick-Firing Mortar, on Central Pivoting Mounting.

Weight of mortar	480 kilog.	(1058 lb.)
,, mounting ...	2700 ,,	(5950 ,,)
,, projectile ...	40 ,,	(88 ,,)
Muzzle velocity in service	200 m.	(656 ft.)
Elevation	− 5 deg. + 60 deg.	
Training	360 deg.	

Armament of Light-Draught Ships.—The arming of very light-draught ships with a medium calibre quick-firing gun is a problem which has often been under consideration. We give below the description of a type of Schneider-Canet armament, which has been designed and tried with good results for this special use.

The gun is a 14-centimetre (5.511 in.), 45 calibres in length, with one-motion breech mechanism, firing being effected by percussion. The mounting has horizontal slides, with compressed air or spring recuperator (Figs. 598 to 600). The gun is carried in a housing, which contains the two recoil cylinders with central counter-rod, and the recuperator placed between the brackets. The housing is provided at its lower part with two shoes, which slide on the paths of the traversing platform. The carriage support consists of a circular platform, on the top of which are two parallel brackets, the upper one forming the horizontal slide paths. Rollers may also be used for facilitating recoil and return. The whole system is bolted on deck. The gun is trained by displacing the ship in the required direction.

The design followed for the mounting, and especially the use of horizontal slides, cause the efforts of percussion on the firing platform to be reduced to a marked degree; the efforts of traction on the piston-rods can also be reduced at will by altera-

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MOUNTINGS FOR MORTARS AND HOWITZERS.

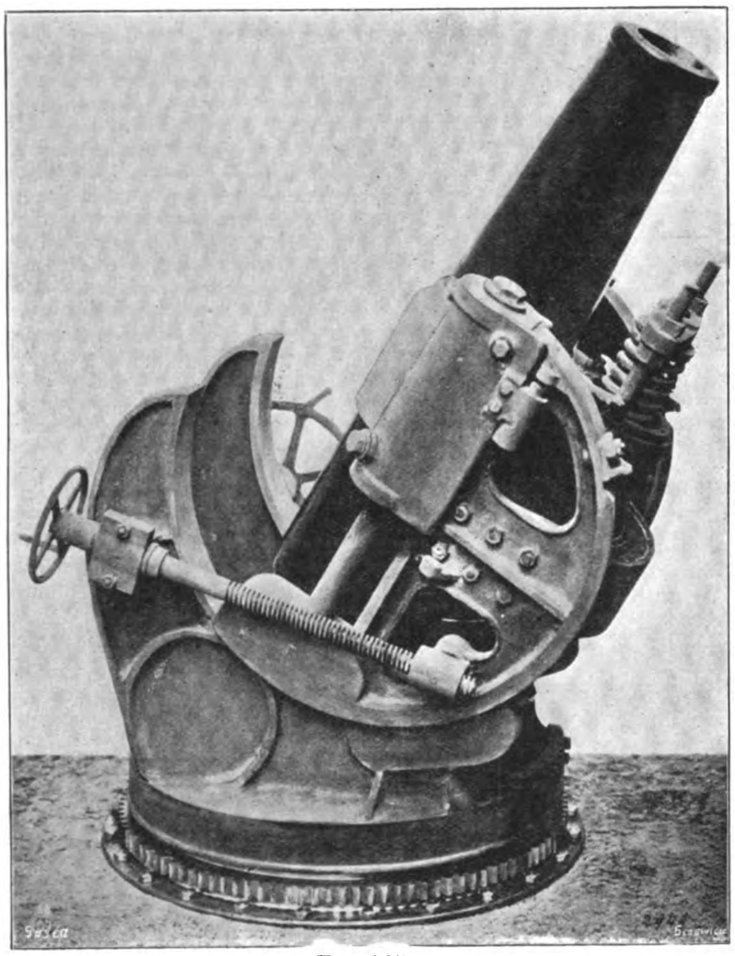


Fig. 595.

Fig. 596.

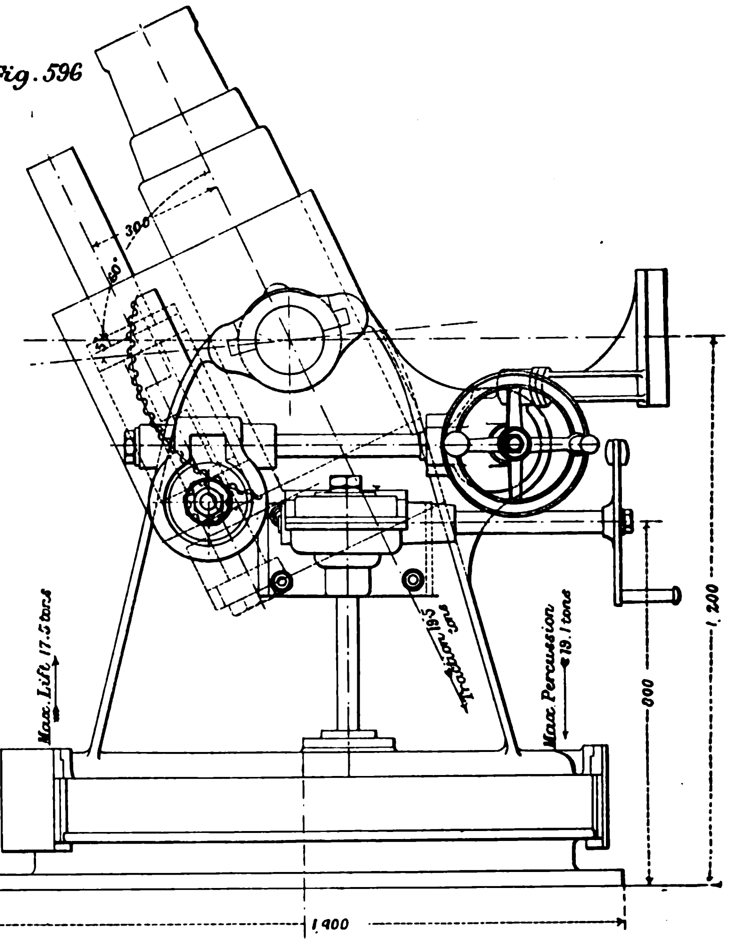
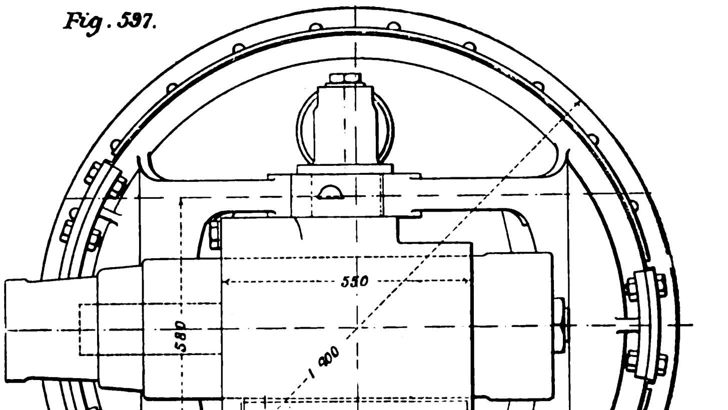


Fig. 597.



tions in the interior design of the hydraulic brake.

It may be mentioned, in this respect, that the circular slide mounting already described, is also very suitable for this special use. Messrs. Schneider and Co. have built one for the French Navy, for firing trials on board ship against movable targets.

The above brief data will show that the Schneider-Canet material solves this particular problem, both as regards the use of mortars and howitzers on board battleships and cruisers, and for arming light-draught ships with quick-firing medium calibre guns of great power.

THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

(From our New York Correspondent.)

(*Continued from page* 197.)

Mr. Cortell's report on the International Congress on Navigation at Brussels followed the President's address. There were 121 delegates representing 24 nations; 410 representatives from cities, technical societies, and like institutions, and 840 from various corporations, making a total of 1371; 123 papers were discussed, and daily bulletins of transactions of the previous day were issued, and the programme for the current day announced. Many important works were inspected, the Congress being divided into five sections, each taking up a separate group of subjects. The next Congress would meet in the United States in 1902, and legislation from Congress, with suitable appropriations, will be sought this winter, as well as to obtain the use of a Government building for the meeting.

It was then announced by the secretary that the Society had been indulging in a little legal practice. Contrary to most experiences, the Society had come out ahead, for, Mr. Hunt said, the Courts had decided the Society was exempt from city taxation, thus saving at present 2000 dols. per annum. The bequest of Mr. Herbert Steward of his technical library and 2000 dols. was also announced, and that the general library of the Society was being thoroughly indexed. The meeting then adjourned for recreation, and it took the form of surf bathing to a large extent, for Cape May has the most beautiful beach anywhere on the coast, and the slope is so gradual there is no undertow and only a moderate surf. Lest any false impression be given in this article as to Cape May itself, it may be said it is a charming place, with many delightful cottages containing many delightful people. It has good golf links and several hotels, such as the La Fayette and the Marine Villa.

Loads on Bridges.

The afternoon session opened with a discussion of the following:

Should the use of the method of wheel concentrations be discontinued in determining the stresses in railway bridges?

In view of present knowledge of the effect of repeated applications of load, should fatigue formulas be used in bridge design?

Mr. J. Snow thought that bidders should figure for the maximum strains permitted by engineers and select their sections so as to agree with these strains. He preferred to use the weight of a train of locomotives in his calculations, and stated he used a uniform train load with an excess panel load in front. Mr. G. S. Morison, who has built some of the finest bridges in the world, favoured the abandonment of the use of wheel concentrations altogether. Mr. Lindenthal also objected to the use of driving-wheel loads, and said the Launhardt-Weyrande formula rested on neither theory or experiment, and only added to the trouble of calculations. For short spans it increased the weight of metal but little, but for long spans it added so much material that the cost was increased without additional strength or durability. He thought the increase of the weight of locomotives had about reached its limit; 150 tons on a 15-ft. wheelbase was about all bridge engineers would have to provide for; this corresponded to a pressure of from 60,000 lb. to 75,000 lb. per square inch on the rail and tyre, which was close to the elastic limit. His own practice was to proportion dead and live load cross-sections separately with high and low units respectively, and then use their sum. Professor Ricketts, of Troy, where some of the most celebrated engineers of this country have graduated, gave as his opinion the use of the method of concentrated loads was being abandoned on account of the time required. He compared it to guessing at the answer, and then expressing the result to six places of decimals. He thought the use of fatigue formulas unnecessary. Mr. Morison took into account four factors in the proportioning: Heavy wheelbase loads,

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Savey, et Cie, and partly to La Société des Ponts et Travaux en Fer. The cupola above referred to has been constructed by the first-named firm. We may here express our indebtedness to all these gentlemen for the information and illustrations that accompany this article.

The types of girders employed have been designed with a special view to simplicity and uniformity. The two large longitudinal galleries, as well as the transept connecting the central entrances, are covered by a circular roof 23.52 metres (77 ft. 2 in.) high. The other two longitudinal galleries of 27 metres (88 ft. 7 in.) and the 29.40 metre (96 ft. 4 in.) end transverse galleries, are covered by pitched roofs (see Figs. 2 to 6). The general character of the framing over the smaller intermediate galleries is a curved lower, and straight upper, member. These roof principals rest on the columns carrying the main trusses; longitudinally they are connected by deep lattice girders, to which are attached the brackets supporting the intermediate roof ribs, &c. (see Figs. 3 and 4). There are upper galleries in the building placed at a height of 7 metres (23 ft.) above the ground floor; great care had been exercised not to allow these upper galleries to interfere with the general effect. They are confined to the narrow 9 metre and other side galleries, and are connected at intervals across the main naves by communicating bridges 9 metres wide. There is also a partial upper floor for the kitchens of the restaurants, and which is isolated from the public. The plan Fig. 1 shows the positions of the various stairways, as well as of the inclined travelling platforms that will be employed in this building.

We may now describe the methods of erection adopted by the contractors, MM. Moisant, Savey, and Laurent, who, we may note in passing, employ steam instead of hand hoists, which, as we have seen, was used throughout in the erection of the Engineering and Transport Building. The contractors have very ingeniously simplified the temporary works required for erection by the use of two travelling stages which suffice for handling all the framework, although the heights of the different roofs vary considerably. One of them is reserved entirely for the lower portions of the work, and the other for the larger spans; the illustrations we give in Figs. 7 to 10, page 260, explain very clearly the arrangement adopted. The staging is carried on four trucks running on rails. Each truck has four wheels, and is provided with the necessary gearing for moving the staging forward on the rails. At the top of the staging is the upper platform, on which is placed the hoisting gear. This platform rests on vertical standards, two placed at the forward angles of the staging above the trucks, and extending downwards as far as the lower platform; the position of the other standards is shown on the drawing which illustrates the construction of the staging. There are three platforms, the first, a few feet above the ground, carries the portable engine that drives the various hoists by rope transmission, as indicated in Fig. 9; it was the intention of the contractors to use electrically driven machinery, but, unfortunately, no source of supply was available. The second platform is placed at a height of 18 ft. 6 in. above the ground, about the height of the upper galleries. As will be seen from Fig. 9, the next platform projects far enough to allow all the operations of erecting the 9-metre span to be carried on. The third platform is 11.90 metres high; this is at the level of the smaller roof trusses and the longitudinal girders between the main columns. The highest platform is at a height of about 67 ft. above the ground; it is used only to carry the hoisting apparatus which runs on rails being laid for that purpose. The device consists of a built-up steel trussed beam mounted on wheels and running around a circular track of two concentric rails; the centre of the beam corresponds with, and is secured at, the centre of this circular track. The lower flanges of the beam serve as the tracks for the travelling carriage of the hoist (Fig. 10), which can be run to and fro from either of the platforms; by this arrangement a universal command is obtained within the limits of the hoist. The staging for the large spans is shown in Figs. 7 and8, and is so simple in its construction as to call for no explanation. It travels forward on rails placed 59 ft. apart, and is sufficiently high (53 ft.) to command the whole of the curved and pitched spans, for the erection of which it is employed. We understand the arrangement of scaffolding we have described gives complete satisfaction.

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXVI.

Torpedo-Launching Tubes.

The Schneider-Canet system of artillery comprises a series of torpedo-launching tubes, of various patterns, fulfilling the numerous conditions required in service in modern fleets. A special section of the artillery department is reserved for this work.

The tubes are of gun-metal or of steel, as may be found expedient, and they can be adapted for launching any type of torpedo now in service in various countries. The series may be divided into two principal classes:

1. *Tubes above Water-Line for Launching Torpedoes.*—The large number of patterns of this class differ one from the other only in their mountings, which vary in design, according to the conditions of service and the type of ship on which they are fitted. They can, moreover, be extended in front by a spoon-shaped guide which insures the horizontal position of the torpedo being retained when it penetrates the water after launching. The following details are common to all the types:

(*a*) The delicate mechanism carried by the torpedo itself, and especially the screw which propels it, are secured against all damage that might be caused either by the sudden influx of compressed air or by the deflagration of powder gases.

(*b*) The closing of the rear of the tubes which is of a special design resembling the interrupted threads of breech-blocks; a progressive turning of the closing arrangement insures a tightness of the joint under the pressure at which firing takes place. Certain closing actions are effected mechanically, reducing the efforts to be developed on the governing crank.

(*c*) For the tubes supplied with compressed air-firing device, the mechanism for launching with powder is also delivered, unless otherwise stipulated.

(*d*) Smokeless powder can be used when required, so as to prevent an enemy from noticing the exact instant a torpedo is fired, and from aiming at a dangerous part of the ship.

(*e*) Firing can be effected by a percussion or an electric fuse, and the firing device can be worked mechanically or by electricity at will.

(*f*) The Schneider-Canet tubes are provided with automatic apparatus which render impossible, in current manœuvres, any mistake in the order of succession of the various actions.

(*g*) The tubes are fitted with luminous sights which render night service possible, the deviations resulting from the speed of the target, and the ship itself being corrected automatically.

From the above remarks it will be seen that it will prove sufficient, to obtain a clear idea of the Schneider-Canet system, to give the details of one tube, a special description being added of each of the principal types of mountings.

Fixed Tube on Deck in the Bow of Torpedo-Boats (Figs. 601 to 604, page 262).—The tube may be made of gun-metal or of steel, the thickness of the walls, and consequently the total weight, varying according to the metal used. It consists of two cylindrical rings, the length and inside diameter of which depend upon the type of torpedo to be used, and which are fitted together by means of flanges and bolts. The top centre line on the inside surface is made with a groove, in which the torpedo fits; this serves as a guide during firing. On the tube are the following parts:

1. The breech-closing arrangement, which is, broadly speaking, like that used for guns; its operation is, therefore, familiar to gunners who are already accustomed to the service.

The closing device consists of a circular plate made slightly convex to the rear, which fits to the tube, and is made to pivot round a vertical hinge; round its circumference are a series of continuous and interrupted threads, similar to those of gun breech-blocks. This disc is strengthened by a certain number of ribs; it carries in the rear a fixed handle, and the firing bolt to be described later. The tube ends at the rear in a ring in which is cut a rabbet in which the disc fits when it is closed. In this rabbet is formed the joint that insures perfect tightness during firing, the disc bearing against a special plastic ring placed in the rabbet. To close the disc and obtain the required degree of fastening, a round ferrule is screwed in the projection of the rabbet, and is made to turn round its centre; on its inside are cut a series of continuous and interrupted threads which correspond exactly to those on the disc, in such a manner that it is sufficient, in order to fix the disc to the tube when it is at the bottom of the rabbet, to turn the ferrule to a degree corresponding with the pitch of the continuous threads, this action being transmitted by a toothed sector fitted to the outside of the ferrule, and by a pinion placed in the thickness of the ring in the rear of the tube. The whole system is worked by a crank.

To open the disc the crank is turned round to disengage the continuous threads, the disc being then brought to the side by drawing on the fixed handle. When the torpedo is placed home in the tube, the same motions are repeated inversely, to close the disc. On its inner concave surface, the disc is provided with a recess in which the charge is placed. The gases flow through the tube by vents, arranged in such a manner that the propelling machinery of the torpedo is not in direct contact with them, the pressure rising progressively in the tube. The vent in which the fuse fits is cut through the centre of the disc and ends in the centre of the small powder chamber. A spring ejector serves to withdraw the fired fuse.

The firing device consists of the bolt and the working mechanism. The bolt, which is similar to those used for guns, is made movable in a longitudinal groove fitted to the outside surface of the disc, the bottom of the groove forming a fixed rack. On the bolt is fitted the centre of the joint of a ball hammer, on the hinge of which are cut a series of teeth that engage the fixed rack. The whole is put together in such a way that when the bolt is at the extreme limit of its travel, the ball of the hammer, which is provided with a percussion pin, is in contact with the rear of the fuse; when it is at the lowest part of its travel, the hammer is brought down. It is sufficient, therefore, to move the bolt in its groove to communicate to the striker the required *vis viva* to fire the fuse. This action is imparted to the bolt by the firing device, the disengaging of which can be controlled either by hand or by electricity.

2. The firing device acts on the bolt to bring it up to the limit of its travel by means of a two-branched lever which is jointed under the lower rear end of the tube and controlled by a horizontal piston worked by a spiral spring contained in a fixed cylinder. A vertical disengaging mechanism held by a pawl mounted on the armature of an electromagnet, keeps it in position. The disengaging of the system is obtained in lifting the pawl by hand or by an electric current. The two-armed lever can then work the firing bolt freely. To bend the main spring, a round rod is operated which is placed in a socket at the end of the shaft which carries the firing lever. This socket is provided with a cam which, when the lever is operated, causes the disengaging gear to turn until it grips the pawl of the electromagnet. When this is effected, the rod is put back in the accessory chest.

3. The stop latch serves to fix the torpedo in the tube as long as the firing device is not worked. It consists of a cylindrical piston made to enter the tube for a certain length, and is fitted to the lower part near the rear. A slit is cut in the piston in which the lower fin of the torpedo fits. This latch is governed by a spring, and, as mentioned further on, is arranged so as to leave the torpedo free previous to the firing of the charge.

4. As long as the torpedo remains motionless in the tube, its mechanism does not work, the compressed air in the reservoir not reaching the cylinders that work the propeller. As, soon, however, as firing takes place, the torpedo advances in the tube and immediately this forward motion is started, the valve opens which admits the compressed air, under the action of the starting finger that projects from the inside surface of the tube at the spot chosen for the lever, which works this valve and which is fitted to the torpedo.

5. A brake serves to fix the torpedo in the tube until it is fired. It consists of a piston which may project on the inside and bear on the torpedo under the action of a spiral spring contained in a suitably shaped casing. It can only act when the torpedo has been placed completely home; until then it is maintained on the outside. To this effect, it is provided with a threaded rod to which is fitted a handwheel. During the time the charging of the tube goes on, the threaded rod is brought down in

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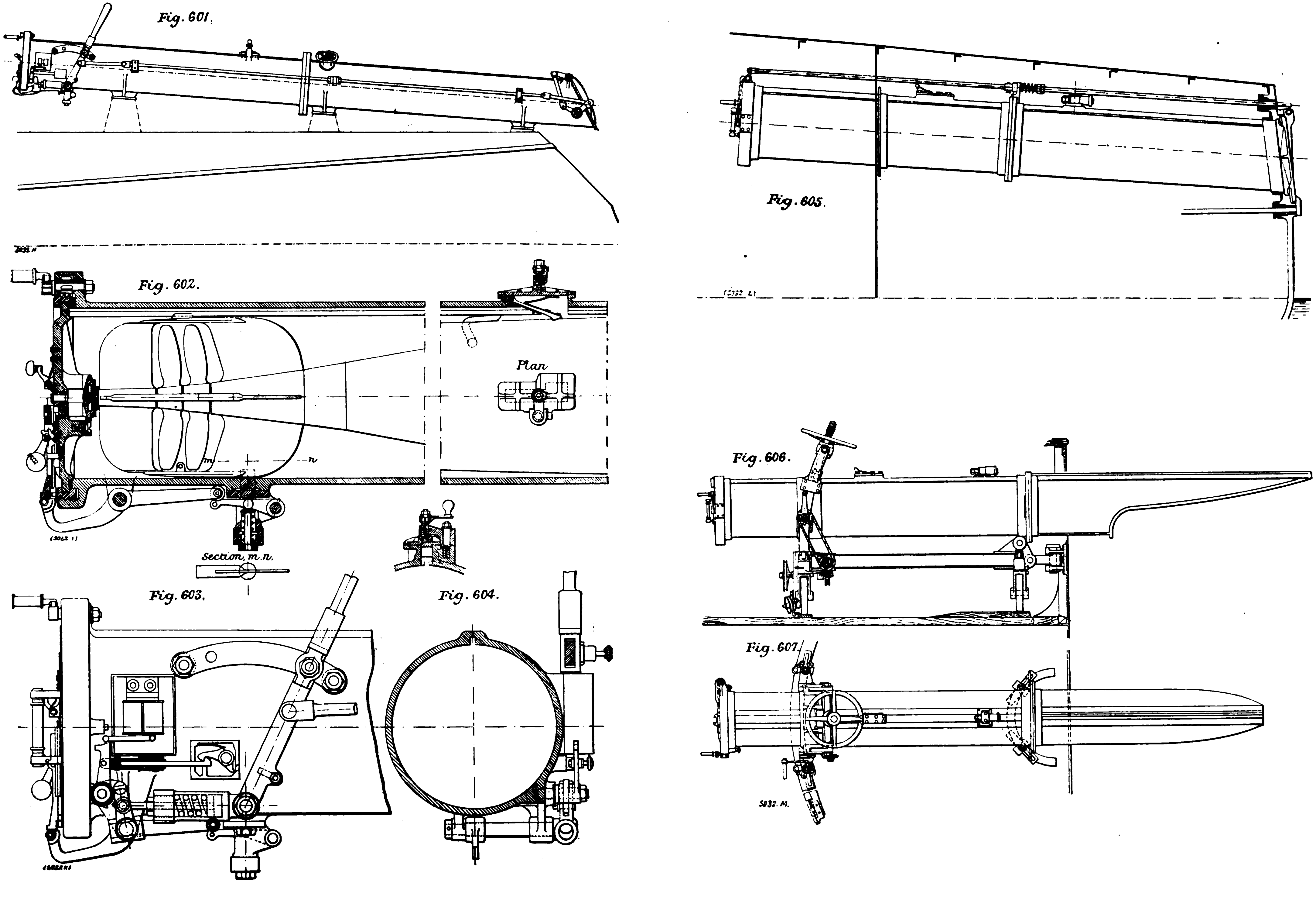
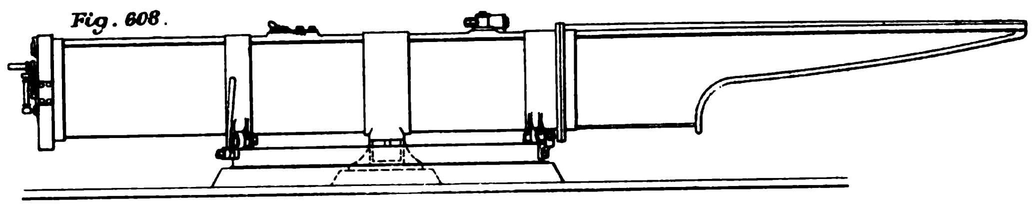
DETAILS OF SCHNEIDER-CANET TORPEDO-LAUNCHING TUBES.

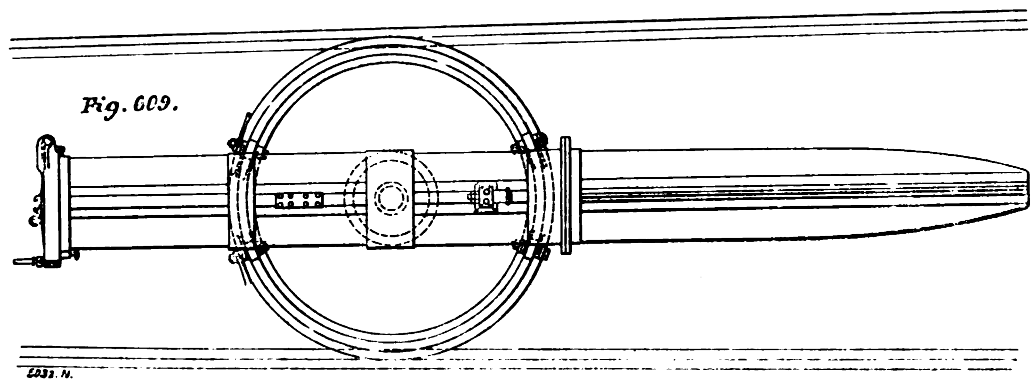
(For Description, see Page 261.)

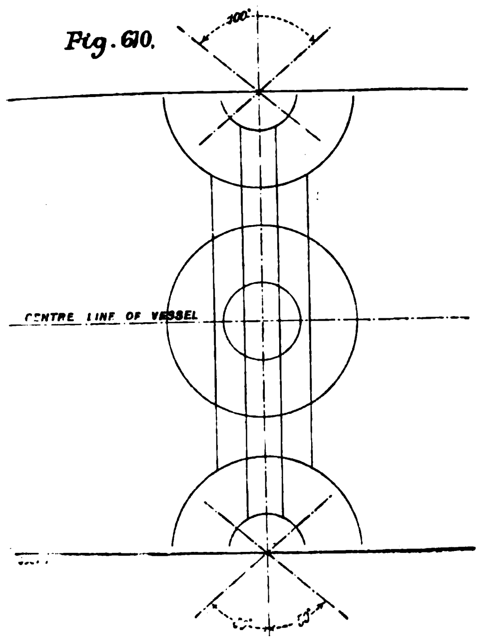


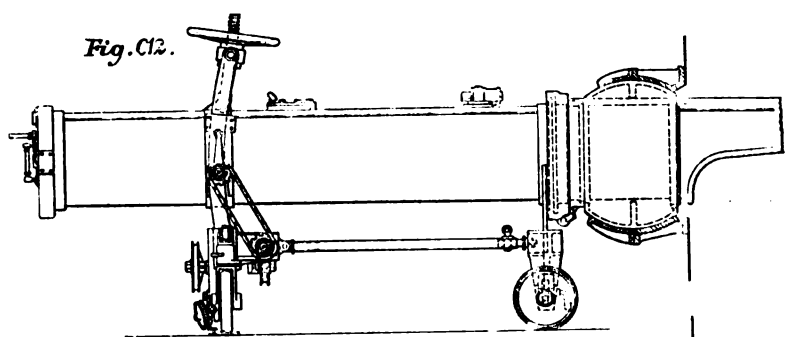
SCHNEIDER-CANET FIXED AND MOVABLE TORPEDO-LAUNCHING TUBES.

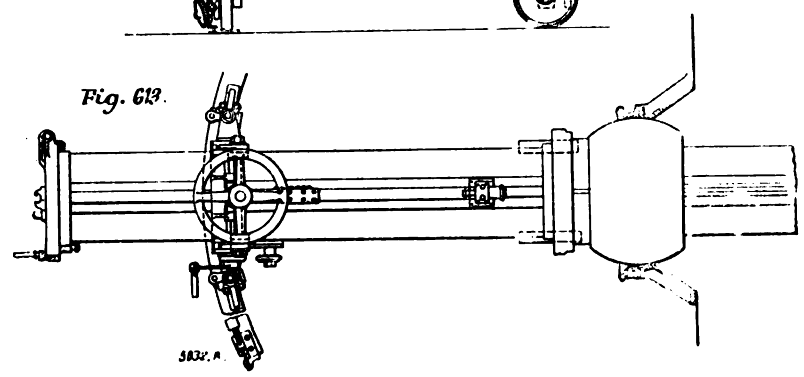
(*For Description, see Page* 261.)











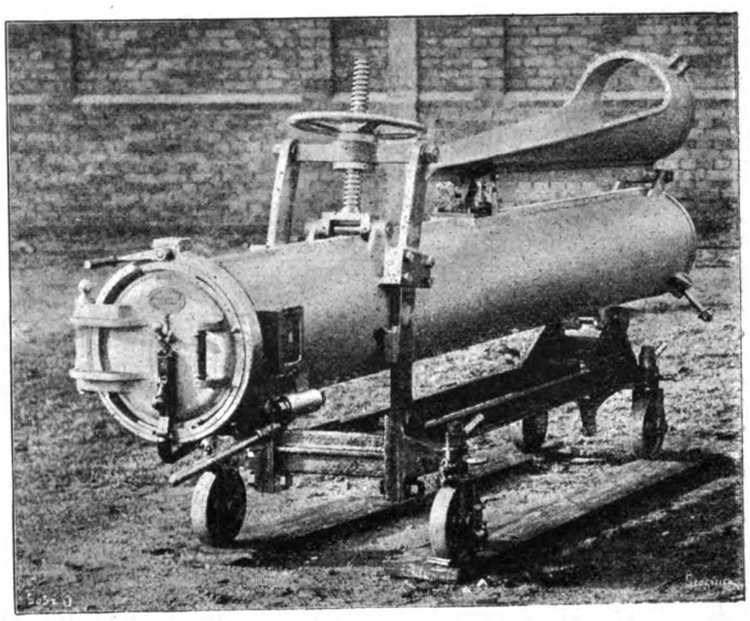


FIG. 611.

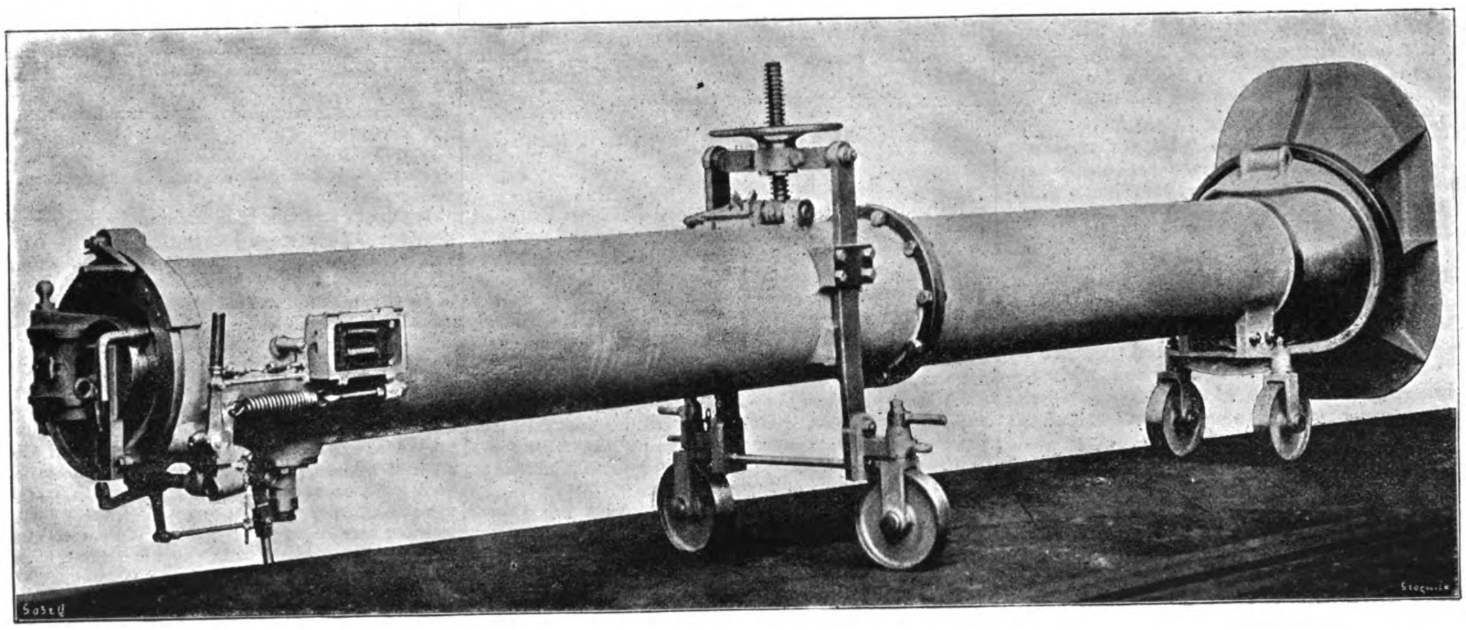


FIG. 614.

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its nut and the brake is flush with the inside wall of the tube, its spring being compressed. As soon as the torpedo is in place in the tube, the brake is made to bear on it and its spring gets relaxed, by turning round the handwheel.

6. In order to close the tube when it is not required in service, to keep the inside free from seawater, a cover is fitted to the front end and made to swing on a hinge, the joint not being tight as is the case for the rear closing arrangement. This cover is worked by a series of levers of the usual kind, the safety devices, however, vary with the shape and dimensions of the tube and with the accommodation on the manœuvring platform.

7. In torpedo-firing service, it is absolutely necessary that the succession in the operations of charging and firing be effected in a perfectly uniform order, as the least mistake might give rise to most serious consequences. All the various working parts must, therefore, be joined together mechanically or united with clutches, so that all mistakes be impossible. These special arrangements are the following:

(a) A system which fixes the firing device until the time when firing is to take place. A movable pin can be placed so as to go through the vertical arm of the firing lever and the trigger. This junction of the two parts prevents all action, and the pin is only removed the instant firing is to take place.

(b) On the same shaft, to which the firing lever is fitted, is a second one which works the stop latch through a finger which penetrates it. The latch forcibly disengages the torpedo before firing takes place, as the striker only drives against the fuse when the firing lever reaches the limit of its travel, while the latch runs down completely when lever has performed half of its travel only.

(c) The front cover is governed by a bar which is connected through a series of levers and a longitudinal rod, to a hand lever placed on the right side of the tube near the rear end. Perpendicular to the axis of this hand lever, and near its joint, is a round stop which, when the lever is brought right back and the front cover open, acts on a spring pawl placed in a frame on the side of the tube. This pawl holds back the trigger, thus rendering firing impossible until the stop on the hand lever disengages it. Firing can therefore only take place when the front end cover is opened out.

(d) A projecting flange on the lower part of the rear ring unites the breech cover to the tube when it is closed. This flange hides the end of the longer lever branch of the firing device, as long as the tube is not completely closed: until then the latch cannot work.

Such are briefly the principal safety arrangements of the Schneider-Canet tubes. They may vary in matters of detail, shape, and position on the tube from one pattern to another; the principle, however, remains the same.

It is not necessary to describe here the mechanism for governing torpedoes at a distance, which in certain cases is found necessary; such mechanism form more especially part of the ship's gear.

Fixed Mounting (Fig. 601, page 262).—In this pattern the mounting consists of a plain support which serves to fix the torpedo to the deck. The required training is obtained by the steering of the ship, the tube always firing direct forward; no special methods of fixing the tube are required, apart from those which result from the ship's outfit, it being well understood, however, that nothing must interfere with the manœuvres and the various launching operations.

Fixed Tube in the Bow of Torpedo-Boats.—This tube, shown in Fig. 604, is fixed, and is placed under the deck in the ship's bow. It differs from the preceding in matters of detail only. It consists of two cylindrical parts joined together by flanges and bolts. The tube is fitted with the breech-closing cover with electric firing device; the starting finger; the automatic stop latch of the torpedo, the front end cover which is kept in place by a latch fitted to the end of a long rod that allows the fastening from the rear; a safety bar on the top part of the tube, constantly drawn forward by a spiral spring, and which prevents, as long as the front end cover is closed, the placing of a fuse in the vent, thus insuring complete safety against premature firing. The torpedoes are always fired direct forward, and the required direction is given by the steering of the ship.

Torpedo-Launching Tube on Central Pivoting Mounting, Without Elevating Gear (Figs. 608 and 609).—This type of tube, with spoon-shaped extension, shown in Fig. 608, is fitted on deck, and made to fire from both sides of the ship. The tube is of steel, in two parts, and is provided in front with a spoon-shaped guide. It contains the various mechanical details already described. The spoon-shaped guide begins with a cylindrical neck cut out at its lower part. The groove is continued in it without interruption, so that when the T-shaped support reaches the end, the torpedo enters the water horizontally, thus doing away with all lateral deviations, and insuring a greater precision in the launching than would be the case were the torpedo to plunge point foremost.

The central pivoting mounting consists of the ring in which fits the tube pivot placed under the centre of gravity of the tube; the support bolted on the deck and carrying the pivot; the racer round which the whole system is made to turn on four rollers placed under the joint rings. These rings are made arc-shaped underneath the tube, and carry the roller axles; they are each provided with a clutch brake to fix the system in any required position. The brake is worked by means of a handwheel fitted to a screw.

Torpedo-Launching Tubes for Service on Deck of Destroyers (Figs. 606, 607, and 610 to 614).—These tubes, with spoon-shaped extensions, are designed for the armament of destroyers. The Chishima Kan, built for the Japanese Navy, is provided with this type of tube. They fire from both sides of the ship, the deck being provided to that end, with straight and circular racers. The tube proper is in one piece, the spoon-shaped extension being made to turn up and down round a hinge bolt. The accessory fittings are similar to those of the preceding types, namely, the closing cover, the firing device, the stop latch, the starting finger, besides the support and joint of the spoon-shaped extension.

The mounting consists of a frame, fitted in the rear with two circular arms joined to the top part by a horizontal stay. The middle part of this stay is made with a nut, in which turns a square-threaded screw worked by a handwheel and jointed to the tube. It suffices to act on this handwheel to give to the tube the required elevation. At the lower part of the frame are placed the sockets in which the rollers fit; these are on a vertical axle, and can be made to turn in the required direction.

In the centre of the ship are two concentric racers formed of two flat strips, round which the rollers turn when their surface is more or less parallel with the end bars of the frame. When the tube is not in service, and when it is loaded, it rests on these racers, its axis being parallel with that of the ship. When loading is completed the tube is turned round normally to its first position, and the rollers having been moved through 90 deg., are placed on the two rails across the deck, the tube being rolled to the side on which firing is to be effected. On both sides of the ship are half racers, as shown in Fig. 610. The tubes can fire round 50 deg. fore and aft. This arrangement enables the firing under a maximum range with one single tube. The manœuvres are very simple and quickly effected.

THE MANUFACTURE OF PROPELLER SHAFTS.

By D. B. MORISON, Hartlepool.

DURING 1898 there were 173 casualties to shafts at sea, and over 1000 shafts were condemned and renewed in British-owned steamships. Such a record represents an enormous loss to owners and underwriters. A very large proportion of these casualties is due to the failure of propeller shafts, and if the accident occurs at sea it renders the vessel practically helpless, and endangers the lives of all on board. From a commercial point of view such a disaster may involve the total loss of the vessel and her cargo, or if rescued by a passing steamer, liability would be incurred for the highest salvage ever awarded by the Admiralty Court, and in addition there would be loss of earnings over a long period, and expenditure for repairs.

The practice of sending vessels of very full model on long ocean voyages in ballast, with the propeller only partially immersed, is undoubtedly one of the principal reasons for the very high mortality of propeller shafts in cargo boats.

If this practice is considered to be a commercial necessity, then provision should be made for the abnormal stresses which it imposes on the shafting, the severity of which is illustrated by the fact that the life of propeller shafts in modern cargo boats is shorter now than ever before in the history of shipping.

If these necessary precautions are taken, it is absolutely certain that this high percentage of failures, with their attendant monetary losses, will be very greatly reduced.

The four chief factors which govern the life of a propeller shaft are:

I. Material.
II. Workmanship.
III. Corrosion.
IV. Wearing down of stern bush.

Ingot steel of good quality (Fig. 1, page 265) is an excellent material for crank, thrust, and tunnel shafting, but for propeller shafts it is unpopular, chiefly on account of its liability to corrosion, and dangerous grooving when in contact with sea water. When propeller shafts are made of ingot steel, every possible precaution should therefore be taken to prevent local corrosion.

Shipyard scrap steel, if of uniform quality and free from hard brittle shearings, produces good general forgings. It is cheaper than ingot steel, but is equally susceptible to corrosion, and especially to the intense local corrosion or grooving which occurs at the ends of the brass liners on propeller shafts. A typical example of this local corrosion in a steel propeller shaft, forged from shipyard scrap, is shown in Figs. 2 and 3, page 265. This shaft was found on examination in dock to have a deep narrow groove immediately forward of the after liner within the stern tube. It was removed from the ship, and on being subjected to one blow under a steam hammer it fractured through the groove. Fig. 2 is a view with the brass liner cut back in order to show this groove A B more clearly. The depth of the groove varied from ½ in. to a maximum of 1½ in., as shown by the dark portion of Fig. 3. The reduction in effective area was such as to decrease the strength by 50 per cent. But a still further decrease in strength is due to the nature of the groove. It is well known that the easiest way to break a bar of any material is to nick it circumferentially, and then give it a sharp blow. This is exactly what occurs with a propeller shaft, as the groove being in a plane at right angles to the axis, produces a maximum weakening effect when the shaft is subjected to a sudden combination of torsional and transverse stresses, such as results from racing; and had this particular vessel done another voyage and encountered heavy weather the shaft would undoubtedly have failed. This is by no means an uncommon example, as thousands of propeller shafts have been condemned for similar reasons.

A mixture of steel scrap and iron scrap is a most dangerous and unreliable material for shafting, as it naturally produces a non-homogeneous forging, and one altogether unsuitable for withstanding severe stresses. The two dissimilar metals also set up very rapid corrosion when in contact with sea water.

There is a consensus of opinion amongst marine engineers that iron is an eminently suitable material for propeller shafts, but unfortunately it is frequently associated with the dangerous belief that the stereotyped expression of "best selected scrap iron" implies a material above suspicion. The difficulty in obtaining scrap iron is steadily increasing, the consignments usually consisting of a miscellaneous collection of every conceivable quality in varying stages of corrosion. This has to be picked over, the serviceable pieces being selected and cleaned for the manufacture of forgings. These pieces are formed into a pile and welded into a slab, the slabs being reheated and welded together to form the forging. The great danger lies in the presence of steel, which it is practically impossible to entirely eliminate, as only the closest examination can detect the difference between the two materials, and it is an undeniable fact that the presence of scrap steel amongst the scrap iron has been responsible for a great many failures of propeller shafts.

Iron, even of the best obtainable quality, does not produce such a clean-looking shaft as ingot steel, as the nature of the manufacture of iron renders it impossible to eliminate all traces of impurities, and it is for this reason that surface marks cannot be entirely avoided in iron shafts.

No portion of a ship's machinery is subjected to such a trying combination of destructive influences as the propeller shaft, which is required to withstand compound stresses of the severest character. It is, therefore, obvious that a structure of such vital importance, exposed to these conditions, and situated in an inaccessible position, should be constructed of a homogeneous and reliably uniform quality of the best and most suitable material known to engineers. Neither scrap iron nor scrap steel fulfils these requirements and a mixture of the two is disastrous.

In order to obtain greater uniformity of material shafts have occasionally been made of manufactured iron. It does not follow, however, that because a shaft is made from newly manufactured iron it is therefore of good quality. The only guarantee of

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entire length of the dock, and branches are carried through from the walls into the three pontoons through flexible joints. The valves for regulating the filling and emptying of the dock, of which there is, of course, a large number, due to the great subdivision of the pontoon, are all manipulated by means of rods and levers from central houses placed one on each wall. From this position also the engines for driving the pumps can be started or stopped at the will of the engineer in charge. The whole of the gear is so arranged that two men, one on each wall, can control all the pumping gear of the entire structure.

A word may here be said about the lengthening of the "Kaiserin Maria Theresia," which is the more interesting as simultaneously she is being converted from a single-propeller to a twin-screw boat, an operation which had not yet been attempted with so large a vessel. The steamer is being lengthened by 66 ft.; she is receiving, instead of one engine of 11,500 horse-power, two engines aggregating 16,000 horse-power, and an additional third group of boilers will be put in the new compartment added to the length of the ship. After the original ship had been parted abaft the second boiler compartment, two hydraulic cylinders of 120 tons pull at a pressure of 1550 lb. to the square inch moved forward the fore part of the vessel without any trouble, although the weight was 2875 tons.

There are two floating sheerlegs, one of which is well shown by the engraving on page 300. These are utilised for lifting heavy loads, machinery, &c., into the vessels when they are being fitted out. They are always convenient for use, for it will be remembered that there is no tide in the Oder. The great advantage is that when two or more vessels are being fitted out simultaneously, as is now frequently the case at the Vulcan Works, it is not necessary to move one ship from the sheerlegs and another to the sheerlegs, as is the case where their position is fixed. The floating sheerlegs can be moved with their load to their respective vessels. They are moved by the main engine with capstans which wind cables lying in the bed of the river, as with floating bridges, the radius of action being limited to the berths where ships are always completed. The chief dimensions of the cranes are summarised in the subjoined Table:

—	Large Sheerlegs.	Small Sheerlegs.
Front pontoon, length	28.25 m. (92 ft. 8 in.)	28.00 m. (91 ft. 10 in.)
,, ,, width	11.00 m. (36 ft.)	9.00 m. (29 ft. 6 in.)
,, ,, depth	2.75 m. (9 ft.)	2.40 m. (7 ft. 11 in.)
Back pontoon, length	22.60 m. (74 ft.)	20.00 m. (65 ft. 7 in.)
,, ,, width	9.00 m. (29.5 ft.)	6.00 m. (19 ft. 8 in.)
,, ,, depth .. .	2.50 m. (8 ft. 3 in.)	2.00 m. (6 ft. 7 in.)
Distance between centre of pontoons	10.00 m. (32 ft. 10 in.)	7.50 m. (24 ft. 6 in.)
Length of sheerlegs	43.56 m. (143 ft. 7 in.)	35.20 m. (115 ft. 6 in.)
Overhang of sheers	14.40 m. (47 ft. 5 in.)	10.00 m. (32 ft. 10 in.)
Maximum load..	100 tons	50 tons

Each of the two cranes consists of a large front pontoon and a small rear pontoon; the two are connected by two strong systems of girders. The front pontoons support the crane legs which rest in strong cast toe-pieces clearly shown in the engraving. At the top the two legs are connected by a strong cross-beam from which is suspended the lifting tackle. The usual back leg has for substitute two strong steel wire ropes fastened at the one end to the front legs, and at the back to the horizontal girders connecting the two pontoons. The movement of the two pontoons from each other, or towards each other, effected by cable and capstan operated from the main engine, increases or decreases the overhang of the sheerlegs and of the load. There are three lifting gears in the larger sheers for 100 tons, 20 tons, and 5 tons, and two gears on the smaller crane for 50 and 16 tons. The winding engines for the crane chains are on the decks of the large pontoons, the small pontoons take ballast only.

In winter the two sheerlegs work together with a steamer, which belongs to the yard. It is 88 ft. in length and 18 ft. 5 in. beam, and is fitted up as an ice-breaker, so that the operations are continued without interruption at all seasons.

This steamer is further constructed as a railway ferry boat, plying between the shipbuilding yard and the goods station of Stettin. On the deck of the steamer there is a track with a carrying capacity of three laden coal wagons or a locomotive and tender—a load of 50 tons. The railway at the station and in the yard runs on to a quay with a portable gangway to meet the slight variations in the water level, so that trucks may be warped on and off the deck of the steamer. The plan on page 285 will show where these trucks are run into the yard from the steamer.

(*To be continued.*)

MESSRS. SCHNEIDER AND CO.'S WORKS AT CREUSOT.—No. LXVII.

TORPEDO-LAUNCHING TUBES—(*concluded*).

Tubes with Spherical Joint for Destroyers.—Tubes for this type have been supplied to the Japanese Navy, and as is the case with the preceding type, the whole of the system is movable on deck; the angle of elevation is 8 deg. and the training range 33 deg. on each side. The tube is generally similar to the preceding one and contains the same kind of fittings. It differs, however, in the spherical shape given to the part in the rear of the spoon-shaped extension, and which fits in a seating provided in the sides of the ship. The spoon is fitted to the tube by a bayonet joint. The system is so arranged that the tube can be moved as required for obtaining the desired angles of elevation and training. The mounting consists mainly of a rear support on rollers provided with the elevating mechanism; in front the tube is carried on a horizontal axle on two rollers which, when the spherical part is in its seating, can be raised so that the tube is only carried by the seating in the side of the ship and the rear rollers, in which position it is given the desired training. This type is not shifted as easily as the preceding one and is better suited for service on ships, in the armament of which several launching tubes are provided.

Spherical Jointed Tubes with Elevating and Training Mechanism for Destroyers.—This pattern differs from the preceding one in the addition of mechanical gearing for training. The front truck is connected to the rear roller-frame by a jointed stay. The system contains two tension rollers placed at the end of the rear racer; a vertical grooved pulley in the rear of the frame, with guide rollers; a flexible cable that surrounds the rollers and pulley, and enables the mounting to be drawn to one side or the other, according to the way the grooved pulley is made to turn. The pulley is worked by a transmission comprising a helicoidal wheel and an endless screw on the axle of a toothed wheel. This wheel is set in motion by a plate chain worked by a similar wheel, the centre of which is on the right-hand circular arm. A hand-crank completes the system. The other manœuvres are executed, as is the case for the preceding pattern.

Tubes for the Armament of Cruisers, with Elevating and Training Mechanism.—Tubes of this type have been built in large numbers, and, among other ships, for the Brazilian cruiser Almirante Tamandare. The tube proper contains the arrangements previously described; it is provided with a spoon-shaped guide, fixed with a bayonet joint, but without a hinge. The mounting is muzzle-pivoting, and consists of a horizontal frame, formed in its central part of an I-bar, in the rear of which oscillate the two jointed circular arms which serve as bearings for obtaining the required elevation, in the manner already described for preceding types. On the right arm is a winch for training the tube, with a crank, which allows the displacing of the system by acting on a flexible cable rolled round a series of rollers and on a toothed wheel; the two ends of this cable are fixed to the deck. At each angle of the frame are the rollers, the rear ones being provided with clutches made to clasp the edge of the rear racer fixed to the deck. In front, the tube rests on the frame with the interposition of a horizontal joint which allows the required vertical displacements for obtaining the desired elevation. Moreover, the front end of the frame is made with a lug which may be connected through a jointed bar to a vertical pivot fitted to the bulwark of the ship. A suitable opening is cut in the bulwark, to give free space to the spoon-shaped extension in the various positions it is made to take.

Special Elevating Mechanism (Fig. 615, page 288).—In certain cases the Schneider-Canet tubes rest at the rear, on an elevating screw similar to that used with some types of field gun carriages. This does away with the two oscillating arms which form part of the tube mountings already described. The whole of the system is thus much simplified.

The cross-piece which forms the body of the rear support, and which rests at its two ends on the rollers, is provided at its centre with a nut that can turn in its socket under the action of a handwheel. In the nut fits the elevating screw, the head of which is jointed in a lug provided at the lower part of the tube; the screw is raised or lowered by acting on the handwheel. During firing, the mounting is held firm by means of tackle fixed to eye-bolts fitted in the bulwarks. The rollers serve to set the tube in the required direction; they can be turned in such a manner as to draw the tube on deck when not required for service. The desired training is obtained by moving the tube itself.

Tubes on Double Mountings with Elevating and Training Gear for Torpedo-Boat Armament (Figs. 616 and 617, page 290).—These figures show twin tubes on a double, muzzle-pivoting mounting. The tubes have spoon-shaped extensions and are arranged for firing forward. The mounting consists of a rear support which forms the circular rack of the training mechanism, and which carries the elevating mechanism. The support is joined to the front pivot by a stiff bar. The lower surface of the rack rests on the fixed circular racer bolted on deck and slides on it during lateral training, no rollers being used in this type of mounting. The front pivot consists of a vertical cylinder hinged on the bottom part of the tube and resting in a socket carried by a foot plate bolted on deck. The tubes are elevated by a mechanism worked by a crank placed on the left-hand side, and containing the gear already described, namely, a screw the head of which is hinged on a horizontal cross-bar that joins the two tubes in the rear; a nut through which passes the screw, made to turn freely and to oscillate, when necessary, round a horizontal axle on the rear of the frame; on the outside surface of the nut is cut a conical pinion made to gear in a bevel-wheel keyed on the horizontal shaft of the elevating handwheel. The required lateral training can be insured by gear set in motion from the inside of the ship. It consists of the rack which carries the whole of the elevating gear, and which rests on the fixed circular racer, suitable clutches holding these two pieces together, and a vertical bar that goes through the deck and is fitted at the top with a pinion which gears in the rack. This rod in turning communicates to the system the required action.

Tubes for Firing with Powder Charge or Compressed Air (Fig. 618).—Fig. 618, reproduced from a photograph, shows a deck tube, with elevating mechanism, training device, and spherical joint, generally similar to those previously described. It is characterised, however, in that compressed air or gunpowder can be used at will for launching the torpedoes. To this effect a compressed air reservoir is provided at the lower part of the tube and follows it in all its actions. A bent tube of large diameter unites the reservoir to the rear end of the tube. A valve with which the tube is provided governs the admission of air in the tube.

Tubes Carried under Deck Beams.—These tubes are required in some cases owing to the design followed in the construction of the ship; they are characterised by the special shape of their supporting gear. They are carried by the upper deck beams, leaving entirely free the firing quarters. The tubes are generally similar to those previously described.

Jointed Tube, with Spoon-Shaped Guide, and Training and Elevating Mechanisms (Fig. 619, page 289).—Fig. 619 shows a side elevation and section of a tube of this type. The tube frame is hinged to a vertical pivot which forms part of the spherical joint support, the axis of the support corresponding with the centre of the joint. The frame rests at the rear on a truck made to turn round a circular track fitted under the deck beams. The tube, when in firing position, is carried in front in a spherical socket, and is provided with a spoon-shaped guide. In the rear it bears on the head of an elevating screw, two lugs being made to move in two circular grooves cut in the lateral vertical supports of the screw; the centre of the grooves corresponds with that of the spherical joint. Lateral training is obtained by the action

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SCHNEIDER-CANET TORPEDO-LAUNCHING TUBES.

(*For Description, see Page* 287.)

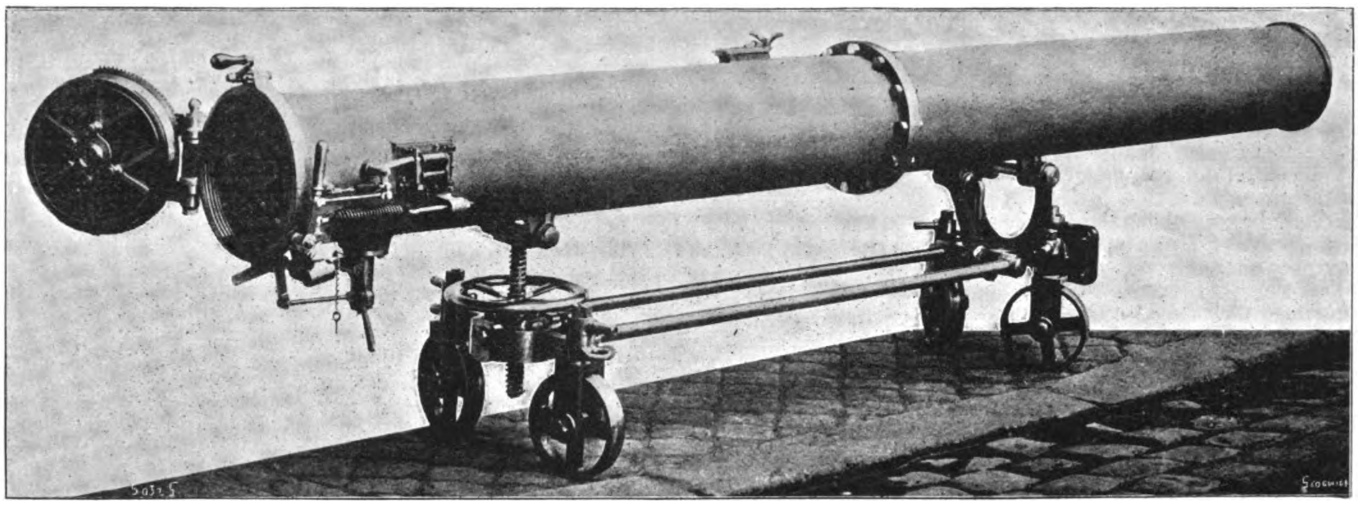

Fig. 615. Deck Torpedo Tube with Screw Elevating Gear.

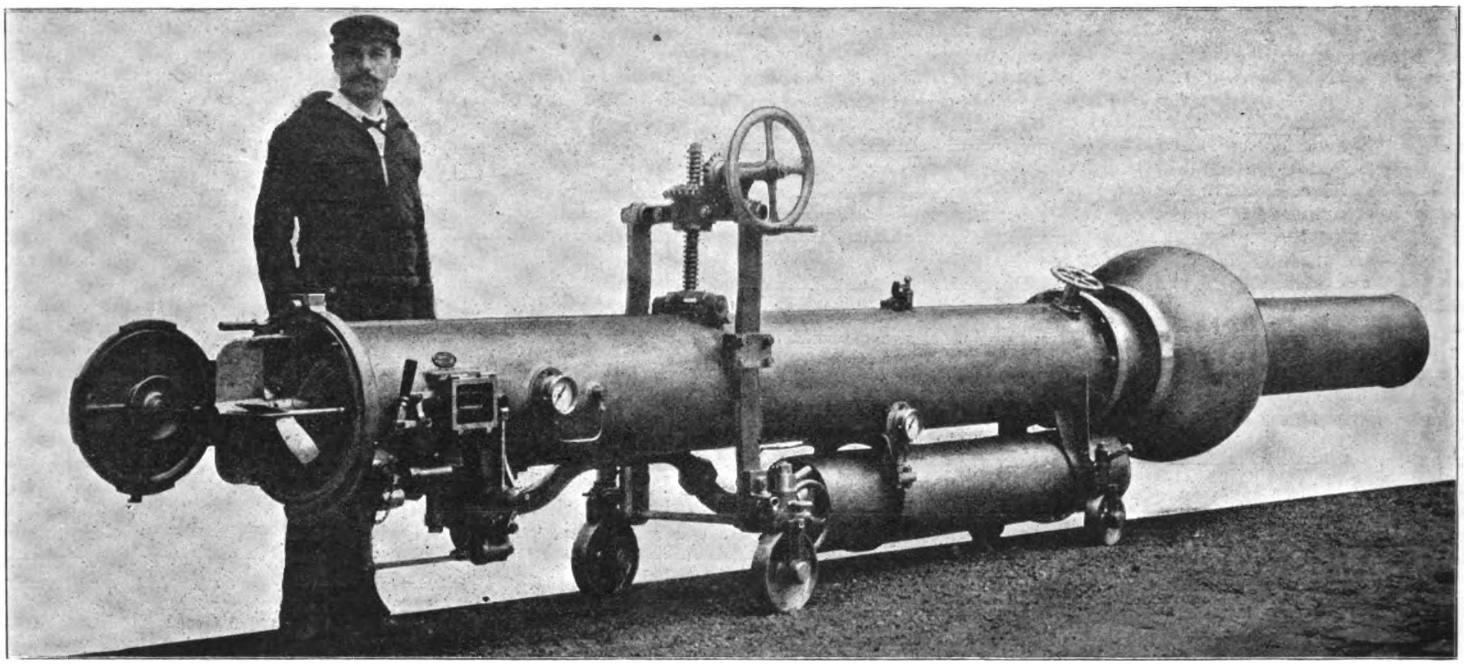

Fig. 618. Torpedo Tube for Firing with Compressed Air or Powder.

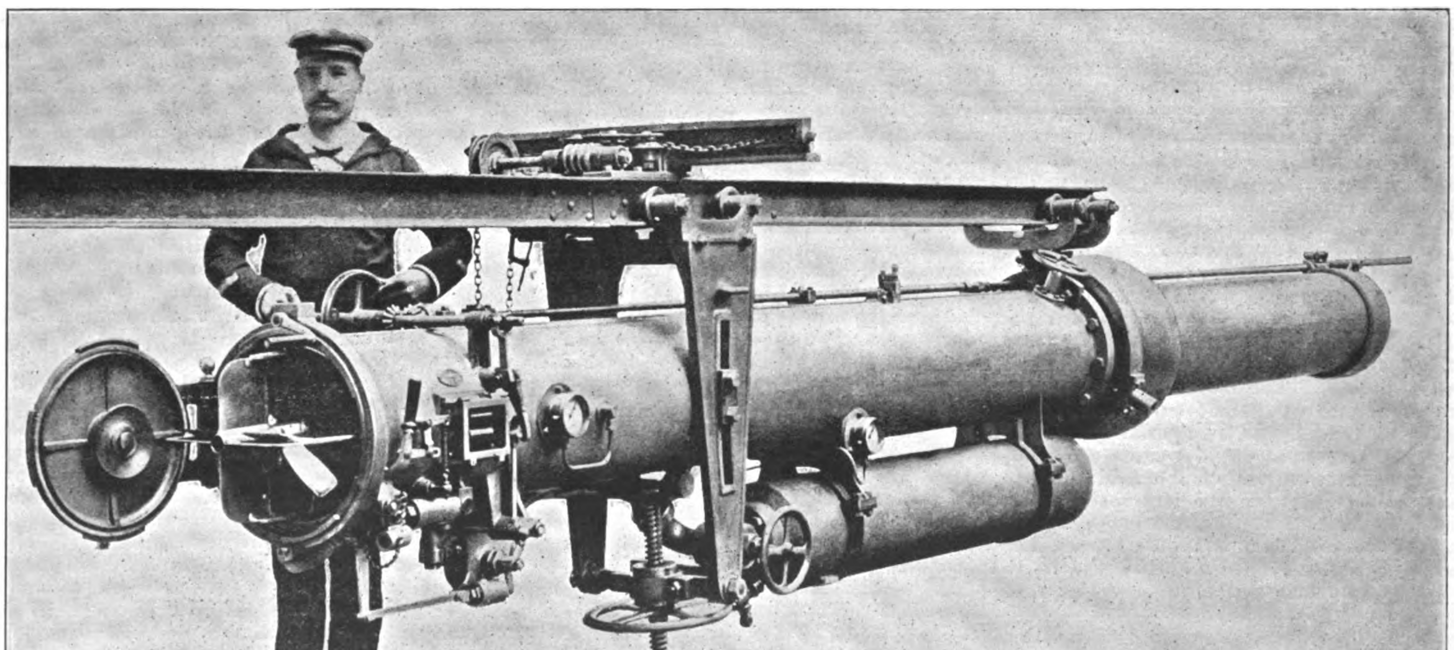

Fig. 620. Torpedo Tube with Overhead Suspension.

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SCHNEIDER-CANET TORPEDO-LAUNCHING TUBES.

Fig. 619.

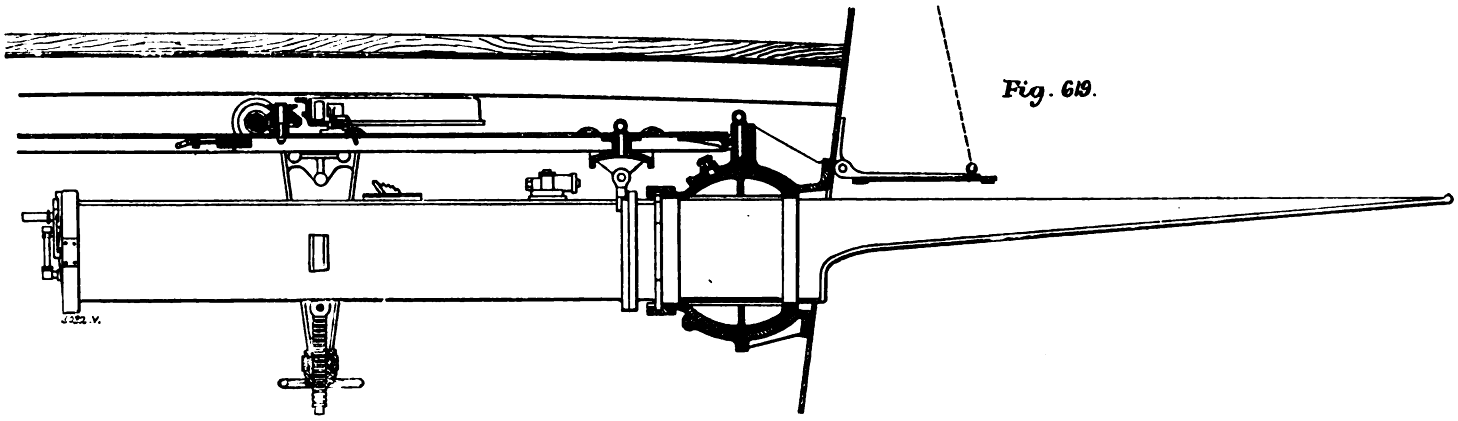
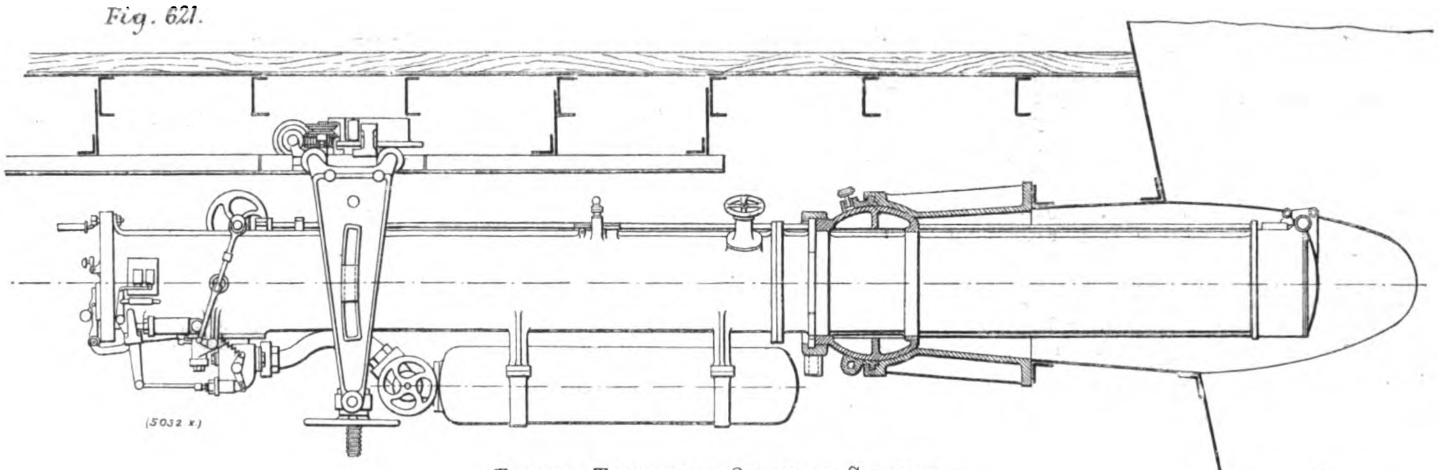


Fig. 621.



TORPEDO TUBES WITH OVERHEAD SUSPENSION.

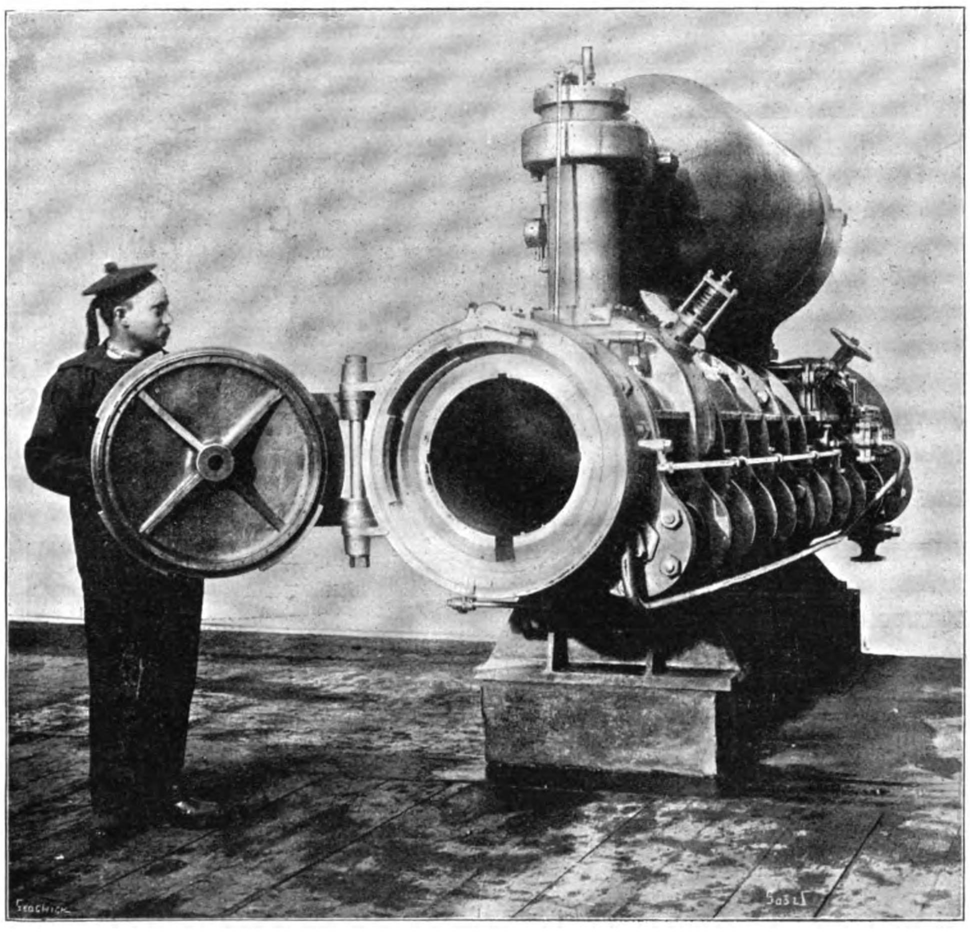


FIG. 623. TORPEDO TUBE FOR FIRING BELOW WATER LINE.

of a winch mounted on a roller truck that rests on the rear of the frame. The tube can be drawn in through a special truck, mounted on the U-section bar, on which it is carried by four rollers. This truck is joined to the tube at a point slightly in the rear of its spherical swell; this swell can be made to leave its socket and the whole system drawn back and the port closed by a cover.

Tube with Spherical Bearing, for Compressed Air and Gunpowder Discharge.—The tube shown in Figs. 620 and 621 is in two parts bolted together. The front part is made with the spherical bearing which fits in the bulwarks of the ship. The rear part carries the breech-closing cover, the powder chamber, the firing, and safety devices. The front closing cover is worked by a rod placed on the top centre line of the tube and a handwheel. The compressed air chamber is bolted to flanges cast in one piece with the tube. A bent pipe joins this chamber to the rear of the tube; the pipe is provided with a valve which is connected with the launching mechanism in such a manner that the compressed air cannot be delivered in the tube, unless the breech-closing cover be completely locked and the front cover open. Two pressure gauges mark the air pressure in the chamber and in the tube. The electric disengaging mechanism for percussion firing is fitted in the usual place; the firing device can also be worked by hand. The whole of the system is carried on a mounting suspended under the deck beams, generally as described for preceding patterns. It can be drawn in during navigation of the ship. Fig. 620 shows the arrangement, the breech-cover open and a torpedo in the tube.

Schneider-Canet Tube, with Intermediate Expansion Chest.—In closing this brief review of the Schneider-Canet tubes for launching torpedoes above the water line, we may give a description of a special arrangement, with expansion chest, adapted for certain particular cases. Fig. 622, page 290, shows the arrangement in question, the advantages of which are the following:

(*a*) It enables quick ignition powders to be used, without damage to the torpedo-propelling mechanism.

(*b*) It allows the production in advance, when necessary and with the use of explosives, of the compressed fluid required, which is introduced in the tube only at the instant of firing.

(*c*) It combines all the advantages that result from the use of compressed air and powder charges.

To obtain this result and to enable the gases to expand fully, the powder charge is ignited in an auxiliary receiver of suitable volume fixed to flanges cast in one piece with the tube. One end of the receiver is closed by a screwed plug which is movable for introducing the powder charge. The firing device is one of the types previously described; the receiver and the tube are in communication with each other through a pipe provided with a loaded valve. The valve is raised by the

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action of the gases which enter the tube as soon as they have reached the required pressure; it may also be raised by hand by means of a lever. In some cases the valve is replaced by a conical tap, which is turned when launching is to take place. This system does away with all piping and air compressors, and facilitates the firing with powder even when the tubes are normally filled with water.

Schneider-Canet Submarine Torpedo-Launching Tubes.—Recent naval engagements have demonstrated the very grave danger that exists for ships of large dimensions in placing torpedo-launching tubes on the upper decks, where they are liable to be hit by the enemy. The experience gained in this respect has led, for ships of recent construction, to placing the tubes below the water line. The problem of launching torpedoes below the water line is, however, surrounded by many great difficulties and renders the use of special apparatus necessary, owing to the very great lateral efforts the torpedo has to withstand when it emerges from the ship's side. Ordinary torpedo-launching tubes might be manufactured at the present time by almost any works that own a suitable plant, but such is not the case with submarine tubes. The analysis of the phenomena which appear at the launching of tubes below the water line is particularly difficult, and the experiments which are necessary in this respect, are costly, and demand quite a special plant. The number of tubes of this type in service at the present day is therefore very limited.

The patterns covered by the Schneider-Canet patents are interesting both as regards their characteristics and the good results they have given from the outset. Messrs. Schneider and Co. have already executed important orders for tubes of this type, chiefly for the French Navy; they have, therefore, acquired a large experience in this speciality.

Schneider-Canet Submarine Tube with Concentric Guide.—This is characterised by the shape given the spoon guide, which is made concentric with the tube; the arrangement allows a favourable division of the strains which the guide has to withstand during the various phases of the launching. The tube proper, or shell, is of gun-metal, made in four parts placed end to end and stiffened by ribs; the rear end carries the closing cover, with its mechanism. On the side of the intermediate rings is fixed a cylinder screwed in a strong socket. There is a cover for opening and closing the tube in front, worked mechanically, and kept watertight, preventing water from entering the tube so long as the breech cover is not closed.

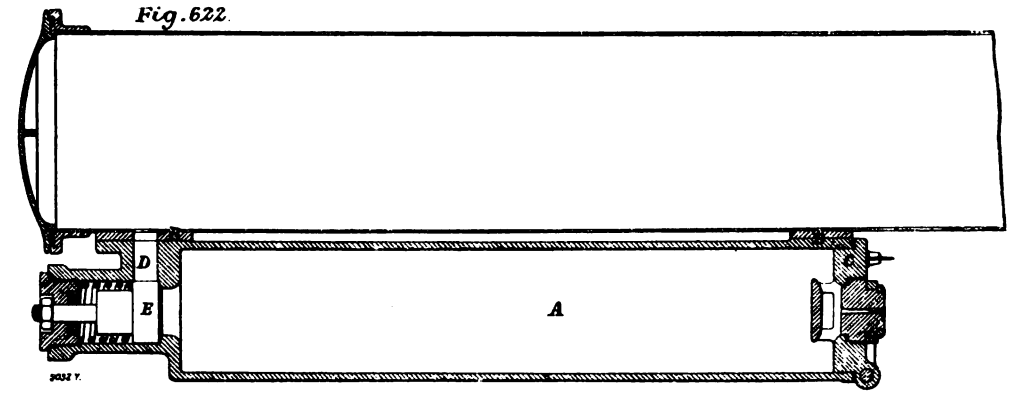
The tube is fitted with the following external fittings:

through a semi-cylindrical cast-iron envelope, jointed to the tube by two flat surfaces strengthened by ribs. This envelope covers a longitudinal slit for the passage of the socket which is cast with the spoon-shaped extension, and on which is fitted the piston-rod which insures its action.

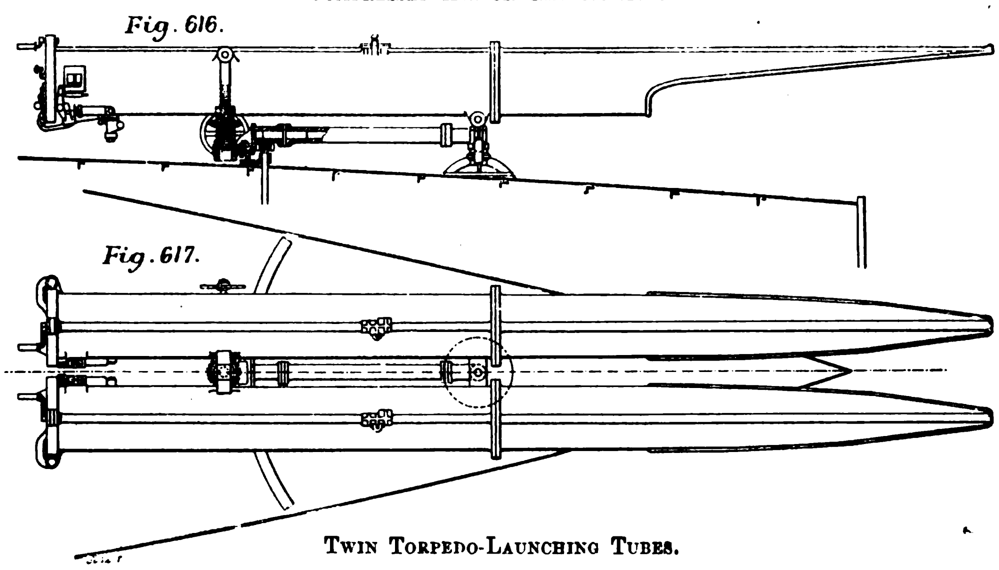
The guide consists of a tube partly cut out in front and forming practically a solid cylinder of equal resistance throughout. It is worked by a piston which travels in the cylinder fixed to the side of the tube. Water under pressure can be directed in front or in the rear of the piston by means of the slide above referred to. The guide

manner that the above operations follow each other automatically. In this case the launching of the torpedo is effected by simply acting on a suitably designed lever. The necessary water under pressure for working the guide, can be supplied by a special pump or by accumulators, in which compressed air supplied by the torpedo compressors, is allowed to expand. The air which serves to launch the torpedoes, is held in a reservoir placed at the top part of the tube, and provided in the rear with a bent pipe which extends to the rear of the tube.

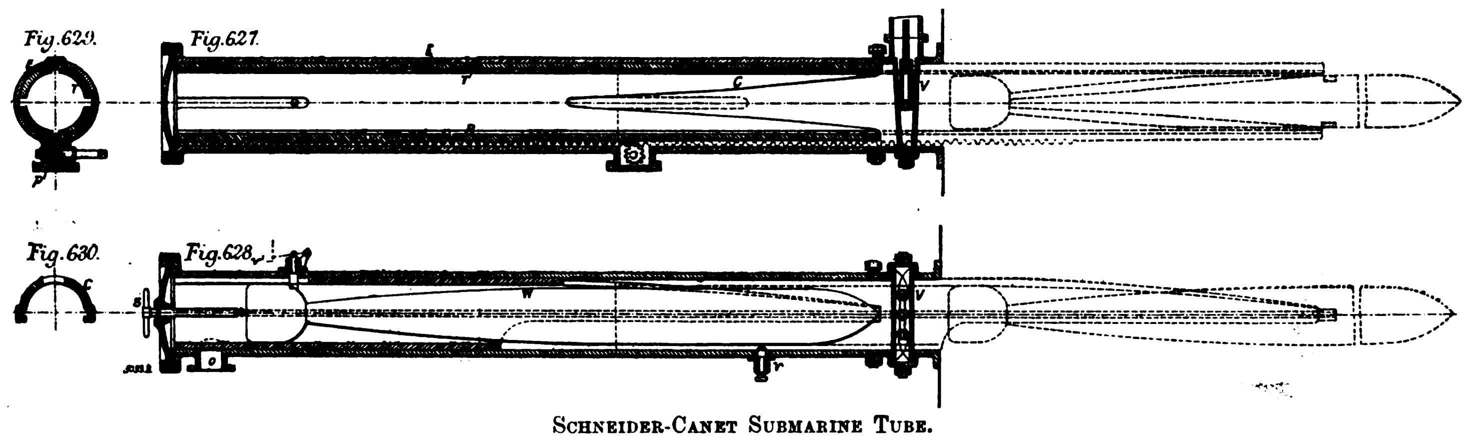
Fig. 625 shows one of these tubes erected in the works. The complete installation contains a large



Compressed Air or Gas Chamber.



Twin Torpedo-Launching Tubes.



Schneider-Canet Submarine Tube.

The latch for holding the torpedo fast.

The launching valve.

The cam casing and a casing for inspecting the valves.

The stop-latch of the spoon-shaped guide and its safety rod, in two pieces, one extending as far as the cam casing and the other, starting from there, reaching the end of the tube.

The finger for opening the air valve connected with the safety rod.

The indicator for the placing of the spoon-shaped guide.

The slide that works the spoon-shaped guide, the mechanism of which is joined to that of the valve and indicator.

An exhaust valve.

The cylinder fixed to the side of the intermediate rings is extended in front and on the valve, fits in the tube over a sufficient length to withstand the considerable pressure of water when the vessel travels at a high speed. Two grooves are cut inside the tube and at the two ends of the vertical diameter in which fit the torpedo guides.

When a torpedo is placed in the tube and the breech-cover is closed, the valve is opened by acting on the working lever; the guide is placed in its position by introducing water under pressure in the cylinder in the rear of the piston. When the torpedo is launched, these operations are repeated inversely and the valve closed. Safety devices are provided for preventing the opening of the valve as long as the breech cover is not closed, and for stopping all forward motion of the guide as long as the valve is not completely closed, and to prevent launching the torpedo until the guide is in place. The tube is made in such a

number of special piping and fittings, the principal ones only having been referred to.

Schneider-Canet Submarine Tube, with Mechanical Working Guide (Figs. 627 to 630). — In this pattern the guide is worked mechanically, no hydraulic machinery being resorted to. When the ship is being navigated the tube contains the guide; this is provided with two grooves, which are extended in the thickness of the tube walls and serve as slides for the tenons on the torpedo. The spoon-shaped extension is provided at its lower part with a rack in which a pinion engages worked either by hand or mechanically, the pinion being placed in a recess on the tube. The principal fittings are the following: The front closing valve V, the breech-covers, two automatic working latches, one to limit the forward travel of the tube, the other holding the torpedo in the

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tube when it has been placed ready for firing; the torpedo is held besides by a screwed plug that goes through the breech-cover. The mechanism is the same as that of the preceding pattern.

When the torpedo is in place in the tube, and the breech-door closed, as soon as the valve V is opened, water enters the tube. The extension guide is then released to the limit of its travel, by turning the pinion which gears in its rack. When the accumulator is connected with the rear of the tube, the latch that holds the torpedo is disengaged automatically, and the torpedo is driven forward. When the torpedo is launched the extension guide is brought back in the tube, the front valve is closed, and the tube is emptied, ready for another operation.

THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

(FROM OUR NEW YORK CORRESPONDENT.)

(*Concluded from page* 231.)

A SERIES of questions proposed for discussion was the following:

(*a*) Should stream contamination by the sewage of cities be absolutely prohibited by law?
(*b*) Should the purification of the sewage of cities be compulsory; and is this feasible for large cities?
(*c*) Is filtration the coming solution of the pure water question for cities?
(*d*) What is the proper friction coefficient for use in the design of riveted steel pipe?

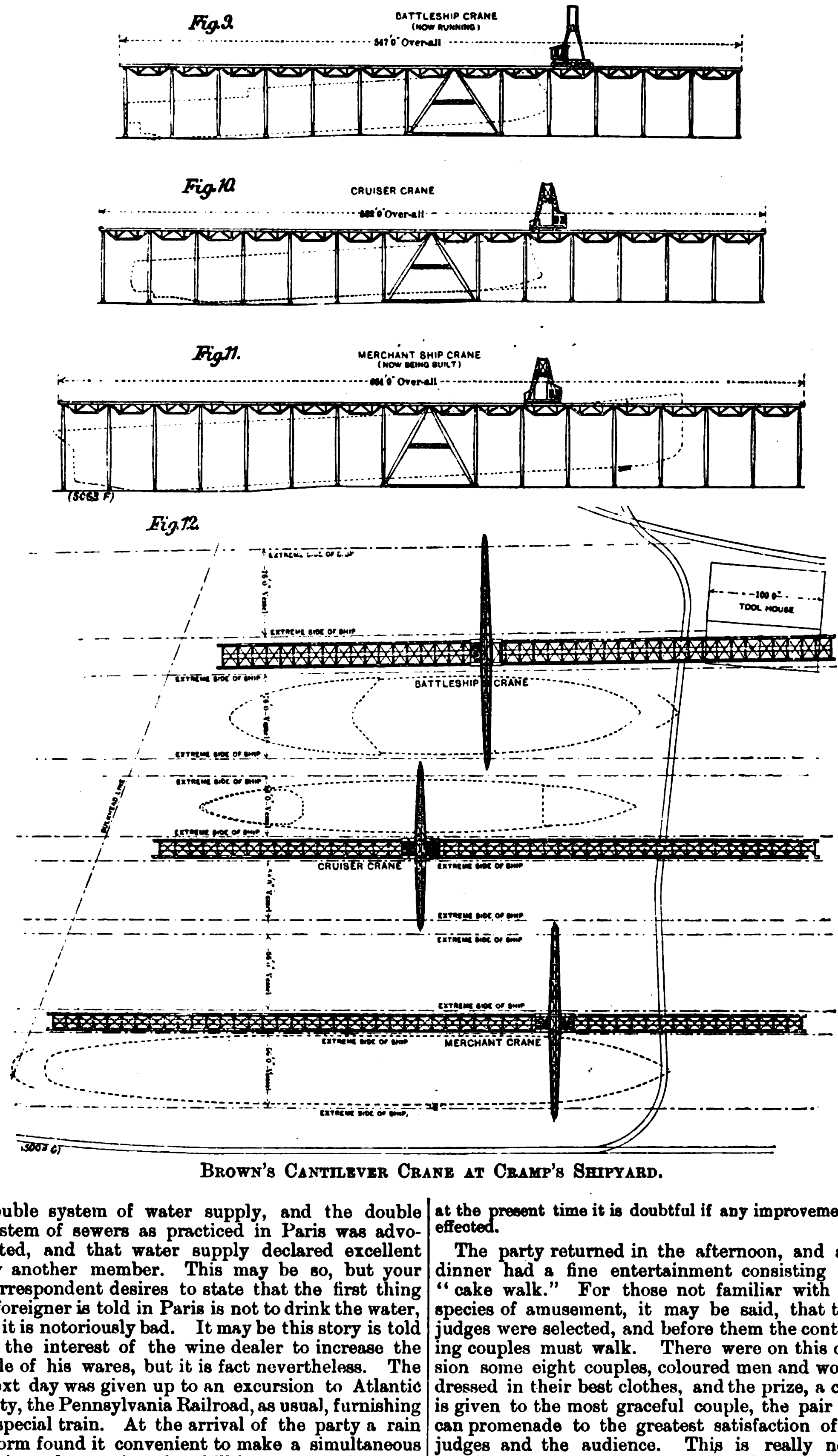
The first two topics were discussed by Mr. R. E. M'Math, who advocated very forcibly in the affirmative. He took the ground no one had any right to injure another, and incidentally he proceeded to cite the case of the Chicago Drainage Canal as a flagrant outrage. This canal, it may be said, turns the sewage of Chicago into the Illinois River. Mr. McMath was forcible and eloquent. He said the originator of this plan could not be found, no one would claim it, and scarcely anyone would defend it. He characterised any system of sewerage which did not provide for an innocuous disposal of sewage unworthy of the name. He cited Berlin and Paris as evidence that it could be done on a large scale, and declared that "we were the men to do it." As to filtration, while he commended it for polluted water, he preferred having the water pure at the start. Mr. W. C. Parmly, of Cleveland, thought streams of absolute purity were impossible in any thickly settled community. If a stream did not give off effluvia or offensive gas, he would permit its use, but would rigidly exclude all sewage or pollution. He also favoured the turning of the storm overflows from a combined sewer system into running streams as really preservative of the purity of streams, since the first washings, which were the foulest, went into the sewers. If this is not done, it is necessary to have either a separate system of sewerage, with all the street washings going into the streams, or else to construct storm-water sewers at an enormous expense owing to the size. He cited the case of Cleveland, where such construction would have added 250,000 dols. to the cost. Professor G. S. Williams, of Cornell University, advanced the proposition that all flowing waters would be used at some time for potable purposes. In that connection he made the following statement: It appeared that, in 1892, Detroit, which usually has a very low typhoid rate, found it had increased to such an extent that only four American cities exceeded it. After some examination the cause was traced, and this was the explanation:

During the previous fall the city of Port Huron, 66 miles north of Detroit, had considerable typhoid. The sewers of Port Huron discharged into Black River, a sluggish stream with very little flow. In the spring of 1892, work was begun by the Government upon the dredging of Black River to improve it for navigation and deposits of foul material from the years' accumulation of sewage in the stagnant reaches, were removed by dredging, some of these deposits being 8 ft. to 12 ft. in depth. This material was taken away in scows and dumped in the swift current of the St. Clair River. Allowing for the time necessary for the water thus polluted to reach Detroit and for the period of incubation of the typhoid germ, the course of the fever in Detroit exactly coincided with the dredging of the polluted material and its deposit in the river 60 miles above. Bearing in mind the great volume of the Detroit River, the purity of its waters in their ordinary condition, and the fact that Lake St. Clair, with its wide area and low velocity of flow, lies between the two cities, this case of typhoid infection through water supply, ranks as one of the most remarkable on record.

The secretary of the rican Water Works Association advocated an appeal to Congress, as State legislation was inoperative. Another member of the Society from Baltimore cited the Report of the River Pollution Commissioners of Great Britain as the best authority regarding how much sewage could be discharged into living waters. He thought each case should be considered by itself, otherwise the altered conditions in one might work hardship in another if there was uniform legislation. He expressed hope that the septic tank system might solve the difficulty. Mr. James Owen thought the question was too broadly stated on the programme. Cities on tidal waters necessarily discharged their sewage into salt water, and no harm resulted if the dilution is sufficient. The double system of water supply, and the double system of sewers as practiced in Paris was advocated, and that water supply declared excellent by another member. This may be so, but your correspondent desires to state that the first thing a foreigner is told in Paris is not to drink the water, as it is notoriously bad. It may be this story is told in the interest of the wine dealer to increase the sale of his wares, but it is fact nevertheless. The next day was given up to an excursion to Atlantic City, the Pennsylvania Railroad, as usual, furnishing a special train. At the arrival of the party a rain storm found it convenient to make a simultaneous visit, and as engineering skill has not found, as yet, any way to make or to prevent rain, the visitors were a little circumscribed in their field of action. The new recreation pier, built of steel, was visited and admired, while others went to see and to smell the sewage-disposal plant which is owned by the company that controls the local sewer system. The permanent population of Atlantic City is about 15,000, but when it gets hot, and Philadelphia gets warmed up—it takes about 110 deg. to do this—then the number of inhabitants may run to 200,000, on a Sunday especially. This plant was described by that eminent engineer, Mr. George W. Rafter, thus:

The purification plant in use consists, in effect, of an elevated bed in which sand with hay below is used as a separating material, and from which the effluent falls in small streams about 3 ft. to gathering gutters leading to the effluent pipe. The results obtained are extremely unsatisfactory. Indeed, with the large quantity treated at the present time it is doubtful if any improvement is effected.

The party returned in the afternoon, and after dinner had a fine entertainment consisting of a "cake walk." For those not familiar with this species of amusement, it may be said, that three judges were selected, and before them the contending couples must walk. There were on this occasion some eight couples, coloured men and women dressed in their best clothes, and the prize, a cake, is given to the most graceful couple, the pair who can promenade to the greatest satisfaction of the judges and the audience. This is really not a "walk" at all, and is a relic of the plantation days of slavery. It was then to be seen in its full perfection, and was a frequent source of amusement to the Northern soldiers during the Civil War. On the present occasion several hundred visitors



BROWN'S CANTILEVER CRANE AT CRAMP'S SHIPYARD.

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