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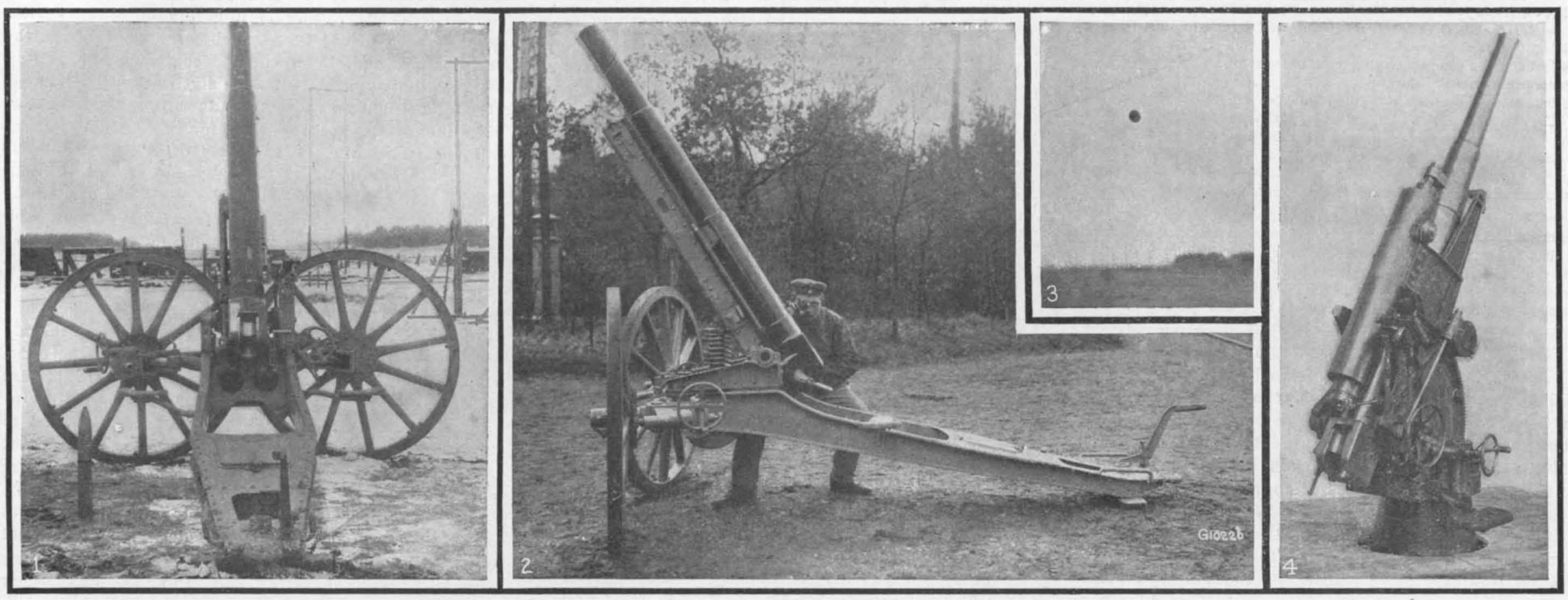

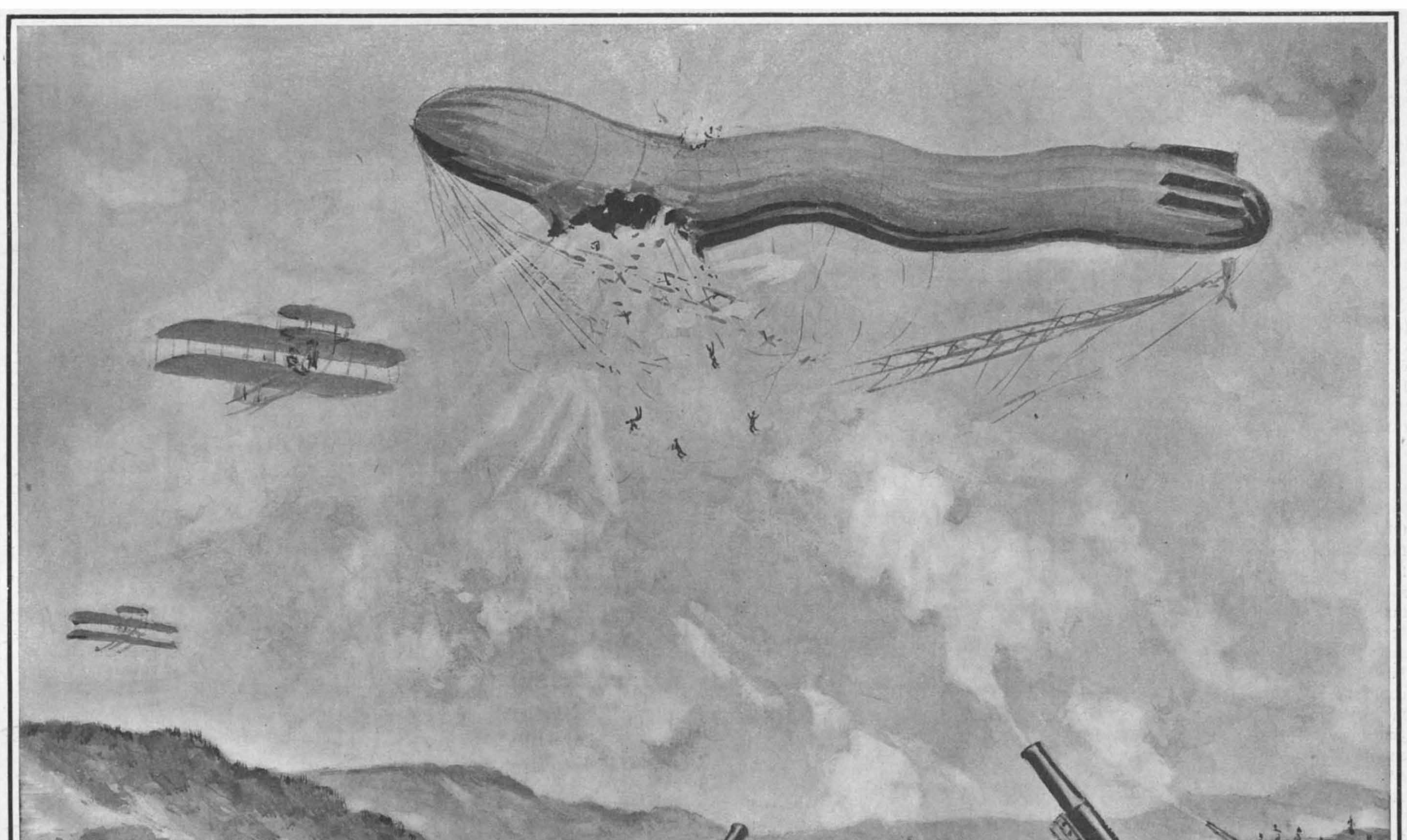

1. Nine-pounder gun in battery. It fires a smoking shell. 2. Gun carriage may be swung in complete circle around a pin at end of tail. 3. Flight of shell marked by streak of smoke. 4. Twelve-pounder for ships and fortifications. 5. Meeting aerial attack with high-angle rapid-fire guns, firing shells of special design.

THE USE OF AERIAL ARTILLERY IN WARFARE.—[See page 262.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

LIEUT. SHACKLETON'S ANTARCTIC EXPEDITION.

Lieut. Shackleton's feat in reaching latitude 88 deg. 23 min., only 111 miles from the South Pole, marks a new and remarkable record in polar exploration, not only because it outdoes Capt. Scott's achievement, but also because it surpasses even Commander Peary's Arctic record for closeness of approach to a geographical pole.

When Lieut. Shackleton sailed from England in July, 1907, success seemed possible. No similar expedition was ever more elaborately fitted out. Shackleton had accompanied Capt. Scott in 1902 on an expedition which reached latitude 82 deg. 17 min, and which brought back such details of the Great Ice Barrier as to warrant the belief that the South Pole might be reached by over-ice travel. Therefore he had a more or less intimate acquaintance with the scene of operations. Even though the temperature at one time fell to 88 deg. F. below freezing, he was favored by an exceptionally mild winter.

Profiting by experience, he took with him fifteen hardy Manchurian ponies and twelve Esquimau dogs, together with a motor sled, the first mechanically driven vehicle ever employed in polar exploration. Only by rapid means of locomotion was there any hope of covering the 463 miles that separated the pole from Scott's farthest south. The partial substitution of ponies for dogs resulted in a reduction of the food consumption, and accordingly fulfilled Shackleton's expectations. The motor sled seems not to have realized whatever hopes it may have engendered; for Shackleton states in his dispatch that it could not cope with the huge upheavals produced by the grinding pack of the Great Barrier, although it covered more than 400 miles and proved serviceable enough in laying depots on the ice.

It can hardly be expected that the expedition contributed much to our store of biological knowledge, for the simple reason that in the very heart of the frigid zone there is but little life. Dr. Wilson, the zoologist of the Scott expedition, found a few sea mammals within the Antarctic Circle. Along the Great Ice Barrier a few birds were seen. Penguins and gulls all but shared the Scott winter quarters at Mount Erebus. But in the dreary interior Wilson could report no life, with the exception of a few mosses and lichens and a wingless fly. If Scott's expedition found only these few evidences of life, it is safe to prophesy that the zoologist who accompanied Lieut. Shackleton can add nothing to Dr. Wilson's report.

Much, however, has been contributed to our geographical knowledge of the Antarctic region. All told Shackleton covered 1,708 statute miles. As a result of his intrepidity our atlases will henceforth appear with firmer outlines of Antarctic continents and islands and with more definite locations of plains and peaks. Shackleton passed the very point reached by Scott in 1903, pushed on for 325 miles, and was eventually compelled to turn back by hunger, fatigue, scurvy, and the loss of his dogs and ponies when he had reached a point distant from the Pole not much more than New York from Philadelphia. It seems unfortunate that with another month of favorable weather before him his hardships were such that he could not push on to the Pole itself. In all probability he might have seen the locality of the Pole from a mountain top on a clear day. He discovered eight new and distinct mountain ranges and more than a hundred mountains. Of great scientific importance was his daring ascent of Mount Erebus, the most southerly of volcanoes, towering 13,120 feet above the sea level and ejecting vast volumes of steam and sulphurous gas in the midst of perpetual ice and snow. The south magnetic pole was reached in lat. 72 deg. 25 min.

Even a cursory reading of Lieut. Shackleton's dispatch must convince one that there is no ground for believing in the existence of that region of atmospheric calm in the vicinity of the Pole which meteorologists have long supposed to exist. Time and time again blinding storms were encountered which raged for days and which completely blocked the progress of the adventurous explorers.

It is inevitable that comparisons should be drawn between Commander Peary's exploit in reaching north lat. 87 deg. 6 min. and Lieut. Shackleton's achievement in planting his country's flag in south lat. 88 deg. 23 min. The topography of the North and South Poles is radically different. For every mile that he crept along the shore of Grant Land, Peary was obliged to travel five or six miles. The South Pole is more continental in character and offers so stable a footing that it could be traversed almost in a straight line, were it not for crevasses, drifts, and gigantic masses of ice and snow. It is therefore difficult, if not impossible, to draw anything like an accurate comparison of the difficulties encountered by the two explorers.

TO TEST FULL-SIZED COMPRESSION MEMBERS.

The fall of the Quebec Bridge, as the result of the crumpling up of one of its main compression members, proved the necessity for testing compression members of the largest size in a machine built for that purpose, in order to determine the correctness, or otherwise, of the formulæ by which the strength of such members is computed. It was realized that a formula which gave reliable results in the smaller sizes might give false results when the structure reached the huge size of the Quebec Bridge members. Many years ago a series of tests was made, which generally confirmed the prevailing theories of that day as to the strength of built-up columns; but because of the limited size of the testing machine, the largest specimens tested were small in comparison with the members which enter into our modern steel structures.

When the Quebec Bridge failed, there was a general call on the part of the technical journals and technical societies for the construction of a testing machine capable of handling the largest pieces and testing them to destruction. The Quebec Bridge member, which was about 5 feet square and nearly 60 feet long, was supposed to carry a load of between 11,000 and 12,000 tons. It failed under a little less than 9,000 tons. Now, a machine capable of taking such a member and crushing it to destruction, must necessarily be planned on a gigantic scale, and must needs be difficult and costly to design and construct. We are pleased to note that a machine of this character (though not large enough to take a Quebec Bridge member) is about to be erected by the United States government at the Geological Survey Testing Station at Pittsburg. It will stand 80 feet above its foundations, will weigh over 200 tons, and will be capable of exerting a maximum crushing pressure of 5,000 tons. The work of the Pittsburg machine will be general in character. It will be used for testing the strength of large blocks of stone, and of columns of concrete and brick, such as are used in the general building and construction work of the government. The Federal government has in hand and will undertake during the next few years works which will require the expenditure of over $70,000,000 per annum. In this work is included a programme on public buildings costing from $12,000,000 to $15,000,000 annually. Hence, the great value to the government of the huge testing machine which is about to be built at Pittsburg.

THE SO-CALLED "DREADNOUGHT" CRAZE.

It is a curious fact, the psychological import of which we will not now discuss, that a chance catchphrase, applied carelessly to some question of importance, will frequently be accepted by the public at large at its face value, and used as if it were a true measure of the scope and meaning of that question. A case in point is the habit into which many people have fallen of speaking of the present activity in the construction of battleships of the "Dreadnought" type as a craze; of referring to the ships as marking a departure, radical if not revolutionary. Great Britain is credited with having started the movement by challenging the world in the production of the original "Dreadnought," which is popularly regarded as having been an entirely new type of warship, in which old ideas and all the ripe naval experience of Great Britain were thrown overboard; the 400 or 500 ships of her existing navy discredited; and an era of warfare, novel, mysterious, and altogether terrible, introduced. In producing this ship Great Britain has endeavored to steal a march upon the world, and render her naval pre-eminence, impregnable before, doubly impregnable for the future. The United States, Germany, and Japan are supposed to have answered the challenge by making more or less improved copies of the "Dreadnought," and building them with an outlay of national treasure that bids fair to bring ultimate financial ruin to those who have entered this race for supremacy.

Thus, in a recent speech in this city, Mr. Carnegie, speaking of the building of the "Dreadnought," says that the British Cabinet "approved of what has amounted almost to a revolution in naval armaments." He tells us that by setting an example which other nations have energetically followed, England has jeopardized her previously existing supremacy; and the building of this ship is designated as "the fatuous blunder of the government of Britain."

Now, as a matter of fact, the "Dreadnought" is not the first battleship of her type that has existed in the British navy. She is a reversion to an earlier type of ship of thirty years before, which bore the same name, and, by a curious coincidence, was herself an all-big-gun ship. In the sixties the line-of-battle of the British navy was made up of large ships, each mounting, in broadside, many guns of various calibers. Then, in the seventies came, if you please, the first "Dreadnought" "craze"; and it was believed that a few (generally four) powerful, armor-piercing guns, mounted in turrets behind thick armor, and carried on vessels of large displacement, would give the most effective type of fighting ship. England produced the "Devastation," with its four 35-ton muzzle-loading guns. The "Dreadnought," "Thunderer," and "Inflexible" were other ships of that date of the all-big-gun type. Then the pendulum swung in the opposite direction, and the development of the rapid-fire gun, with its ability to smother an enemy's ship with a cloud of projectiles fired in rapid succession, led to the enlargement of the big-gun ship so as to admit of carrying amidships a broadside battery of rapid-fire guns. It was reserved for the United States, in the reconstruction of its navy in the early eighties, to partially revive the all-big-gun idea, which she did by mounting in the intermediate batteries of the "Oregon," "Massachusetts," and "Indiana," eight 8-inch armor-piercing guns.

Fifteen years later came the first great test of modern naval material; and the conflict between Russia and Japan proved the enormous superiority, in accuracy and in power to inflict vital injury, of the 12-inch gun. The swing of the pendulum of naval opinion back to the all-big-gun ship, which was commenced in our "Oregon," was completed by the overwhelming victory of the 12-inch gun at Tsushima. It was realized by every thoughtful naval man throughout the world that the battleship of the future would be an all-big-gun ship; and it was merely because England, always alert and to the forefront in naval construction, was the first power to set afloat the new type of ship (which, as we have seen, was a reversion to an earlier type), and name her the "Dreadnought," that the origination of this class is credited to her. The "Dreadnought" merely marks a logical step in the gradual growth of the battleship in size, speed, protection, and gun power. Had Great Britain not built the "Dreadnought," somebody else would; and the first ship so built would have given her name, whatever it might have happened to be, to the type.

To make the statement, as Mr. Carnegie does, "that Britain's navy of more than 400 efficient warships is now held to be of little worth," is to come pretty near to talking arrant nonsense. The construction of our own "North Dakota" has not rendered the "Connecticut" so much junk, fit only for the boneyard. The earlier ships of any navy are just as efficient against ships of the same date in other navies as ever they were. Because the "Dreadnoughts" will be formed into independent squadrons and fleets, it does not follow that the "Connecticuts" and "King Edwards," the "Mikasas" and "Deutschlands," are one whit less effective if employed against one another, or as forming the second line of battle in the great fleet engagements of the future.

Before leaving this subject, we wish to draw attention to the article on another page of this issue, describing our new 26,000-ton "Dreadnoughts," and ask whether we are not pushing the matter of size a little too far. The Scientific American has always been alive to the inherent value attaching to size in a battleship; but we think the time has come to put a question mark against a ship of the size of these huge fighting leviathans which together displace 52,000 tons. The same displacement would give us three ships of the size of the first British "Dreadnought." If the wing turrets of that ship were shifted to the median line, giving two forward of the superstructure and three astern, the three smaller ships would be able to concentrate twelve guns ahead or astern as against eight ahead or astern for the two big ships, and thirty guns on the broadside as against twenty-four. And, moreover, there would be three ships to two; that is to say, there would be fifty per cent more ships in numbers; a fifty per cent heavier end-on fire, and a twenty-five per cent more powerful broadside fire.

These facts present food for serious thought.

ENGINEERING.

It begins to look as though the predictions of her captain that the "Mauretania" will shortly cross the Atlantic at an average speed of 26 knots will be fulfilled. Each succeeding trip is faster than its predecessor. On her last but one crossing to the eastward, the course was covered at an average speed of 25.28 knots. On her last trip, she left New York March 17th and reached Queenstown on March 22nd, covering the distance in 4 days, 18 hours, and 35 minutes at an average speed of 25.61 knots.

The tower for the navy wireless station, which is to be erected in Washington, will be of concrete. At the base it will be 50 feet in diameter, and 8 feet at the top. The total height will be 650 feet. There will be a staircase within the hollow shaft, but no elevator. The antennæ will diverge from the top of the tower, and will meet the surface of the ground on a circle, which will measure 200 feet across.

The great cost of underground railways is shown in a comparison of the total cost of all the tube railway systems of London with the total cost of the railway system of Ireland. The latter includes 3,363 miles of road and its total cost was $222,500,000. The railway tubes of London, which aggregate 81½ miles, have cost about $137,500,000.

The Ohio Electric Railway of Cincinnati, Ohio, has equipped for its Columbus and Dayton division a number of flat cars with removable sides, on which it is transporting large loads of hay and grain. To prevent fire accidents to the cargo, an asbestos fiber shield, 4 by 10 inches in size, is placed under the trolley pole connection to catch any falling sparks.

The Manchester ship canal, which failed to pay its way in the earlier years of its operation, is to-day carrying a big tonnage and providing a profitable investment. During the past year about $150,000 was added to the total cost, which at present amounts to over $83,000,000. The canal, which accommodates seagoing steamers of considerable size, has made of the great city of Manchester a maritime port.

Prof. Albert Frank of the Hanover Technical School, has been investigating the resistance of smooth surfaces when they are moving through the air with the surface parallel to the direction of motion. The result as given in the Zeitschrift of the Society of German Engineers shows that at the same speed, the resistance of 236 square feet of side surface is equal to the resistance of one square foot of front surface placed perpendicularly to the direction of motion.

As to the result of a competition instituted by the Zeppelin Airship Company, for designs for a new airship shed at Friedrichshafen, the plans of consulting engineer E. Meier of Berlin were recommended for purchase. The building is to have an interior length in the clear of 525 feet, a width of 141 feet, and a height of 65 feet 7 inches. There will be no inside columns, and a hinged gallery is provided along each side of the inside walls, capable of being lowered at will to any desired position. The building will be of iron construction. Of the 74 sets of plans submitted, 43 were for an iron building, 28 for armored concrete construction, and 3 for a wooden shed.

The present British smokeless powder, known as cordite M. D., is in many respects a marked improvement over the original cordite of 1890, which contained 58 parts of nitroglycerine, 37 parts of guncotton, and 5 parts of crude vaseline. The cordite M. D. of 1901, as now used, contains 30 parts of nitroglycerine, 65 parts of guncotton, and 5 parts of mineral jelly. Cutting down the percentage of nitroglycerine has considerably reduced the erosion of the guns. With a density of loading in each case of 0.2, the heat of explosion at constant volume, water gaseous, is for cordite 1,156 calories per gramme, and for cordite M. D. 965. The total gases, water gaseous at 0 degrees, are for cordite 871 cubic centimeters per gramme, and for cordite M. D. 920. The temperature of explosion for cordite is 2,663 deg. Cent., and 2,374 deg. Cent. for cordite M. D.

That part of the report of the Block Signal and Train Control Board of the Interstate Commerce Commission which covers the observations of the committee sent to Europe last year to examine signaling practice in England and on the Continent, states that the committee found the block-signal operators abroad to be more carefully trained than they are in this country. This is due largely to the fact that the signalmen take up their occupation as a life calling, whereas in the United States most of the employees enter such service with the intention of taking something better whenever it offers. At present the English railroads are giving much attention to the development of a system of signals in the cab, preferring this to the use of automatic, train-stopping devices. The engineers are generally found to be reliable in their observance of signals; but the prevalence of fogs has led to the installation in the cab of signals which will indicate to the engineer at all times the position of the approaching fixed track signal.

ELECTRICITY.

A cable line is to be laid between New York and Newfoundland by the Commercial Cable Co. and will there connect with a cable to Europe. The new section will be 1,700 miles long. It will furnish a more direct means of communication with Europe than we have now, and will reduce the time of transmission.

All-steel street cars are being made for the United Railway Company of St. Louis. The reason for using steel in place of wood is not owing to the danger of fire or destruction in collision, but because the cars can be made lighter in this way, and will cost less for upkeep. It is estimated that from $50 to $60 a year can be saved in the operating cost of each car owing to its lighter weight.

A new type of high-tension switch has been designed by a German company in which each switch is mounted on a carriage so that it may be removed whenever desired for inspection or repairs. The connections are made by means of plug contacts. In practice an extra switch carriage is provided which may replace the one that is being repaired, or inspected, so that interruption of the service is reduced to a minimum.

An instrument is being used in one of the South African mines which automatically keeps a record of the cage or skip journeys as well as the signals given in the shaft and in the engine room. A band of paper ruled off into time spaces is marked by a small disk provided with a needle at one side. While the skip or cage is in motion, the disk travels over the cylinder making its record. When the signal bell is sounded the needle is caused to perforate the paper once for each ring of the bell.

A French inventor has devised a means of simultaneously cleaning and electroplating an object. He uses an anode of the metal that is to be electro-deposited on the object while the object itself serves as the cathode. The liquid used is an alkaline substance with a small amount of alkaline cyanide. When the current passes through this liquid it cleans the cathode and attacking the anode produces the desired electrolyte and thereupon the metal is deposited upon the cathode.

An automatic telephone exchange system is in use in Vienna, and has been tested for a number of years. As a result of these tests the head of the Austrian telegraphs, Mr. Charles Barth de Wehrenalp, declares that the automatic system can be made to seriously compete with the manual system. He states that in New York it takes on the average sixteen seconds from the time the subscriber removes his telephone receiver to the time the ringing signal is set; whereas in the automatic system for 100,000 subscribers this work is done in but ten seconds. Three seconds after the subscriber hangs up the receiver the line is clear. Owing to this saving in time a larger number of messages can be delivered through the automatic exchange than through the manual exchange.

As a rule in the electrical equipment of a vessel a low voltage is preferred, this being due to the action of salt air on the switches and plugs, which produces considerable leakage. Furthermore, the lamps used on a higher voltage than 110 must be provided with delicate filaments which cannot withstand the jarring and vibration of the vessel. Another reason is that there is a greater danger of fire at sea, because, owing to ignorance, fewer precautions are taken by those responsible for the electrical equipment. These reasons are outlined in a paper recently presented before a section of the British Institution of Electrical Engineers. The paper further contains the statement that a 2 x 110-volt three-wire system is soon to be adopted in the British navy, and that one large battleship is already wired in this way.

As an echo to the sleet storm which interrupted communication with Washington on inauguration day, comes the following suggestion from one of the readers of the SCIENTIFIC AMERICAN. Nearly all sleet storms and so-called "blizzards" of the East are accompanied with easterly winds. Why would it not be a good plan to place all the telegraph and telephone lines which border our railroads, on the westerly side of the track. Then, in case of a storm severe enough to blow the wires down the railroad, at least, would not suffer from the tangled mass of wires and poles. To be sure, all railroads do not run north and south, and those that do run in this general direction have many curves which lead them in easterly or westerly directions. But the telegraph lines could cross the track wherever it was found necessary, and then in case of a storm the only interruption which could occur would be at these crossings, whereas the stretches of track running approximately north and south would be free from interruption. If necessary a double line of telegraph poles could be used on the westerly side of the track to carry the number of wires required. In case of a sleet storm telegraph and telephone communication would still be liable to interruption, but there would be no interference with postal communications and railroad travel.

SCIENCE.

The glass works at Baccarat, France, have produced glass chimneys of remarkable properties for lamps used in coal mines containing much fire damp. Ten of these chimneys were placed in water, slowly heated to the boiling point and then plunged into water at 59 deg. F. Not one of the chimneys cracked.

It is announced in press dispatches that Sir William Ramsay in an address before the Chemical Society stated that he had succeeded in transmuting zirconium, thorium, hydro-fluorsilicic acid, and bismuth into carbon. The announcement can hardly be credited until Sir William's complete paper is published. If true, the discovery is fully as important as the conversion of radium emanation into helium.

Creighton and Mackenzie have shown that radium has an effect on the decomposition of iohydric acid. At temperatures below 24 deg. C. the quantity of iodide liberated from a solution of iohydric acid kept in the dark is increased by the presence of radium. The acid is not decomposed by sunlight nor by radium emanation in the absence of oxygen. These experiments show that radium has the remarkable property of decomposing some compounds.

The extremely complicated problem of earth tides has recently been brought into public prominence by the researches of Prof. Hecker of Potsdam. Prof. Hecker showed that it is possible to estimate how much a pendulum would be deflected by the attraction of the sun and moon if the earth were perfectly rigid. The difference between these two records is the measurement of the earth tide. The observations of Prof. Hecker go to show that there is a movement of the earth's surface to the extent of some 20 centimeters only.

Inasmuch as the supply of natural turpentine oil will soon be unable to meet the demand, chemists have long been endeavoring to produce the oil synthetically. Most artificial oils are combinations of coal tar and petroleum derivatives and do not completely answer all requirements. M. A. Poulverel, a French chemist, has recently succeeded in obtaining an oil from the residuum left in manufacturing natural turpentine oil. Poulverel's oil is said to have the same chemical properties and composition as the natural oil. The result is that the output of oil is vastly increased.

Camille Flammarion has revived his old scheme of digging a geothermic well 200 meters in diameter to ascertain the internal constitution of the earth. The imaginative Flammarion proposes to find an economic and almost inexhaustible source of heat, to verify the rate of caloric increase, to find out if the materials constituting the terrestrial globe are in a state of fusion—in a word, to do rationally and directly what has been done slightly and a little by chance up to the present time in mines. To carry out the work the standing armies of the world are to be called into requisition.

Tannisol is a methylditannin obtained by the action of formalin on tannin. The two substances are heated together on the water-bath, when effervescence occurs, and a viscous mass is formed. This is dried, powdered, and exposed to a temperature of 45 deg. to 50 deg. C., to drive off excess of formaldehyde. It forms a red-brown, odorless, and tasteless powder, insoluble in most solvents, except alcohol and dilute alkalies. It is prescribed in intestinal catarrh as an astringent antiseptic, in doses up to 8 grains for adults, or 1½ to 4 grains for children. It is also used externally as a dusting powder, either alone or combined with other powder, or in the form of a 10 per cent ointment or soap.—Nouveaux Remèdes.

Prof. Cecil Rowntree, F.R.G.S., of the Middlesex Hospital Cancer Research Laboratories, in the course of a lecture before the Royal College of Surgeons on the X-ray and cancer, stated that X-rays have two separate and distinct actions upon animal and vegetable cells. In relatively large doses they have destructive or paralyzing action upon the cells' activity, whereas in small and oft-repeated doses they bring about exactly the opposite condition and stimulate the tissues to abnormal activity and increased growth. Prof. Rowntree is of the opinion that these observations may have an important practical application in connection with the treatment of cancer.

A dinosaur has been found in Wyoming which is something more than a fossil skeleton. The very skin has been preserved, so that paleontologists are at last able to determine definitely the character of the hide that covered one of the world's greatest extinct animals. Needless to say, the American Museum of Natural History has acquired this valuable relic. The animal must have died on some dry, sandy spot, exposed to the sun, so that the carcass was mummified. Then it must have been suddenly buried by a flood of sand from a freshet, so rapidly and deeply that the skin had no chance to soften and decay, but was preserved and petrified with the bones. This occurred 3,000,000 years ago, on a moderate estimate of geologic time.

AN ENORMOUS INDUCTION COIL.

BY CHARLES B. HAYWARD.

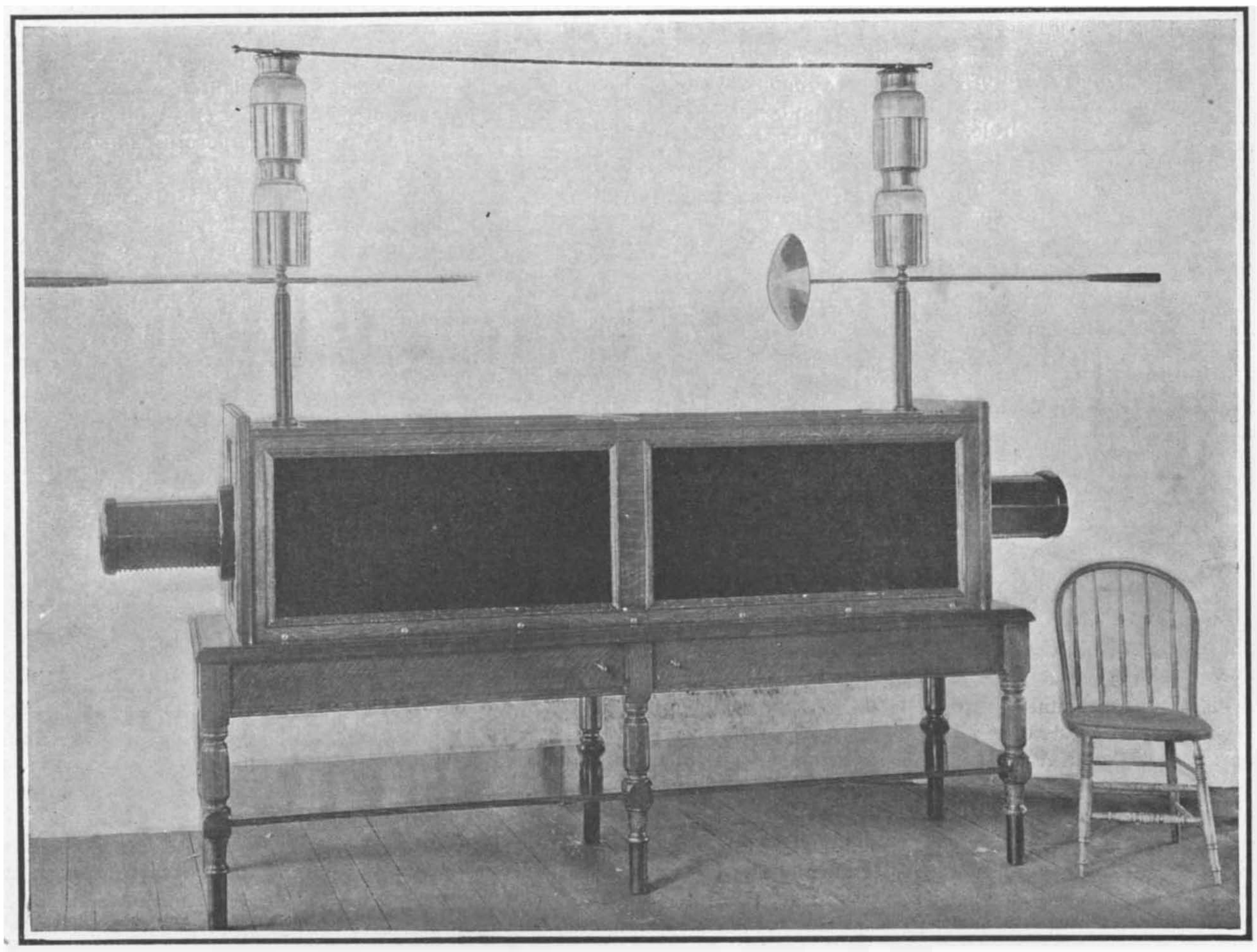
Developments in automobile ignition on the one hand, and in wireless telegraphy on the other, have taken the induction coil from the laboratory, and in less than a decade have made of it a piece of electrical apparatus of far-reaching importance. With this difference, however: that on the automobile it has practically reached its zenith, and is likely to be supplanted sooner or later by a system of ignition employing a mechanical current generator, either embodying the coil within itself, or dispensing with it altogether, while in wireless telegraphy its possibilities are unbounded. The development spoken of has been along directly opposed lines, in that the aim of the experimenter has been to reduce the size and increase the efficiency of the coil for automobile use, while advances where wireless telegraph coils are concerned have been mainly in the direction of size and better insulation, current consumption naturally being a negligible factor for the latter service.

The induction coil of the present day for automobile use has been brought to such a high state of refinement and efficiency, that it is scarcely half the size of its predecessors of as recent a date as 1904, and no longer bears the faintest resemblance to its prototype of the laboratory, though the classic lines given it by Ruhmkorff are still apparent to some extent in its powerful successors that are employed to flash messages across space. In fact, it was not until the induction coil and its makers went into experimental sessions extending over two or three years, that it really became an accessory of value to the automobile.

In the course of developing both types of coils, an American manufacturer undertook to build an experimental type that should be the largest of its kind extant, and the result of his efforts is pictured in the accompanying photograph. It is not only unique in point of size, but also differs totally in design and construction from the ordinary type of induction coil. To begin with, its primary core is 6 feet in length by 4 inches in diameter and weighs 210 pounds. The primary winding consists of two layers of No. 6 B. & S. gage, double cotton-covered magnet wire, there being 748 turns in all. The resistance of this winding is but 6.2 ohms, although the wire composing it tips the scales at an even hundredweight. The insulation between the primary and secondary—naturally one of the most vital factors in the entire construction of the coil—consists of a micanite tube 10 feet long. The walls of this tube are 1½ inches in thickness, its inside diameter being 5 inches, and the external diameter, 8 inches.

The secondary winding is made up of 284 separately-wound coils but 3/16 inch thick and not unlike a pancake. They are 9½ inches inside diameter by 13½ inches outside. Unlike smaller coils, no attempt has been made to use unusually fine wire, nor have any extraordinary precautions been taken to insulate superimposed layers from one another. Instead, No. 32 B. & S. double cotton-covered magnet wire has been employed, there being 961 turns in each of the pancake coils, the coils themselves being insulated from their neighbors on either side by means of micanite plates, 1/32 inch thick. These plates extend beyond the contour of the windings at every point in their circumference for an inch or more, utilizing the long air gap thus interposed to prevent short circuiting from one coil to another, instead of the customary practice of impregnating the entire coil with paraffin or similar insulating material. In the secondary winding, when assembled complete, there are no less than 272,924 turns, or 138.3 miles of wire in all. The weight of this wire is 213 pounds and its resistance is 118,428 ohms, the ratio of the resistances between the primary and secondary thus being as 1 : 19,101.1. This is naturally its cold resistance, based on a temperature of 68 deg. F., and would be increased by fully 10 per cent before the temperature had risen to a point exceeding the safe working limit.

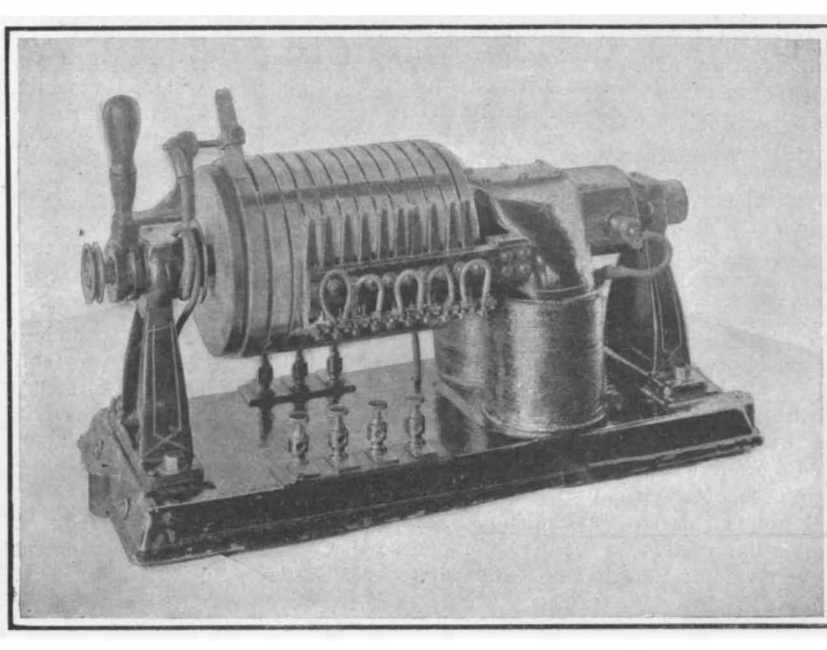
The insulation throughout the coil consists of mica, the secondary coils all being exposed to the air. The cabinet work on the coil consists of wood that had been subjected to a long and thorough vacuum drying process, after which it was immersed in boiling paraffin, the remainder of its inclosure consisting of plate glass sunk in deep rabbets in the wooden frame, and protected by felt strips to exclude every possible suspicion of moisture from reaching the interior. The coil operates on 110-volt direct current, and when producing a spark 50 inches long, consumes 25 amperes.



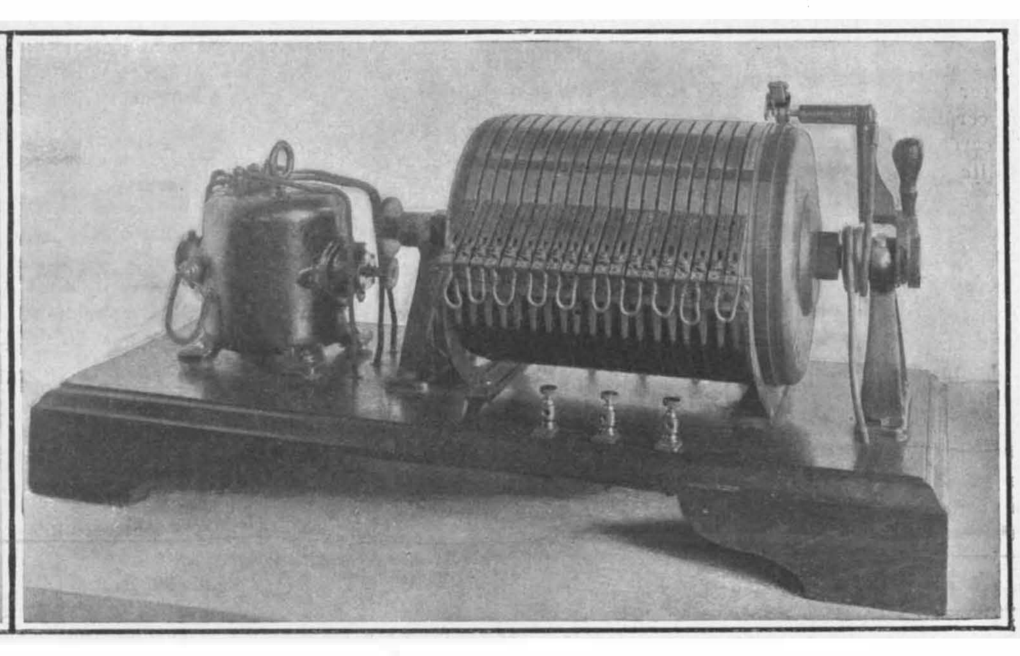
AN ENORMOUS INDUCTION COIL WHICH MAKES A SPARK 50 INCHES LONG.

It would manifestly be out of the question to construct a magnetic vibrator of the type ordinarily used on small induction coils to handle such a current, and the method of accomplishing this part of the coil's operation is quite as interesting as the details of the latter itself. A drum, 12 inches in diameter and carrying 20 copper rings, is driven by a small direct-current motor, as shown by the accompanying illustration. The drum consists of an insulating material, and each one of the rings is insulated from its neighbor, while the rings themselves are split at diametrically opposite points and mica sections inserted, thus making the whole construction similar to a 40-bar commutator, except that the bars are parallel in a vertical plane. The comparison may be carried further, in that there are two oppositely-disposed sets of brushes employed, the carriers holding 40 in all, or a pair for each ring. All of these brushes are connected in series, so that the current has to pass from one brush to its corresponding ring, through the latter to the brush diametrically opposite; from that brush to its neighbor, and back through the adjoining ring to the brush adjacent to the one at which it started, progressing in this manner through the whole series. For every revolution of the drum, two interruptions of the current are produced, but the brushes, rings, and the mica insulators of the latter are so arranged that this break is accomplished throughout the whole series at the same moment. At 1,000 R. P. M. of the driving motor, 2,000 impulses are thus produced in the coil, the duration of the interruption amounting to 1/39,424 part of a second. The length of the break as compared with the duration of the contact is as 1 : 2,240, from which it will be evident that the current is broken with practically the same rapidity with which the iron core demagnetizes. There is accordingly almost an entire lack of the inductive "back kick," common in coils depending upon a magnetic vibrator for their operation, and a condenser across the primary is of little or no service.

Larger coils than this have been built, notably those constructed by Prof. Elihu Thomson and by Nikola



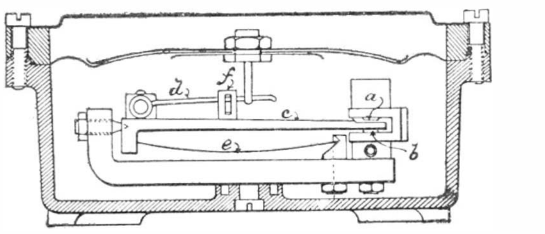
The commutator forms part of the armature of the motor.



The commutator is driven by the motor through step-down gearing.

TWO FORMS OF INTERRUPTER FOR THE ENORMOUS INDUCTION COIL.

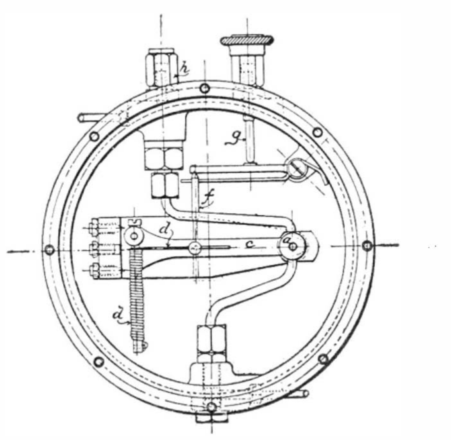
Tesla, but they were of the high-frequency type. Some other unusually large coils of a type similar to the Heinze coil just described are the Spottiswood coil, of English make, and designed to give a spark of 42 inches between terminals, and a coil of German design and manufacture, said to be at the University of Charlottenburg, Berlin, with a capacity of bridging a gap of 46 inches; so that the Heinze coil, which was made in this country, may be said to be the largest extant



The compressed-acetylene flashing chamber.

using a direct current and operating through a mechanically-driven circuit breaker.

Considerable interest attaches to the calculation of the voltage produced in the secondary of such a monster coil as the 50-inch Heinze coil described. It has been ascertained that the voltage necessary to jump a gap increases rapidly up to one inch, and then decreases up to about 24 inches. From that point it appears to increase again, for the reason that the air is apparently such a good conductor, that it is necessary to provide an enormous amount of energy to make good the leakage through the air and still pro-



Plan view of the compressed-acetylene flashing chamber.

duce a spark. From all measurements and calculations that have been made, it is estimated that the voltage necessary to bridge the 50-inch gap is in the neighborhood of 1,000,000 volts. It goes without saying that no instruments have ever been designed to measure this more than approximately. This huge coil has largely been used for experimental work, and has given excellent results in service.

FLOATING LIGHTS OF INLAND WATERS.

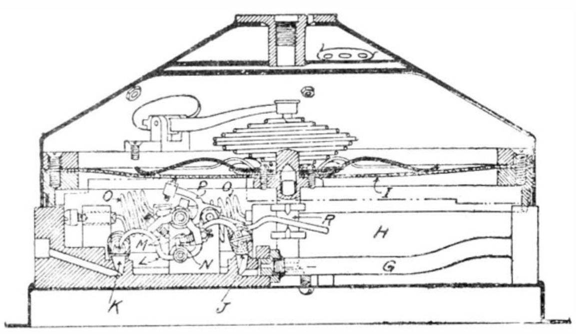
With the towering lighthouse that blinks its warning signal unperturbed while the tempest storms at its base, and the solitary stump-masted lightship that fights a hand-to-hand battle with the waves, we have been made familiar by many a thrilling tale; but seldom, if ever, do we find any mention of the humble light buoy which does its duty day and night without any attendance for months at a time. Yet these buoys are indispensable to navigation, and in themselves possess a great amount of interest.

Obviously, a buoy must be able to take care of itself. It would be enormously expensive to light and trim the lamps every evening, and it frequently happens that because of storm, fog, or ice, no one can approach them for weeks at a time. For this reason light buoys are usually arranged to burn continuously, night and day, the extra amount of fuel thus consumed being more than offset by the saving in expense of tending the lamp.

For many years the only light buoys used by this government burned compressed oil-gas, or Pintsch gas, stored in the shell of the buoy. Now, acetylene-gas buoys are being introduced with considerable success. Recently electricity was tried, but found wanting, owing to the difficulty of maintaining the electrical circuits.

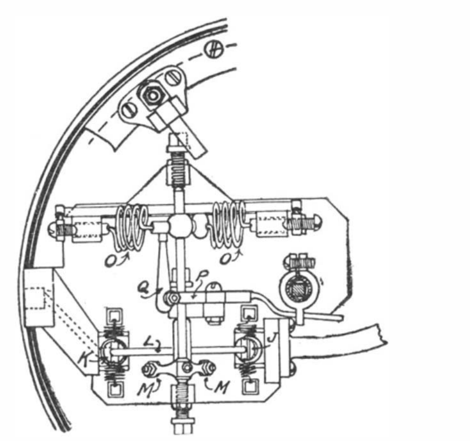
As the lamp of a buoy lies close to the water, the light is liable to be mistaken for a ship's lantern, and for this reason it is customary to provide the lamp with a flashing mechanism producing an intermittent light, the character or period of which may be varied to differentiate one buoy from another. Furthermore, the intermittent light results in a great saving of gas, the exact amount of which will depend upon the relation of the dark periods to the flashes or light periods.

The flashing mechanisms used on these buoys are very ingeniously contrived, and have reached a high degree of development. They are actuated by the pressure of the gas they burn, and work with clocklike precision. One of our illustrations shows a vertical section taken through the flashing mechanism of a Pintsch light buoy. The gas enters the lamp through the strainer *A*, and passes by way of the valve *B* into the pressure-regulating chamber *C*. This chamber is provided with a flexible diaphragm *D*, connected by a link to a lever *E*. As the chamber fills, the diaphragm flexes upward, raising the lever *E*, and operating the valve *B* to throttle the flow of gas. A spring *F* resists this motion of the lever *E*, and thus governs the pressure of the gas admitted into the chamber. The gas flows from chamber *C*, through pipe *G*, to the flashing chamber *H*. The details of the mechanism in this chamber are best shown in the line drawings. The upper wall of the chamber *H* consists of a diaphragm *I*, which is normally pressed downward by a coil spring. When the chamber fills with gas the diaphragm rises, shutting off the inlet valve *J*, and opening the outlet valve *K*, through which the gas passes to the burners; and when the diaphragm falls, it closes the outlet valve and opens the inlet valve. A special mechanism is provided to effect a positive opening and closing of the valves, else they might assume a neutral or partly open position, and permit a continuous flow of gas to the burner. The valves are connected to the opposite ends of the lever *L*. A rock shaft carries at one end a pair of pallets *M*, adapted to engage a pin *N* formed



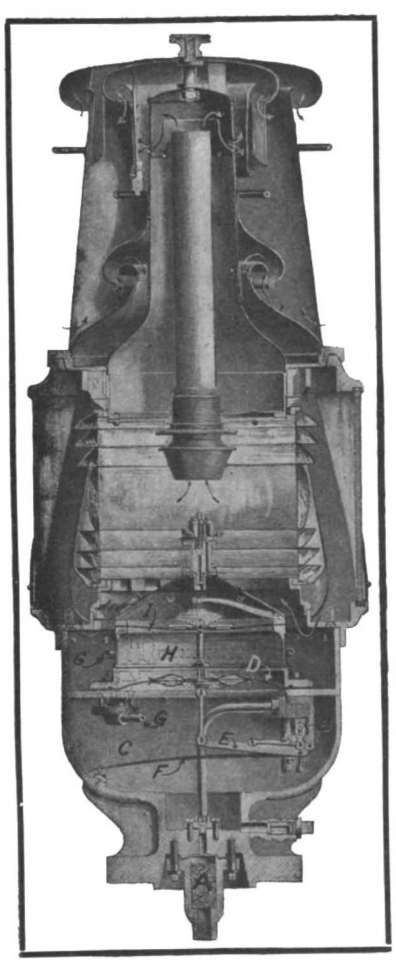
Section through the flashing chamber of the Pintsch lantern.

on the lever *L*. A pair of compression springs *O* bear against the ends of a cross piece, mounted on the opposite end of the shaft. These springs serve to throw the shaft out of a central or neutral position, causing one or other of the pallets *M* to hold the valve lever *L* in inclined position. The rock shaft is operated by means of a yoke *P*, which bears either on the upper or lower side of plate *Q*, formed on the shaft. The yoke is carried by a lever, which at the opposite end projects between a pair of stops formed on a sleeve *R*, connected with the diaphragm *I*. While the flashing chamber *H* is filling with gas, the valve *K* remains

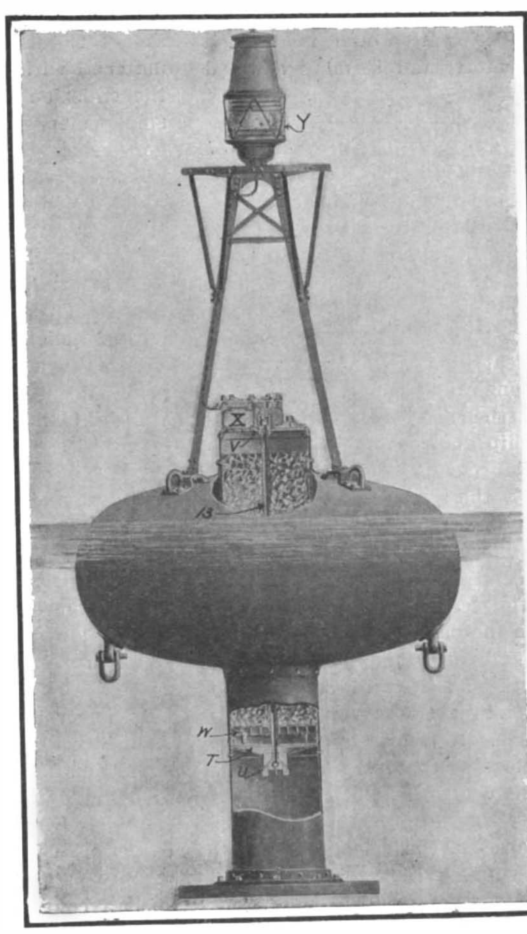


Plan view of part of Pintsch flashing chamber.

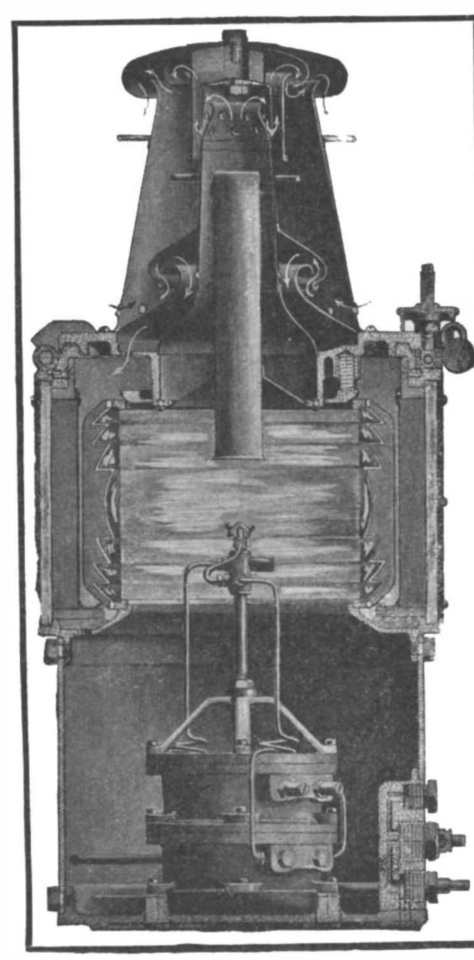
tightly closed, and the lamp is dark with the exception of a tiny pilot flame fed from a small by-pass tube. When the diaphragm has been flexed upwardly sufficiently, the yoke *P* presses the plate *Q* downward, and the springs *O* then act to throw the left-hand pallet *M* sharply against the pin *N*, forcing the valve *J* shut and opening the valve *K*. The gas now flows to the burner



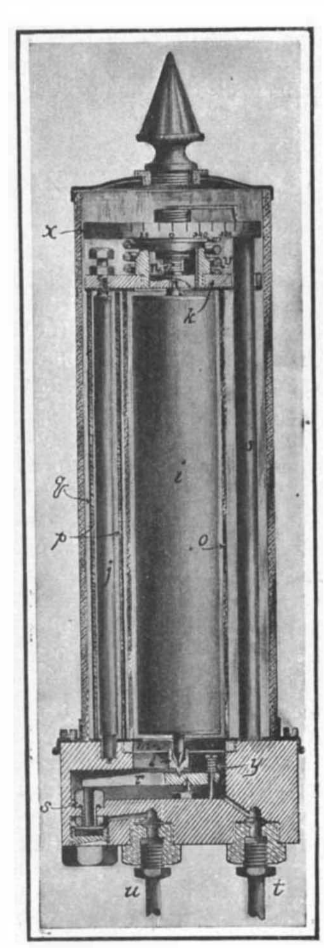
The flashing mechanism of the Pintsch gas lantern.



Acetylene is generated by entrance of sea water into the carbide tank.



A lantern using compressed acetylene.



Sun valve. Gas is turned off by day and on at night.

under pressure of the spring, which bears against the diaphragm. A constant pressure at the burner is thus assured, even though the pressure in the gas reservoir may fall greatly during the several months of consumption. The flashing mechanism is usually adjusted to give equal periods of light and darkness of five seconds each. While the period of light cannot be regulated, a valve controlling the flow of gas into the flashing chamber may be adjusted to increase or decrease the interval of darkness. The lantern is fitted with a cylindrical lens of the type used in lighthouse lanterns, which projects the light in a horizontal zone.

Of the acetylene buoys, the oldest type is one in which the gas is generated by the admission of the sea water into a tank containing calcium carbide. One of our engravings illustrates the complete buoy, partly broken away to show the steel generator tube in which the carbide is stored. The tube is supported by a float chamber, on which the lantern tower is mounted. A counter weight in the form of a disk with a small central opening to admit the water is bolted fast to the bottom of the generator tube, in order to give the buoy the necessary stability. A diaphragm *T* is located in the lower part of the generator tube, and is fitted with a conical valve *U*, the stem of which passes up through the generator head *V*. A nut on the end of the stem permits of adjusting the valve. A cap screwed down on the generator head may be adjusted to press the stem downward, and keep the valve open to the desired degree. The generator tube is filled with large crystals, 8 by 4 inches, of calcium carbide. Water enters through the valve *U*, and passing through the grate *W*, comes in contact with the carbide. The gas which is immediately generated passes through a purifier *X* and thence to the lantern *Y*, which is fitted with a flashing chamber of the same type as the one described above. At first the gas is formed more rapidly than it can be consumed at the burner, but soon it reaches sufficient pressure to prevent water from entering through the valve, and this pressure is automatically maintained; for as soon as the pressure drops, the water enters and more gas is formed.

In a more recent type of acetylene buoy the gas is generated, not by admitting water into the carbide, but by dropping carbide into the water. At first sight, it might seem as though the result would be the same; but it is claimed for the latter method that the gas produced is more pure, because the heat generated when gas is formed is absorbed by the water. The cool generation prevents the breaking up of the acetylene into other hydrocarbons. The carbide used in this buoy is in granular form.

In another type of acetylene light buoy, the fuel is not generated in the buoy, but is stored under pressure in tanks. The tanks contain a porous material which absorbs acetone, a fluid similar to wood alcohol. The acetone has an affinity for acetylene, and absorbs twenty-five times its own volume of gas at a pressure of 150 pounds under a normal temperature. The porous material which absorbs the acetone prevents danger of an explosion, for under ordinary conditions compressed acetylene is very highly explosive. The advantages claimed for the use of compressed acetylene are that the gas being generated in the factory may be made absolutely pure, so that there is no danger of carbonizing at the burner. This permits the use of a much smaller pilot flame, the lamp we illustrate using 1/75 of a foot per hour for this purpose. The tanks in which the gas is stored are placed on each side of the central tube and contain a supply sufficient to last from nine months to a year, depending upon the duration of the flash.

The flashing mechanism used in this type of buoy differs materially from the one described above. As shown in the drawing, the upper wall of the flashing chamber consists of a flexible diaphragm. The inlet valve seat is indicated at *a*, and the outlet at *b*. A valve lever *c* is mounted to operate between these valve seats. The valve lever is magnetized, and clings strongly to the seat, with which it is in contact. It is moved into engagement with valve seat *a* by the diaphragm, acting through a spring *d*, while the spring *e* serves to return the lever against the valve seat *b*. The spring *d* is mounted on the lever *c*, and its tension is adjustable. The end which is fastened to the diaphragm projects through a slotted yoke on the lever. As the diaphragm rises during the filling of the chamber, the end of the spring is drawn upward without moving the lever until it strikes the upper wall of the slot, when with the increased leverage thus afforded, the diaphragm lifts the valve lever off the valve seat *b*. Thereupon the lever springs against and clings to the valve seat *a*. The gas now flows out of the chamber to the burner at a rate that is determined by the tension of the spring *d*. The dark period, or the interval during which the chamber is filling, may be varied at will by means of a wedge *f*, which is forced into the slotted yoke to limit the play of the spring therein, so that the diaphragm will more quickly lift the lever to close the inlet port and open the outlet to the burner. The wedge *f* is operated by a thumb screw *g*. The flow of gas can be regulated by means of a thumb screw *h*. So delicate is the adjustment, that one cubic foot of acetylene can be divided into 56,000 flashes.

In connection with this type of light buoy, a most ingenious device called a sun valve is sometimes used for turning off the gas by day, and turning it on again at night, thus saving from 30 to 40 per cent of the gas consumed. The device is a Swedish invention, and has been used with success in Sweden for a number of years. At present it is being subjected to an exhaustive test by the United States Lighthouse Establishment. The sun valve depends for its operation upon the difference of expansion between a copper cylinder coated with lampblack and three copper rods protected from radiant heat by silver-plated sleeves. As shown in the engraving, the carbon-coated cylinder is placed in the center at *i*. Equally spaced about it are three copper rods *j*, mounted in the base of the instrument and supporting a head *k*. The cylinder *a* rests at the bottom in step *l*, carried by a diaphragm *m*, while at its upper end it engages a slide *n* in the head *k*. The cylinder *i* is protected by a heat-insulating tube of glass *o*, and the rods *j* are protected by similar glass insulating tubes *p*. Over the tubes *p* silver-plated sleeves *q* are placed, which serve to reflect radiant heat. In the base of the instrument is a gas chamber, in which is fulcrumed a valve lever operating over the valve seat *s*. This lever is magnetized, so that it will adhere to the valve seat. The gas flows from the gas tanks through the sun valve by way of the inlet *t*, valve *s*, and outlet *u*, and to the flashing chamber. At night the valve lever *r* is raised, so that the flow of gas is not interrupted; but in the day time, when the radiant heat of daylight strikes the sun valve, it is absorbed by the carbon coating of cylinder *i*, causing the latter to expand, but it does not expand the rods *j*, owing to its reflection from the highly-polished silver-plated sleeves *q*. The head *k* is held down by means of a spring *v* abutting against a disk supported by the rods *w*, and hence the cylinder *i* presses the step *l* downward, forcing the valve *r* into engagement with the valve seat *s*, and thereby shutting off the flow of gas. As darkness comes on, the cylinder *i* loses its heat and contracts, permitting the lever *r* to rise under action of a spring *x*. The sun valve may be regulated by an adjusting nut *y*, which may be moved to raise or lower the slide *n*, and thus vary the pressure of the cylinder *i* on the valve lever *r*. It must be understood that the valve cannot be operated by heat conducted from the surrounding atmosphere, for the sleeves *q* offer no resistance to heat of this form, and the rods *j* will expand and lift the head *k* while the cylinder *i* is expanding. Thus, should there be a sudden change of temperature during the night, it will not affect the sun valve, but as soon as daylight comes, the radiant heat that accompanies light passes through the glass insulating tubes, and causes the unequal expansion which operates the valve. The advantage of this valve over a clock mechanism is that it does not have to be regulated for days of different length, but operates automatically at any time of the year, turning on the gas as soon as it commences to grow dark, whether because of a fog or lowering clouds. Although as we have stated above, the sun valve has been used on light buoys, the instrument is really too delicate to be exposed to the buffeting it would receive on buoys placed in stormy waters, and is more adapted for use on a fixed light.

AERIAL DEFENSE ARTILLERY.

It is a curious fact that the promise of a practical fighting ship of the air has called forth means of defense which are strikingly similar to those which are used against the fighting ship of the high seas. To oppose a hostile fleet, we build opposing fleets, and send them out to meet the enemy as far distant as possible from our own shores, and destroy him. Should he elude our ships, or defeat them and appear off our coasts, he is met by the long-range gun.

Things are so shaping themselves in the development of the military airship and aeroplane, that it is already evident that similar means of defense will be employed. Unquestionably, the most effective way to defeat an aerial navy, and to detect and destroy its outlying circle of scouting aeroplanes, will be to build and equip similar fleets, and surround them with a far-extended fringe of aerial scouts. If military aeronautics ever are carried to the point at which airships are built in sufficient numbers to be assembled in fleets, it is probable that these fleets will be made up of dirigible airships, built in sizes corresponding to our cruisers and battleships. It is also probable that to the aeroplane will be relegated the duties which now fall upon the fast scout, the destroyer, and the torpedo boat.

At the present time, however, the science of aerial attack and defense is very much in the air in more senses than one. Nobody knows in just what way the new engine of war will be used in attack, and it is just as problematical as to what will constitute the best form of defense. The Scientific American has always believed that the only practicable way to resist aerial attack is from the air itself; that is to say, by opposing dirigible to dirigible and aeroplane to aeroplane. But failing this, as a forlorn hope, recourse must be had to artillery. We have several times pointed out that the difficulties of accurate shooting are enormously increased when the object aimed at can move in three dimensions. Moving objects upon the land or the sea may be located, thanks to modern range-finding, with great accuracy. As far as the gunner is concerned, the distance of the object may be met by a corresponding elevation, and direction by corresponding traverse; the range finder will give the changes of position, and the gun may be kept upon the object with remarkable accuracy. Furthermore, errors of range and traverse may be corrected by observing the fall of the shot, as indicated on land by the cloud of dust or the burst of explosion, and on the sea by the splash of the water.

But in the air, where the moving object is ever changing its position laterally, longitudinally, and vertically, the difficulties of the range finder and the gun pointer are increased to the point of bewilderment. Moreover, with ordinary artillery he has no means of determining by dust clouds or water splash whether his shots are long or short, to right or left, above or below, the object.

However, the military men of Europe have so far recognized the potentialities of the new warfare, that they have already designed artillery for the express purpose of attacking the dirigible and the aeroplane; and the great firm of Krupps have worked out two designs of weapons for aerial defense. Necessarily, all firing must be of the high-angle kind; and the guns must be capable of rapid training over a wide arc of fire. These conditions are met in the two guns herewith illustrated, one of which is mobile for operations in the field, and the other designed for a fixed position either on fortifications or on board ship, or possibly on a moving platform, such as would be afforded by an automobile or an auto truck. The field gun is a 2½-inch piece, which fires a 9-pound shell with a velocity of 2,000 feet per second. The gun is mounted to slide on a chassis, in which is contained the spring recoil mechanism. The chassis is pivoted near the breech of the gun, and elevation is secured by means of a large vertical hand-operated screw. The methods adopted for traversing the gun, which may be moved through a circle of 360 degrees, are particularly ingenious. A large pin passes through the tail of the gun carriage into a fixed shoe, which is driven into the ground. The two wheels of the carriage are attached pivotally near the front of the carriage, and, by means of a hand wheel and suitable gear, they may be swung around in front of the gun until their axles are radial to the fixed tail pin above referred to. By this arrangement the whole gun carriage may be traversed through a circle of 360 degrees. Furthermore, the gun itself may be traversed upon its carriage by means of a system of swivel bearings, which permit of a rapid change of training independently of the gun carriage.

The most novel and meritorious feature of this gun, however, is the means which have been adopted to enable the gunner to follow the flight of the projectile. The shells have been so designed that they are ignited at the moment of discharge, and the slow-combustion material with which they are filled burns slowly, with the emission of much heat and smoke. The trail of smoke marks the exact line of flight of the projectile, and assists the gunner in "finding" the mark. In one of the accompanying illustrations, the path of the shell is recognizable by the dark gray line, passing diagonally across the picture just above the balloon. This type of shell is designed for use against gas-inflated balloons and dirigibles; and it is believed that when the shell passes through the gas bag, the gas will be ignited and the balloon destroyed.

For the attack of aeroplanes, some other form of projectile must be used; and we believe that shrapnel will be found the most effective. The burst of explosion will assist the gunner in correcting his aim; and the wide dispersion of fragments and bullets will afford the only likely means of "winging" the small and elusive aeroplane in its swift flight through the air. The aeroplane of the near future, if present indications are reliable, will fly at a speed of 60 miles an hour or more, and swing to the right or left and swoop up and down with the swiftness of a stormy petrel. It will be an exceedingly difficult object to hit.

It is probable that the institution of the North American Conservation Congress for the protection of National Resources, the first session of which was held on February 18th, will lead to the extension of the idea by the institution of a great international conference for the conservation of all natural resources. President Roosevelt formulated a call for such a congress, and it is proposed that the conference meet at The Hague in September of this year. This action was prompted by many intimations conveyed through diplomatic channels that such a conference would be welcomed by a considerable number of the powers.

Correspondence.

THE STEAMSHIP "REPUBLIC."

To the Editor of the SCIENTIFIC AMERICAN:

Your editorial entitled "Lessons of the 'Republic' Disaster," in the SCIENTIFIC AMERICAN of February 6th, is misleading in certain respects, if the facts as I have learned them are correct. With reference to the building of this ship, you state "had she been built for a company that was hampered by a shortage of funds," etc. This, with what you say further, would imply that she was built for the famous and substantial White Star Line Company, who have a system of contracts peculiarly favorable to first-class construction. I have been informed with positive assurance that this ship was built for the Leyland Line as a freight and cattle steamer, and before completion, on account of finances, she was taken over by the Dominion Line for Boston service, and before being put in commission was again transferred to the White Star Line Company, her name being changed from "Columbus" to "Republic." I have been informed that the "Republic" was not a first-class ship, and could not be compared with the other boats of the White Star Line. If this is true, it seems to me your editorial hardly does credit to the White Star Line, since it reduces their other boats to the level of the "Republic." O. A. WEISS.

Minneapolis, Minn.

END VERSUS CENTER DOORS FOR EXIT ON SUBWAY CARS

To the Editor of the SCIENTIFIC AMERICAN:

The articles in the daily papers together with a personal experience leads me to say a few words concerning the question of "side doors" in the New York Subway. The problem of loading and unloading passengers with ease and speed is a great one, and before any plan is adopted and with great expense installed, all should be given a fair test. In my opinion, the plan now being tested is faulty in principle and not conducive to the best results.

My idea is essentially this: To put two wide doors for the purpose of exit, in the middle of each car, one on each side, and to use the present doors for entrance. The plan now being tried requires four new doors, two at each end, also providing for separate means for entrance and exit.

With a car comfortably filled and nobody standing, little or no difficulty is met in loading or unloading passengers. Therefore the plan for separate entrance and exit will show its efficiency chiefly in crowded hours and under crowded conditions. It is, in other words, a rush-hour improvement.

When one enters a crowded car, the tendency is naturally to stop near the door—the standing is no different and it is easier to get out. This idea carried out by a few immediately causes congestion; and this is what I would emphasize—the new doors are practically at the ends of the car and will not eliminate this congestion or help it to any great extent. The two streams of people will still conflict, not at, but just inside of the door. What is the difference?

A door in the middle of the car is going to effectually solve this problem for the reason that as the crowd enters it will instinctively move toward the middle, or exit. A natural circulation will thus be established, the comers and goers will move without opposition and congestion will not arise at any one point. The saving of expense also, in installing two instead of four doors in each car, is manifestly evident, and if cost is considered, this point is strongly in its favor.

The two great disadvantages of the plan are, first, the distance between the door and the guard who operates it, with corresponding danger to the passengers, and second, the space that would occur between the door and platform when the station is located at a sharp curve. These two, however, are mere mechanical incidentals, easily solved, and should in no way interfere if the fundamentals are right, which I think they are.

I am hoping for your consideration of this matter and a comment through your columns will be appreciated, for I am sure that there are others who feel the same as I do in the matter. It is something for every strap-hanger to consider.

Brooklyn, N. Y. H. B. FORMAN.

SEAWORTHINESS OF PASSENGER STEAMSHIPS.

To the Editor of the SCIENTIFIC AMERICAN:

Regarding the letter of your correspondent bearing on the foundering of the steamship "Republic," permit me to say that as regards structural strength, or indeed, the general seaworthiness of large mail and passenger steamers, the specification of the owners does not make any material difference with good shipbuilders. It may sound strange, but I can assure you that there are certain shipbuilders who do not know how to construct a bad ship. I know several of such who never have built a bad ship. On the other hand there are builders who, apparently, do not know how to construct a good ship. I have known many of such who never have built a really good ship, and all the specifying and superintendence possible cannot bring forth a good ship from their works. I incline toward the opinion that the builders of the "Republic" never built a bad ship, i. e., as regards materials and workmanship. They built some vessels of faulty proportionate dimensions, but that was the fault of the times. They also made a mistake in designing the "Britannic" with a lowering screw shaft and a large open tunnel exposed to the sea, but they were almost warranted in adopting that novelty in ocean navigation, as the very same arrangement gave at least satisfactory results in their little steamship "Camel," 170 feet in length, which they built in 1870 to carry the boilers, etc., for the first "Oceanic" and "Republic" and others. This was a very instructive experiment and it proved conclusively that a mechanism which may work well on a small scale will not necessarily do good work and be safe on a very large scale. This mistake cost the builders $300,000 before the "Britannic" and her machinery were restored to normal design.

The great value of a good specification is in securing good furnishings and fittings. The specifications for these, for the old P. & O. steamers frequently covered one hundred pages of close print. The owners in those days would not look at veneer; they demanded maple, mahogany, and such woods, all solid. However, there is one thing which I would like to see specified, that is, that all large ocean passenger steamers should be arranged with a large augmentation of bilge pumps, which, with their boilers, should be placed from 7 to 10 feet above the maximum load water line. It would also be a safeguard, as collisions must occur, to have a few large sheets of canvas reinforced with wire netting and loaded at one end with cast iron pipes to sink them over the fractured bow or side. These could be rolled up and placed in large hooks just below the boat deck. In these days without sails I think you could find many passenger steamers without sufficient strong canvas to check a large inrush of water. Tarpaulins on passenger steamers' hatches are not sufficiently large and it requires considerable time to get them in place.

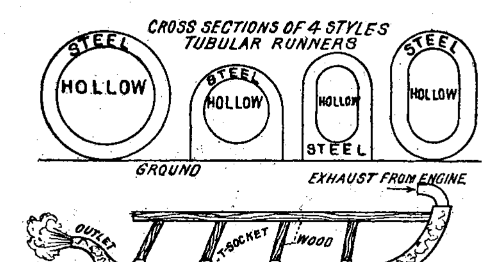
Cleveland, Ohio. JOSEPH R. OLDHAM.

DEFECTS IN MOTOR-SLEIGHS.

To the Editor of the SCIENTIFIC AMERICAN:

In reading the article on motor-sleighs in the SCIENTIFIC AMERICAN for February 27th, 1909, I saw that the main trouble with motor-sleighs is their sticking when standing still, so that it is hard to get them under way. To facilitate their getting under way, the runners can be warmed. It is to let the engine exhaust through tubular steel runners, at the will of the operator, who can switch the exhaust from the regular exhaust to the runners for starting and then switch it back to its original place, as soon as the sleigh is under way. As may be seen, the exhaust will warm the runners so they will not stick. To use this device on the Austrian Wells motor-sleigh: In starting, you would start the engine and switch the exhaust into the runners and start the propeller, behind the sleigh, going fast enough so that when the runners did not stick any more, the sleigh would glide ahead. This done, you would switch the exhaust to its original place.

To use this scheme on a belt driven or planetary transmission, you would switch the exhaust into the runners after starting the engine, and put on a little power, either letting the belt slip until the sleigh starts or not quite entirely throw in the planetary transmission clutch. The same would hold good on a friction drive, for you could put on a little power and let the disk slip until the sleigh started. The whole operation is quite simple.



SCHEME TO OVERCOME DIFFICULTY IN STARTING A MOTOR-SLEIGH.

The back end of each runner has a cap which can be unscrewed to allow the runners to be cleaned inside. Near the back end of each runner a pipe branches upward and backward; this is the place the exhaust leaves, in order that snow will not clog the runner-pipe in backing.

The braces to the runners can be fastened to the runners by means of T sockets, which are fastened to the runners by welding, rivets, or screws.

The exhaust pipe from the engine can divide into two pipes, one for the regular exhaust, and the other divides into two pipes, each to a runner. A valve is to direct the exhaust through either the regular exhaust or through the runners.

Washington, Conn. MEREDITH CLARK.

The Current Supplement.

A novel system of automatic railway signaling is described and illustrated in the opening article of the current SUPPLEMENT, No. 1735. An authoritative life of Thomas A. Edison will shortly be published from the pens of Frank L. Dyer and T. Commerford Martin. From this life we abstract a chapter which sets forth in figures the commercial value of Edison's inventions. In an article entitled "Testing the Hardness of Metals," the various methods of testing hardness are reviewed at length. W. R. Turnbull writes on his original studies of the efficiency of the aerial propeller. Modern Experimental Biology is again discussed in an excellent article entitled "Artificial Mutations of Animals and Plants as the Basis of Technical Biology." K. Sajo writes on the sense of hearing in insects. "Silver Plating" is the title of a good technological article.

A Chance for Rubber Heel Inventors.

The inventor of a well-known, widely-advertised rubber heel for shoes has expressed a desire to examine patents covering rubber heels, or even mere ideas. Inasmuch as many readers of this journal are inventors of rubber heels, it will give the Editor pleasure to place them in communication with this manufacturer. Inquirers should send in printed copies of their patents to be forwarded, if their ideas are patented.

OUR NEW 26,000-TON BATTLESHIPS.

The recent decision of Congress authorizing the construction of two battleships of 26,000 tons displacement, assures to the United States navy the possession of the two largest battleships ever built; for 26,000 tons is about 5,000 tons greater than the displacement of any foreign battleship now under construction. The next in point of displacement are the latest "Dreadnoughts" of the Japanese navy, of about 21,000 tons, and the latest British "Dreadnought" of about 20,000 tons.

So that if there is any cause for congratulation in the fact of the possession of the biggest fighting ship in the world, we are entitled to no small amount of national self-felicitation. The time is approaching, however, when we may well begin to ask if we are not somewhat overdoing this question of size; whether, indeed, the total displacement of 52,000 tons represented in these two ships could not be divided up to better advantage in three "Dreadnoughts" of more moderate dimensions. But that is another story.

The two big ships will be a logical development of the "North Dakota" and her successor the "Florida," now building at the Brooklyn navy yard. The "Florida" will displace 22,000 tons, and a ship of her size does not require much increase in the individual dimensions to secure the additional 4,000 tons. The length over all is increased from 521 feet 6 inches, to 545 feet; the beam from 88 feet 2½ inches to 92 feet; and the draft from 28 feet 6 inches to 29 feet. In general outline, in the disposition of the guns, masts, smokestacks, superstructure, etc., the new ships will conform very closely to the "Florida." The principal change is in the addition of a two-gun turret, containing a pair of 12-inch guns. By comparison with the drawings of the "Florida" or "North Dakota," it will be noticed that the additional turret is placed between the two after turrets, and that it is elevated sufficiently to permit its guns to fire on the axial line, astern, over the roof of the turret astern.

All of the guns are carried on the median line of the ship. Turrets Nos. 1 and 2 will be mounted on the forecastle deck, which has a freeboard of 28 feet. The axes of the guns in No. 1 turret will be about 34 feet above the water and the axes of those in No. 2 turret will be about 40 feet above the water. Aft of this turret will be the conning tower and the comparatively small bridge which is characteristic of the latest battleships. Abaft of the conning tower will be the fore fire-control mast, flanked by searchlight towers. This type of mast has been adopted as standard for our new ships. Abaft of this is the forward stack, abreast of which are two small open-work towers, carrying each a large searchlight. Then follow in their turn the main fire-control mast (both masts rise 120 feet above the water) and the after smokestack, and immediately abaft of the smokestack is a second open tower surmounted by a searchlight. The ship's boats are carried in two nests, one on each beam, and they are handled by a pair of boat cranes, the masts of which are surmounted by searchlights.

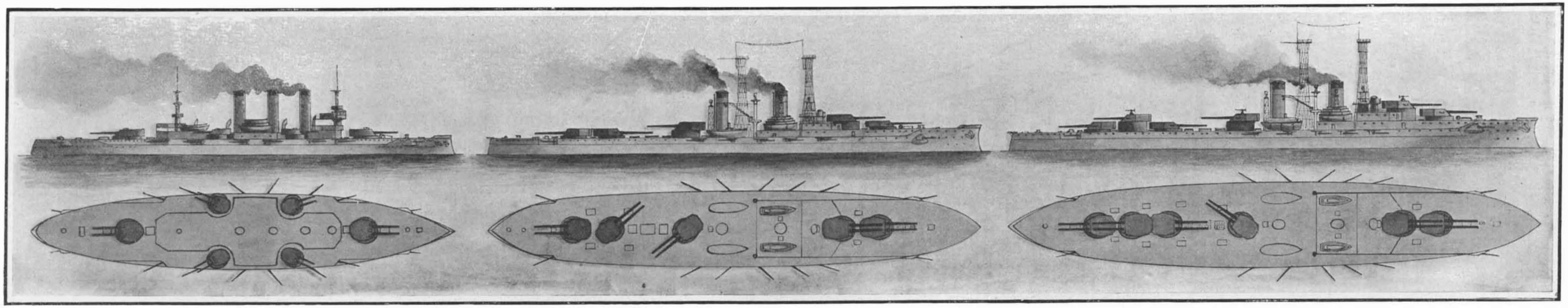
The forecastle deck is carried aft as far as the mainmast. From this point the main deck extends flush throughout the remaining length of the ship, and upon it are mounted eight of the 12-inch guns, in four turrets. Turret No. 3 is placed immediately abaft the after smokestack, and the axes of its guns are about 32 feet above the sea. Then comes the engine-room hatch and abaft of this a group of three turrets, of which Nos. 4 and 6 carry their guns at an elevation of 25 feet above the sea, while the guns of No. 5 have a command of about 32 feet.

The guns will all be of the new pattern 50-caliber type, throwing an 850-pound shell with a muzzle energy of 50,000 foot tons. Four of these guns can be fired ahead, four astern, and the whole battery of twelve can be trained through wide arcs on either broadside.

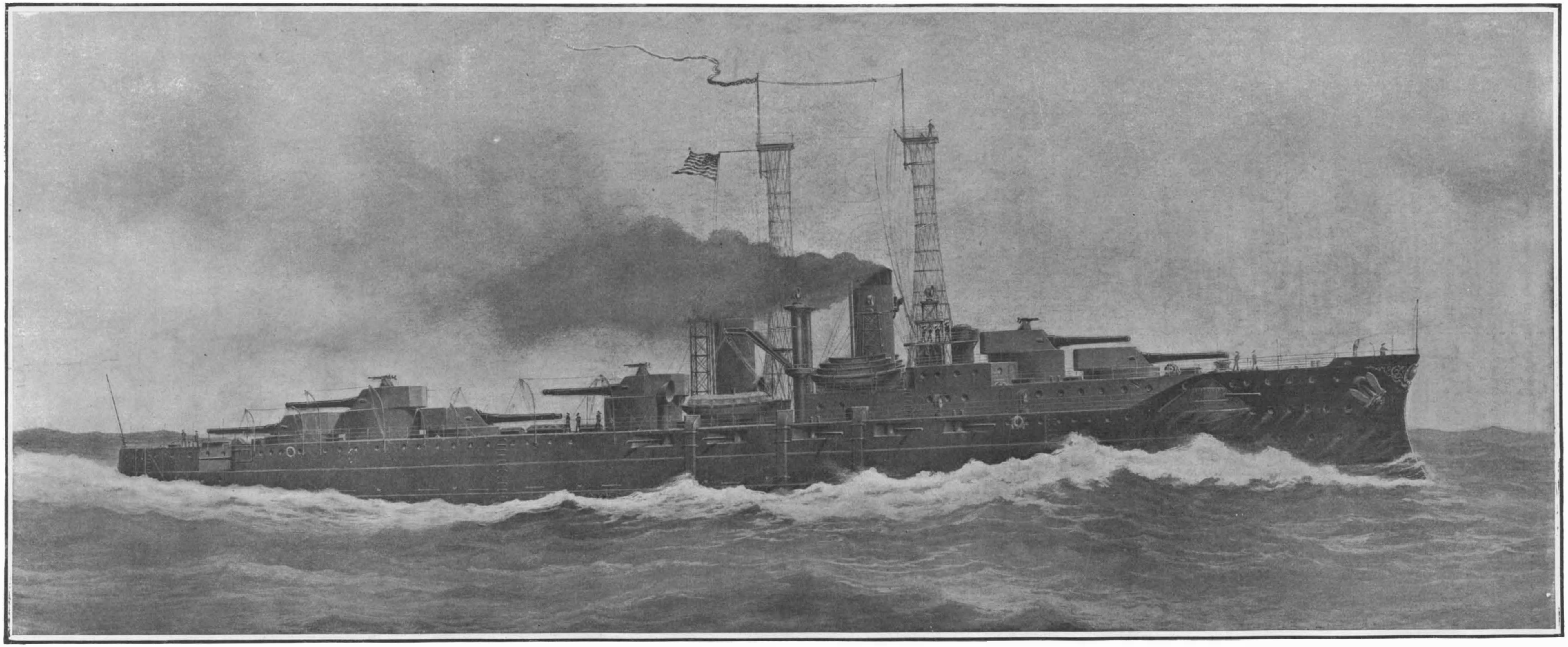
For defense against torpedo attack, the ship will mount a numerous battery of 50-caliber 5-inch guns, of high velocity. Two of these will be carried forward in sponsons under the forecastle deck, and the others in broadside on the gun deck behind 8 inches of armor protection.

One result of recent target practice and maneuvers and the experience gained in the cruise around the world has been to enhance the value of the 3-inch gun for torpedo defense. On the new ships and those that are now building, and on all the ships of the Atlantic squadron that have recently returned from the cruise, a large number of these pieces will be mounted—as far as possible on lofty positions. In the new 26,000-ton ships a pair of these guns will be carried upon the roof of the turrets whose guns have the loftiest command, as shown in our engraving on turrets 2, 3, and 5.

The general plan of armor protection will be similar to that of the "North Dakota" and "Florida," but with certain improvements. The main belt, which will extend from 3½ feet above to 6 feet below the normal water line, will be 11 inches thick at the top and 9



"Connecticut," 16,000 tons. Four 12-inch; eight 8-inch; twelve 7-inch; 20 3-inch. Date 1903. **"North Dakota,"** 20,000 tons. Ten 12-inch; fourteen 5-inch. Date 1907. **Enlarged "Dakota,"** 26,000 tons. Twelve 12-inch; sixteen 5-inch. Date 1909.



Length, 545 feet. **Beam,** 92 feet. **Draft,** 29 feet. **Displacement,** 26,000 tons. **Horse-power,** 33,000. **Speed,** 21 knots. **Coal supply,** 3,000 tons. **Armament:** Twelve 12-inch; sixteen 5-inch. **Armor:** Belt and barbettes, 11-inch; sides, 8-inch. **Complement,** 1,100 officers and men.

THE LATEST UNITED STATES "DREADNOUGHT" OF 26,000 TONS DISPLACEMENT.

inches thick at the bottom. Above this will be a wall of armor extending from abreast of turret No. 1 to abreast of turret No. 3, which will be about 15 feet in height and will vary in thickness from 10 inches at its bottom edge to 8 inches at its top edge, which will be flush with the main deck. Behind the protection of this wall of armor will be the greater part of the 5-inch gun battery. The barbettes and turrets for the 12-inch guns will carry armor of from 10 to 11 inches in thickness. A considerable amount of the displacement of these ships will be devoted to rendering them more stable when they have been struck at or below the waterline by shell or torpedo. This protection will consist of longitudinal and transverse bulkheads of extra stiffness and strength, in the riveting of which particular care will be taken to secure joints that will hold water, even under the heavy stress of flooded compartments. This work is of a character that does not make a spectacular showing, or convey the impression of fighting strength that is due to the guns, turrets, and other visible portions of the ship above the waterline; but it is of vital importance for the all-round efficiency of a battleship. In this respect our new ships, and our "Dreadnoughts" in general, are believed to be superior to contemporary foreign ships of the same type.

To drive this 26,000-ton mass at 21 knots calls for a considerable increase of engine power. The ships will be driven by turbines, either of the Curtis or Parsons type. If of the latter type, they will have four screws; if of the former, two screws. Before the question of type of engines is decided, however, the full data of the competitive trials of Parsons, Curtis, and reciprocating engines on our scout cruisers will be available, and we think it is more than likely that the Curtis type will be found to have sufficient points of superiority to warrant its adoption in the new ships. The total contract horsepower will probably be about 33,000. This, if Curtis turbines are used, will call for the development of between 16,000 and 17,000 horse-power on each shaft—an amount that has already been exceeded on each of the four shafts of the Cunard liner "Mauretania," which, however, is driven by Parsons turbines. The contract speed will be 21 knots, and it is probable that the bunker capacity will be sufficient, with full stowage, for 3,000 tons of coal.

The above description and the accompanying illustrations of the ships approximate closely to the plans in their present state of completion. The main features will be as shown and described, though minor alterations may be made before the final contracts for the two vessels are placed.

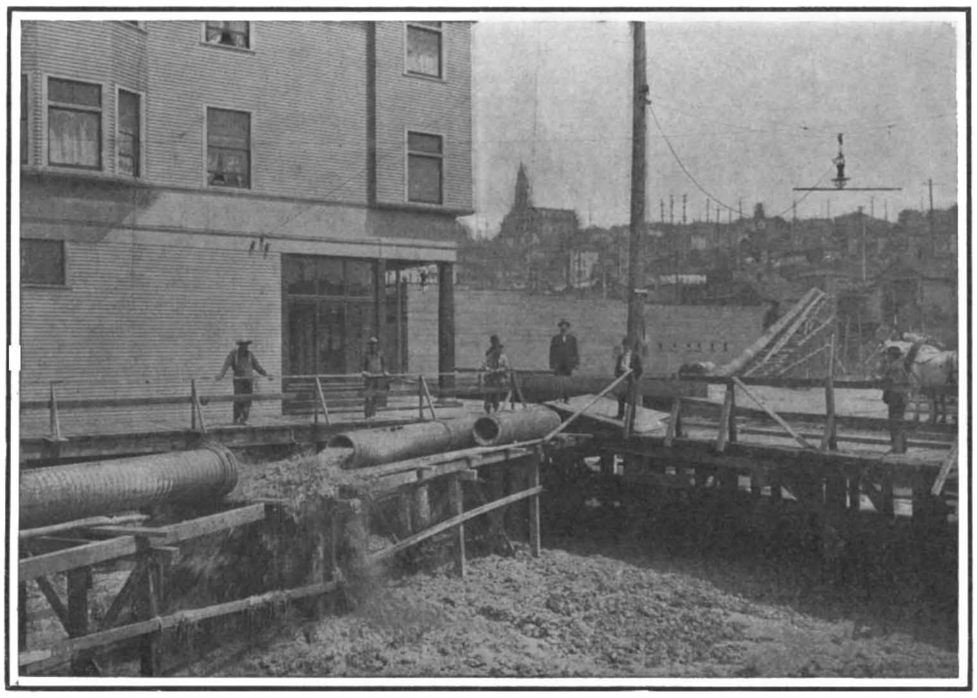
In educating users in the proper care of a storage battery, there is still a great deal of work to be done. The majority of automobiles are cared for in garages, not always to their benefit. The owner of an electric car usually does not attempt to care for his own machine and do his own charging until he has familiarized himself with the work. Moreover, he is dealing with his own property, and therefore naturally gives it special attention.

REGRADING A CITY BY MEANS OF HYDRAULIC SLUICING.

BY J. MAYNE BALTIMORE.

The city of Seattle, Wash., which has quadrupled its population in much less than two decades, has found its growth badly hampered by the succession of hills rising from the water level of the Puget Sound, over which the city has been forced to expand.

At an expense of more than three million dollars, the hills are being washed into the fills; the tide flats are being filled level, for business and manufacturing purposes, and steep grades are being reduced to smooth the way for commerce and to encourage the growth of manufacturing and other lines of business. To do this work it has been found necessary to "make over" a large section of the city already built. Hundreds of houses have had to be moved out of the way of the work of regrading. In addition churches, schoolhouses, and business structures have been remodeled or torn down. Paved streets, water mains, and sewers, have also been dug up to be replaced with better ones, when the work of regrading has entirely been completed. The work accomplished and in progress covers 374 blocks located in the very heart of Seattle, while the work thus far completed covers 239 blocks.



One of the sluice pipes delivering mud on the tide flats.

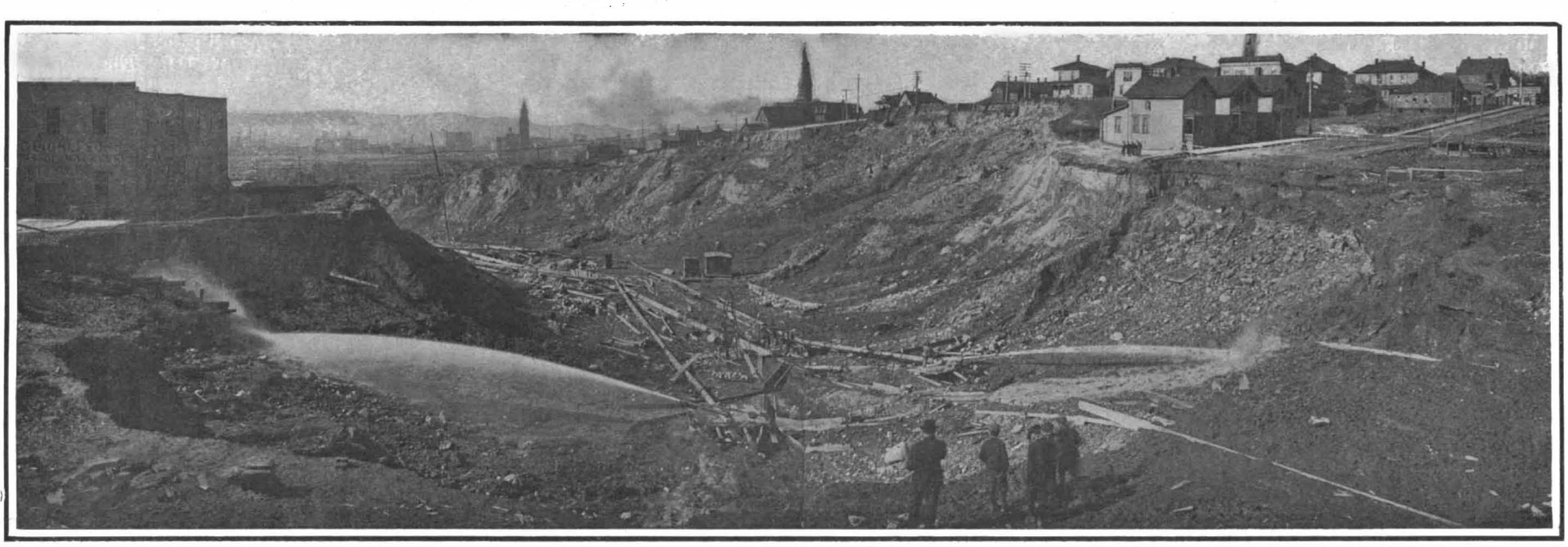
In one place the level of Third Avenue, one of Seattle's principal streets, is being lowered 107 feet, and several blocks in the Jackson Street regraded district which extends to the Seattle tide flats have been filled to a depth of 46 feet, and more. So far over ten million cubic yards have been removed out of the total of 13,586,977 cubic yards involved in this entire colossal piece of engineering.

The work has progressed very rapidly. At first giant steam shovels were used; but later a new method of excavating was adopted, namely, the substitution of hydraulic jets for steam shovels. This is the first time that hydraulic methods have ever been used on the Pacific Coast for street grading purposes. So powerful are these jets that they quickly tear down the hills. The vast masses of disintegrated earth are carried away through flumes and big pipes to the fills and the tide flats some distance off—often many blocks from where the hydraulicking is in progress.

The method is simply the application of hydraulic mining methods to excavating, on a very large scale. Streams of water are forced through great mains from a central pumping plant, and are directed against the hills through "giant" nozzles, and the clay and dirt crumble and melt away before these streams like snow under a warm rain.

It frequently happens that the main lines of cable and electric cars have been blocked for a day or two by some house on its way to a new location; and in many sections of the city where the grade of streets has been lowered 30 or 40 feet without lowering adjacent property, residents have been compelled to reach their front doors with long ladders, until flights of steps have been constructed.

So rapidly have the contractors been crowding forward this regrading piece of engineering work, that they expect to have it all completed within a period of three or four months.



Washing down a hill by means of "giant" hydraulic jets. The mud is carried down to the tide flats.

REGRADING A CITY BY MEANS OF HYDRAULIC SLUICING.

Transferring Proofs to Celluloid.

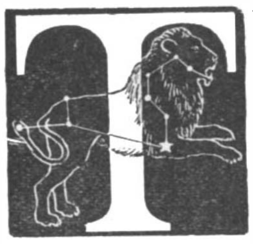
For making slides for lantern projection, or where for any reason it is desired to transfer to a flat celluloid surface a printed proof—such, for instance, as an illustration from a book, magazine, or newspaper—a process recently made public in Germany is very simple and effective. The surface to which the proof is to be transferred is rubbed gently for about two minutes with a rag or a ball of cotton wool dipped in alcohol. For this purpose the ordinary "denatured" alcohol, if colorless, is just as good as the pure, and much cheaper. The proof to be transferred is then promptly laid face downward on the plate, and pressed firmly thereon for about fifteen seconds—for instance in a copying press—several thicknesses of paper being put below the celluloid and over the proof, to equalize the pressure. The result is that all the lines of the engraving are transferred, naturally left-handed, to the softened surface of the celluloid. The paper must be withdrawn before the celluloid hardens.

Should, however, the softened surface harden too quickly, the paper may be removed by rubbing with a wet sponge; the impression of the picture will not be injured. Fresh proofs transfer more readily than old ones; but even the oldest printed lines will leave the paper and adhere to the partly dissolved celluloid.

It is reported that some time ago Mr. Louis Brennan made an offer of his monorail to the Australian Commonwealth, and the late government was considering the proposal at the time of its going out of office. The terms of the offer were that in consideration of the Commonwealth providing $57,500 for the construction of the first full-sized car, and to enable the inventor to perfect his invention, the Commonwealth government should have the sole right for Australia to manufacture other cars on payment of a royalty of 5 per cent on the cost price of all cars built within ten years after delivery of the first car ordered by the Commonwealth.

THE HEAVENS IN APRIL.

BY HENRY NORRIS RUSSELL, PH.D.



THE constellation Leo (which is illustrated in our initial letter) is one of the easiest to recognize in all the heavens. There is nothing else in the sky like the familiar "Sickle," with the bright star Regulus at the end of the handle; and, once seen, it can hardly be forgotten. Regulus is in the Lion's heart, and the curve of the sickle nearly outlines his head. The three bright stars to the eastward are in his hind quarters and tail. Besides these, two fainter stars (not shown on our map) west of Regulus mark his fore paws, and the line of his hind legs is indicated by three small stars south of θ; and so, all told, we have one of the best cases (alas! too rare) of resemblance between a constellation and the thing for which it is named. The very bright object near the middle of the constellation is Jupiter.

Some of the individual stars of the Lion deserve our notice. Regulus, according to the parallax measurements of the Yale Observatory, is a distant star, whose light takes about a century to reach us. To look as bright as it does, at so great a distance, it must really be of very great luminosity — according to the best data, about three hundred times as bright as the sun, or ten times as bright, in reality, as Sirius (which looks so much brighter because it is over ten times nearer us).

The next star, in order of apparent brightness, in Leo is β Leonis, or Denebola, at the other end of the constellation. The Yale observers have also measured its distance, and find it about one-third of that of Regulus. Its real brightness comes out some ten times that of the sun.

None of the other conspicuous stars in Leo has been the subject of measures for parallax, and so we cannot continue our catalogue of their distances and real brightness. But the star γ deserves attention as a very fine double, whose components, one three times as bright as the other, are separated by about 3½ min. of arc, and so can be easily seen in a small telescope, with a suitable eyepiece. These two stars are moving together through the sky, but their relative motion shows no sign of curvature as yet. It is probable that they are really revolving about one another, but in a period of thousands of years, and an orbit so large that the little piece of it over which they have passed during the century looks like a straight line. Below Leo, on the left, is Virgo, with one bright star, Spica, which, like Regulus, is at an enormous distance from us. The star γ in this constellation is again a fine double. It can be easily found on the map, or without it, a little less than half way from Spica toward Denebola.

In this case the period of revolution is about 180 years, and almost a complete revolution has been observed. The orbit is a very eccentric ellipse, and the two stars, which are now not far from their greatest separation, were separated by only 1/15 their present distance in 1836.

Below these constellations we find the huge Sea Serpent, Hydra, with two small groups, Corvus and Crater. The latter is inconspicuous, but the former is quite prominent. Its two uppermost stars point toward Spica, just as the "Pointers" do toward the Pole Star. The one nearest Spica is double—a much wider pair than those mentioned above. The star ϵ Hydræ (in the Serpent's head) is too remarkable a double to pass by. It has an eighth-magnitude companion, 3½ min. distant, which is visible with a small telescope. A large one brings out a fainter attendant, six times as far off, and a very powerful one reveals that the principal star itself is a very close double. This last pair is a rapid binary, completing a revolution in about fifteen years. The other two stars belong to the same system; but their periods of revolution must be counted by hundreds of years in one case, and thousands in the other.

In the last we find Boötes, whose chief star, Arcturus, forms an almost equilateral triangle with Denebola and Spica. Below its northern portion are Corona and Hercules (just rising). Draco is displayed, head downward, in the northeast, and Ursa Major is above, north and east of the zenith. Cassiopeia and Cepheus lie low along the northern horizon, and Ursa Minor extends to the right from the Pole. Perseus is low in the northwest, with Auriga above him. Orion, with Taurus on the right and Canis Major on the left, lights up the western sky. Gemini and Canis Minor higher up complete the tale of the brighter constellations.

THE PLANETS.

This is a poor month for the planetary observer. Only Jupiter is well placed, though Mars can be seen in the small hours of the morning.

Mercury is in conjunction with the sun on the 21st, passing behind him. Before this time he is nominally a morning, and afterward an evening star, but he is practically invisible all the month.

The same, word for word, may be said of Venus, except that the date of her conjunction is April 28th.

At 11 o'clock: Mar. 8.
At 10½ o'clock: Mar. 16.
At 10 o'clock: Mar. 23.

At 9½ o'clock: March 30.

At 9 o'clock: Apr. 7.
At 8½ o'clock: Apr. 14.
At 8 o'clock: Apr. 22.

NIGHT SKY: MARCH AND APRIL

Mars is morning star in Sagittarius, rising about 2 A. M. in the middle of the month, and only moderately bright.

Jupiter is in Leo, and comes to the meridian about 9 P. M. in the middle of the month. He is by far the most conspicuous object in the evening sky and, next to the moon, the one which most repays observation with a small telescope.

Saturn is in conjunction with the sun on the 3d, and is practically invisible, except just before sunrise at the end of the month.

Uranus is in quadrature with the sun on the 11th, and comes to the meridian at 6 A. M. Neptune is likewise in quadrature, on the 4th, but, being east of the sun, souths at 6 P. M.

THE MOON.

Full moon occurs at 3 P. M. on the 5th, last quarter at 9 A. M. on the 13th, new moon at midnight of the 19th, first quarter at 4 A. M. the 27th. She is nearest on the 18th, farthest on the 3rd and 30th. She is in conjunction with Jupiter on the 2nd, Mars on the 14th, Saturn on the 18th, Mercury and Venus on the 19th (when both planets and the moon are close together but all too near the sun to be seen), Neptune the 25th, and Jupiter once more the 29th.

Princeton University Observatory.

An Opportunity for Inventors.

Among the numerous opportunities open to inventive genius at the present time, there is one problem the solution of which, in view of its vital importance to certain flourishing industries, possesses advantageous financial possibilities. A flourishing trade is maintained in what may be termed the cheap and essential liquids of commerce, both of a domestic and industrial nature, which have to be placed on the market at a very low price. The best example of such a commodity is vinegar. Unfortunately, however, such liquids have to be stored for transit in substantial, well-built, durable barrels made of oak, such as are used for the more costly alcoholic liquors and beverages. The result is that the package is worth more than its contents. Where the material is being transported in bulk, say in casks of twenty-five gallons capacity or thereabout, the manufacturer seldom experiences any losses in non-returns or damage owing to their cumbrous nature, weight, and expense; but in those trades where recently it has been found necessary to adopt a small cask, say of six gallons capacity, to meet the demand of small tradesmen, different conditions prevail. The cask is small, and the purchaser often considers it a waste of time to return it to the manufacturer, while the imposition of a charge for non-return by the latter may mean the possible loss of a customer. Moreover, considerable expense is incurred in maintaining these barrels, which suffer severely from damage in transit, and consequently require periodical overhauling, such as rehooping. The result is that the manufacturer finds that the small cask trade is unprofitable, albeit it is a developing factor in his business. To remedy this state of affairs a demand has arisen for a new type of cask, and there are two possible solutions of the difficulty. One is the evolution of a strong small cask, capable of withstanding at least one railway journey, sufficiently cheap to enable the manufacturer to give it away with the contents. The second alternative is the production of a cask infinitely superior to the wooden barrel at present used, especially in point of durability, with necessity of repairs obviated, and comparing favorably with the oak cask in point of cost. The vessels of whatever material composed, must be of the same design as the ordinary cask, and must conform with the regulations of railways and other carriers of merchandise. Care must be exercised in selecting a constructive material which shall be able to resist the corrosive or other characteristics of the liquid with which it is to be filled—Chambers's Journal.

The following case-hardening mixture is recommended in the American Engineer and Railroad Journal. Put in a 2-inch layer of charcoal, broken into about 1-inch pieces, and pack it down in the bottom of the box used for the case-hardening. Then sprinkle about 1 pound of common salt over the charcoal, and 1 pound of pulverized sal soda over the salt. Then 1 pound of powdered resin is placed over the sal soda, and 1 pound of black oxide manganese over the resin. The material to be case-hardened is now laid on this, care being taken not to place the pieces too close together or too close to the sides of the box. Between the pieces, charcoal is filled in and well packed, care being taken to have about 2 inches of charcoal between the different pieces, if they be large. Now the sprinkling of the compounds on the work is repeated in reverse order, so that a 2-inch layer of charcoal is placed on the top of the box. Sprinkle a little salt on the top of the charcoal, then put the cover on the box, calk with clay, and place the box in the furnace from ten to fifteen hours, heating it to a bright red. Then cool it in cold, clear water.

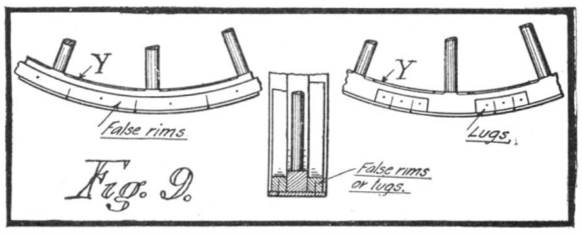
FURNISHING THE WORKSHOP.—V.

BY I. G. BAYLEY.

(Continued from the issue of March 13th.)

THE SCROLL-SAW.

The following description of a scroll-saw was given to the writer by a first-class mechanic, who assured him that it was one of the most useful articles he had in his shop; and judging by the number of times it was borrowed for cutting many shapes of ornamental

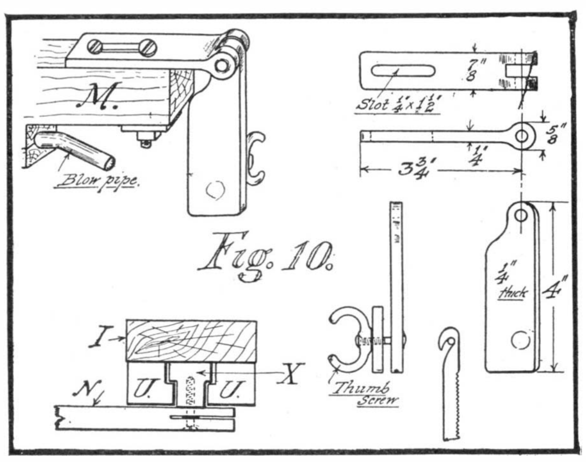


woodwork, which can generally be found in almost any kind of house building, it spoke well for the mechanic and the efficiency of the saw. Brackets up to 3 inches in thickness were easily cut out, and all the ornamental scroll work on the outside of his beautiful framed house.

A general side view of the saw is given in Fig. 13, while the lathe attachment, which will be described in the next article, is shown in dotted lines. The other illustrations give various details and sections. The reference letters, from *A* to *Z*, are duplicated on each figure, and tend rather to make an otherwise very simply constructed mechanism appear complicated.

While the proper sizes of lumber will be given, there is no reason why every part of the saw cannot be made from such material as may be found around almost any house.

It will be noticed that the framework consists of but three different sections of timber and 1-inch boards. The bottom framework is 2 feet 6 inches wide and 8 feet in length over all. The height from the floor to

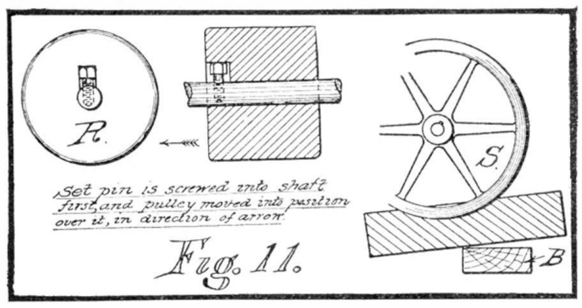


the top of the table, *J*, is 3 feet 7½ inches. A list of material follows, with allowance for cutting where necessary:

Pieces.		In. In.	Ft. In.
2	(A)	3 x 4	x 8 0
2	(D)	2 x 6	x 4 4½
2	(C)	2 x 6	x 3 4½
2	(I)	2 x 6	x 3 4½
6	(B)	2 x 6	x 2 6½
1	(P)	2 x 6	x 1 0
1	(G)	2 x 3½	x 4 6
2	(H)	2 x 3½	x 4 6
1	(E)	2 x 3½	x 3 3
2	(F)	2 x 3½	x 3 3
1	(Z)	2 x 3½	x 2 7½
1	(Q)	2 x 3½	x 0 6
2	(U)	2 x 2	x 1 0
1	(X)	2 x 2	x 0 8
1	(J)	1 x 36	x 3 0
2	(K)	1 x 9	x 2 9
1	(N)	1 x 3	x 5 1½
1	(M)	1 x 3	x 4 10½
1	(O)	1 x 2	x 5 9
2	(L)	1 x 2	x 2 0
2	(V)	1 x 2	x 1 0
1	(W)	1 x 2	x 0 7½
1	(T)	1 x 1½	x 1 9

The upright *D* can be made from a 4 x 6-inch instead of two pieces as given in list, and the guides *U* with the block *X* can be made from 1-inch stuff.

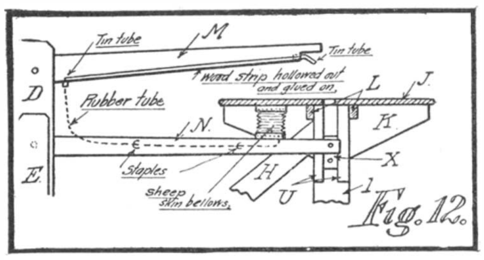
When level, the saw frames *M* and *N* are 15½ inches apart, out to out. Pieces are secured to the ends, 1-inch by 8-inch, cut to the same shape, and provided with holes for an adjusting bolt, with washers top and bottom. The holes should be of such a shape to give ample room for this bolt. Mortises are cut in *D* for the saw frame, 1⅛ inches wide by 4½ inches deep. They are centrally located with the frames, and the



top edge of the first mortise is 3 inches from the top of upright *D*.

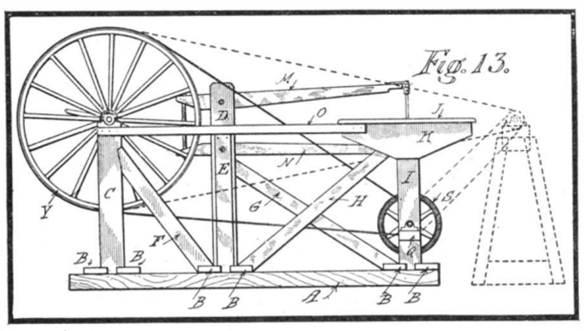
All the uprights and braces are cut where they come in contact with the bottom framework *A* and *B*; some of them being further secured to the inside face of the 3-inch by 4-inch sills with nails or screws. While nails will be permissible, if clinched, it will make a more satisfactory job to use screws throughout the construction. The bearings can be made of hard wood, if there is any difficulty in procuring suitable ones made of brass or iron.

An ordinary light buggy wheel, *Y*, is provided with



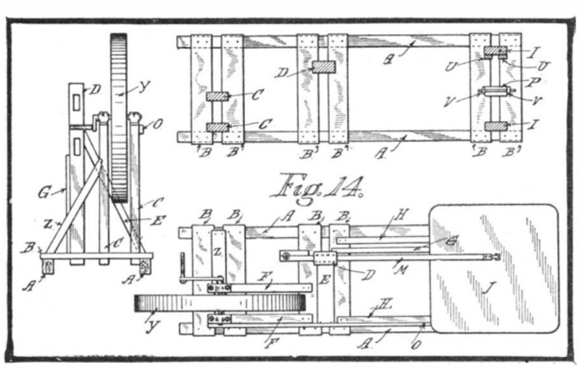
a 4½-inch rim, made of ¼-inch oak or pine, bent into shape by steaming or soaking in water, and secured to the tire of the wheel, *Y*, by means of two false rims, or lugs, as detailed in Fig. 9.

The saw blades are generally provided with a small hole at either end. By means of an ordinary wood screw or a bolt, one end of the saw blade can be connected to the arm *N* and the block *X*. The arm *M*, however, has a different attachment, to allow for the necessary alignment of the saw blade, and in all probability this will necessitate the aid of a blacksmith,



so a detail sketch is given (Fig. 10). The hole at this end of the saw blade is filed open to form a hook. Details of the guides *U* and the block *X* are also given in Fig. 10.

The balance wheel *S* was purchased from a junk dealer. It was found insufficient in weight, when heavy stuff was to be cut, so an extra wheel was put on the end of shaft beyond the out-bearing *Q*. A strip of wood *W* was secured to the vacant holes left by the spindle and crankpin of the old wheel, and a new center made for the end of the connecting rod *T*, giv-



ing a stroke of 3½ inches to the saw. The two strips *V*, secured to the upright *P*, are used to hold down the bearing by means of a hardwood wedge driven over the top, as indicated in Figs. 14 and 15.

The hardwood pulley *R* is 6 inches diameter and 5 inches face. It is secured to the shaft in the manner shown in Fig. 11. A simple brake, made from a piece of 3-inch by 4-inch timber, shaped on one edge to fit the rim of the wheel, and operated by the foot, is shown in Fig. 11, it having been omitted in the general views. The connecting rod *T* is made from hardwood, 21 inches long, 18 inches center to center of holes for two ordinary wood screws, to connect the ends to the block *X* and crank *W*.

Ordinary jig-saws are usually provided with bellows, so an arrangement similar in construction is given in Fig. 12. The bellows are of sheepskin or soft leather. The head is to be secured to the under side of the

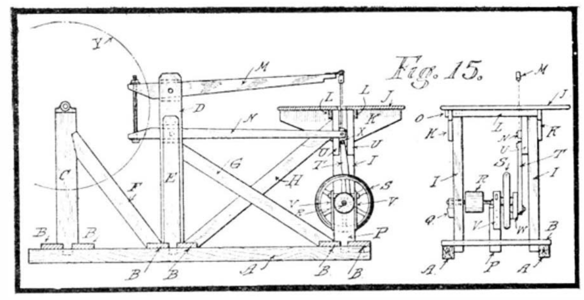


table *J*, and the bottom furnished with a leather flap valve on the inside. The opening must of course clear the arm *N*; so also must the tube connection.

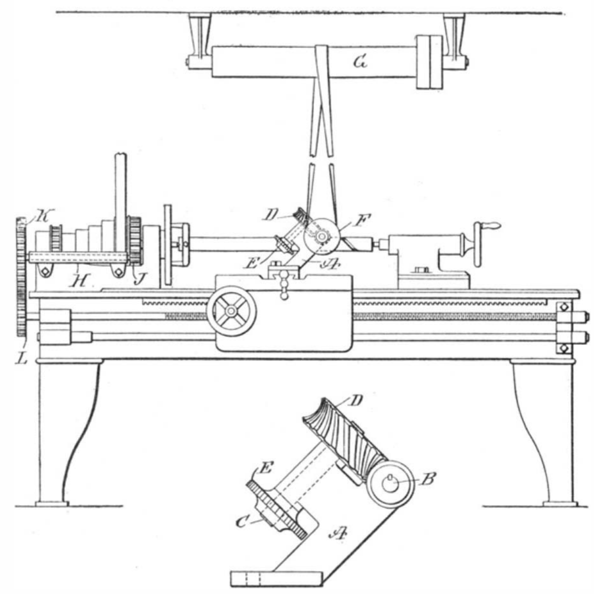
The motive power of this scroll saw is of course someone at the crank end of the driving wheel *Y*, but there is no reason why the wheel and its supports should not be taken off, and a small gas or oil engine connected direct to the pulley *R* with a belt. When the saw is not in service the wheel may be taken off and the framework placed against the end wall, or even hung up.

(To be continued.)

THE HANDY MAN IN THE FACTORY.

BY K. R. HENRY.

One is apt to think of the handy man as a pottering amateur, who delights to dabble at all classes of work, but cannot do any single thing in a thorough, workmanlike manner. While there are such handy men, they constitute only a part of the classification, which is broad enough to include the most skillful mechanics. In the large machine shop it frequently happens that a special piece of work of unusual character must be done. The ordinary mechanic is nonplussed. He cannot do anything out of the common run. But the handy man steps forward, and suggests a brand-new method of procedure, which solves the



A MILLING ATTACHMENT FOR THE LATHE.

difficulty. Every machine shop needs a handy man, and here is a case in point. In a certain factory where the writer was employed, a machine was being constructed which called for a 3-inch shaft cut with a spiral groove of very flat pitch. It was impossible to cut this groove with a screw-cutting lathe, owing to the unusual pitch. The piece was too large for the universal milling machines in the shop, and the pitch was not flat enough to be cut in a planer.

The handy man of the shop proposed that a milling attachment be used. Accordingly, a bracket *A* was made with bearings for two shafts *B* and *C*, lying in planes at right angles to each other, the one horizontal and the other inclined. The horizontal shaft *B* was fitted with a worm, which meshed with a gear *D* on one end of the shaft *C*, the opposite end of which carried a face mill *E*. The inclination of the shaft was such that the plane of the cutter coincided with the desired pitch of the spiral groove. The bracket *A* was bolted to the cross-feed slide of the lathe. The shaft *B* was fitted with a pulley *F*, which was belted to a long pulley or drum *G* on the countershaft above. A special gear was required to feed the carriage at the requisite speed. A bracket *H* was bolted to the headstock of the lathe, and furnished bearings for a shaft which was fitted at one end with a pinion *J*, adapted to engage the face gear of the back drive, and at the other with a gear *K*, adapted to mesh with a gear *L* on the feed screw. By this means a 12 to 1 reduction was furnished between the face plate and the screw. The low speed of the driving pulleys was used, so that a single rough cut and a finishing cut sufficed to form the spiral groove in the shaft.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

CLOTHES-HANGER.—H. K. SMITH, Union S. C. The invention provides a hanger which can be used for hanging up suits, jackets, etc., and which will dispense with the ordinary hooks in connection with the body or main bar of the hanger. The hanger will prevent snagging or tearing of garments resulting in the rush of business from the use of hooks in suspending the garment hangers.

Of General Interest.

MOLD AND MEANS FOR MAKING THE SAME.—E. A. CONNER, Tacoma, Wash. The mold is more especially designed for use in making concrete columns such as are used in buildings and other structures to permit of its being conveniently and quickly built up and each part accurately placed in position and firmly secured one to the other, and parts of the mold being readily removable after the column is built.

FIREPROOF WALL.—W. DRYDEN, New York, N. Y. The invention relates to fire-proof construction, and the object is to produce a wall which will resist the passage of flame through it. It concerns itself not only with the construction of the wall itself, but also with the blocks out of which the wall is constructed.

COLLAPSIBLE PACKING-BOX.—M. T. LYNCH, JR., New York, N. Y. The aim in this instance is to provide a packing box, more especially designed to take the place of expensive wooden packing boxes, and which is durable in construction, capable of standing hard usage in shipping and the like, and at the same time fully protecting the contents of the box.

Machines and Mechanical Devices.

CLOCK COMBINED WITH COIN-FEED WINDING-UP APPARATUS.—A. G. P. WIINGAARD, Romersgade 3, Copenhagen, Denmark. The present invention pertains to a clock in which a clock combined with a winding up mechanism is provided with a stop device arranged in the clock, which device when in the normal position prevents the clock from being wound up. This device is released by means of a coin introduced into the clock through a coin chute.

CHANGEABLE-SPEED GEARING. — W. MORROW, Fremont, Neb. The gearing is such as used in connection with motor cycles or any other types of machinery where it is desirable to increase or decrease the speed rapidly while the machine is in motion. One object of the invention is to provide a changeable speed belt driver which may be adjusted while the machine is in motion.

MICROMETER-GAGE. — L. MASTRANGEL, New York, N. Y. The invention provides a standard serving as a support for a laterally-extending arm, and at the end of the arm an indicating mechanism is provided whereby the distance between the end of a movable member at the end of the arm and the base for the standard may be read on a suitable dial carried by the arm.

APPARATUS FOR FEEDING FLOUR IRON ORE TO BLAST-FURNACES.—E. L. HARPER, JR., Big Stone Gap, Va. This invention refers to improvements in the apparatus for use in feeding of flour iron ore, that is, ore in an extremely fine state of subdivision, to blast furnaces, in such a manner that it will not be blown out immediately by the blast, but will become amalgamated with the molten mass in the bosh of the furnace.

DIPPING-MACHINE.—W. B. CROCKER, New York, N. Y. This invention relates to confectionery machines, and its purpose is to provide a machine, more especially designed for coating marshmallows held on biscuits or cakes with chocolate, icing, cocoanut or other coating material and without submerging the biscuits or cakes in the material.

BREAKAWAY-CLUTCH FOR ELEVATORS AND MINE-CAGES.—M. C. HUTCHINGS, Bozeman, Mont. The invention relates more particularly to self-detaching hooks such as are already known for use in the attachment of shaft cages or the like to the swing chains. An object is to provide a self-detaching hook which will automatically release the cable-hold when the elevator car or cage has been drawn too high, as when the engine which operates the winding drum is beyond control.

Railways and Their Accessories.

RAILWAY-WHEEL MOUNTING.—J. H. BROWN, New York, N. Y. The purpose here is the minimizing of the friction incident to, and the power required in, rounding curves, and reducing lateral stress on rails tending to spread the gage. To this end the wheel is pivotally supported at one side to swing in a horizontal plane, which admits of the turning of the wheel, by the contact of the flange with the rail, in the direction of the track. This is preferably done by journaling the axle in a bearing-box at the outside of the wheel, having substantially vertical trunnions.

LIFTING DEVICE.—J. P. RENEKER, Logansport, Ind. The invention relates to lathes for turning a pair of car or locomotive wheels mounted on an axle, and its object is to provide a device arranged to permit of conveniently lifting the wheels to bring the axle in axial alinement with the lathe centers, for the latter to engage the axle and allow the same to be rotated for turning the wheels.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12055) E. E. B. asks: 1. Could a 24-volt storage battery in an automobile be replaced with 12 dry batteries of 2 volts each in case of emergency? A. A dry cell when fresh may have 1.4 volts. To replace a 24-volt storage battery will require as many dry cells as 1.4 is contained in 24 volts, or 17 dry cells. 2. Would the motor in SUPPLEMENT No. 641 run a bicycle if more cells of battery were used? A. The motor in SUPPLEMENT No. 641 is not adapted to be attached to a bicycle, nor has it power enough to drive a bicycle. 3. Please give me formula for bichromate battery, and also for chromic acid battery. A. For a bichromate of potash solution take water 1 gallon, sulphuric acid 1 quart, and potassium bichromate 1 pound. Pour the acid into the water slowly with constant stirring, and add the bichromate while hot. Use when cold. Bichromate of soda may be used in place of the potash salt; many think to better advantage. For a chromic acid solution take 6 quarts of water, 1 pint sulphuric acid, and 1.5 pounds chromic acid. Mix and use as above.

(12056) C. C. W. asks: Will you kindly answer and settle a very simple but confusing question? A horse running away attached to a four-wheeled wagon turns a corner sharply, and the wagon overturns. Which way does it tip over? That is, in or toward the corner or outward or away from the corner? It is not supposed that the wheels stick in striking an obstruction that overthrows the wagon or that it is overthrown by cramping the wheels so as to tip it over. In going around the corner, the corner being a curve, can the inside wheels get off the ground? Will not the outside wheels gradually rise from the ground until the wagon tips in or toward the corners? A. Under the conditions you mention, when the wheels lock against the side of the buggy, it must turn over toward the side upon which the wheels are locked, i. e., toward the corner it is turning. This is the only case in which a vehicle turning a corner too sharply overturns inward; in an automobile, for instance, turning a right-hand corner, the right-hand wheels leave the ground first and it turns over onto its left side from its momentum tendency to go straight on. The causes are different in the case of the buggy, the inner side being first retarded by the locking of the wheel.

(12057) C. B. B. asks: I have a problem to submit, the solution of which will confer a great favor upon the writer. There are two large public halls with practically no ventilation; one is illuminated by gas, the other with electricity. Both rooms are occupied by the same number of people. In which room, the former or latter mentioned, is the air purest? Does not the gas have a tendency to purify the oxygen by consuming a large percentage of the impure air or hydrogen? A. Although not at all for the reasons you give, it has been sufficiently proven that under equal conditions of ventilation (whether good or bad) the air at breathing level in any room illuminated by gas will, after several hours' occupation by a number of persons, be more healthful than if the same room was electrically lighted. The products of combustion of a gas flame in air are largely identical chemically and nearly identical physically with those of exhalation from human lungs, and as the least quantity of gas consumed by a single burner (say 4 cubic feet of gas per hour for an atmospheric incandescent mantle) produces 2 cubic feet of carbon dioxide per hour, while an average man breathes out only 0.6 cubic foot per hour, one gas burner vitiates the air of a room more than do three persons. As incandescent electric lamps not merely add nothing to the impurities of the atmosphere, but withdraw no oxygen from it, it has been assumed not unnaturally that it must be the most hygienic form of illumination to employ; but in the years which have elapsed since electricity was first used for lighting purposes, experience has increasingly proved the contrary. The burning of gas does not in any way purify the air or consume any irrespirable constituents—quite the contrary; but because the heating effect of gas in proportion to its lighting effect is so much higher than that of electricity, the carbon dioxide, otherwise much heavier than air, is heated sufficiently to rush to the ceiling of a room, where its descent upon cooling is prevented by diffusion. The explanation involves chemical, physical, and physiological considerations and cannot be at all completely given here, but you will find it admirably discussed in an article by Prof. Vivian Lewes, a high authority on this subject, in our SUPPLEMENT, Nos. 1661 and 1662, which we shall be glad to send for 10 cents each, postage paid.

Legal Notices

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SMALL HOUSE NUMBER *of* AMERICAN HOMES AND GARDENS

THE artistic and inexpensive house is the chief demand of the home seeker of to-day. For that reason the April, 1909, number of American Homes and Gardens is a **SPECIAL SMALL HOUSE NUMBER.**

This issue contains a vast amount of most valuable information for the prospective home builder. It tells him how to select a country site, and how the various rooms of the house should be planned; the style of architecture in which the house should be designed; the material of which it may be built; the kind of plumbing fixtures to be used; the heating system to be selected; the choice of the hangings for the walls, doors and windows; appropriate furniture for the home; the interior decoration of the home; and the laying out of the grounds surrounding the house, as well as the planting of them.

THE ARTISTIC EXPRESSION OF THE SMALL HOUSE is well explained in an article by Francis Durando Nichols, illustrated with fifty engravings showing exterior and interior views and floor plans of a group of model houses of small size and small cost.

PLUMBING FOR A SMALL COUNTRY HOUSE, by John A. Gade, is a very important subject. No part of a house needs greater attention than the laundry, kitchen and bath room. Hence the economic and convenient placing of the plumbing fixtures, the kind to use, and the cost of the same are matters of interest to all prospective home builders.

THE MAKING OF AN IRIS GARDEN, by Samuel Howe, is an illustrated article showing how a swamp or lowland can be developed and transformed into a beautiful iris garden.

DECORATIVE FEATURES IN THE SMALL HOME, by Alice M. Kellogg, presents in a brief way with ten illustrations artistic schemes of covering the floors and walls of the house, harmonious and appropriate hangings for the doors and windows, with numerous suggestions for the decorating of the various rooms of the house.

A GROUP OF MODEL MOTOR HOUSES FOR THE SMALL COUNTRY PLACE, by Ralph de Martin, forms two pages of illustrations and sets forth the best designs for a small motor house suitable for the accommodation of one motor car and with sufficient space for a work bench.

HOME-MADE NOVELTIES FOR THE COUNTRY HOUSE, by Mabel Tuke Priestman, treats of the conversion of unlikely things into useful articles, and the illustrations show the results.

THE EVOLUTION OF THE SMALL HOUSE PLAN, by Joy Wheeler Dow, is an important article by a well-known architect on the economic planning of a small house, costing from $2,500 to $8,000. The plan and the arrangement of the rooms is the first thought given to the house and is one in which the layman should be most interested.

A FORMAL GARDEN AND PERGOLA, DESIGNED BY AN AMATEUR, by Alexander R. Holliday, informs the reader how an amateur planned and laid out his garden and how he built his pergola. Illustrated with plans and scale drawings.

PROPER FURNITURE FOR THE SMALL HOUSE, by Esther Singleton, with illustrations showing the artistic and appropriate furniture for the house, and the proper position in which it is to be placed, together with an accurate treatment of the fireplace and mantel.

THE USE OF CONCRETE IN THE BUILDING OF A SMALL COUNTRY HOUSE, by Benjamin Howes, is a timely and comparatively new subject, and is one in which much interest is shown at the present moment. The article is profusely illustrated with fifty engravings showing exterior and interior views and floor plans of small houses of various styles of architecture in which concrete is used with artistic results.

THE HEATING APPARATUS FOR THE SMALL COUNTRY HOUSE, by Allyn Frogner, is the title of an article treating in a practical manner one of the most important features of a small country house. How to heat and what is the cost? That is a question which has been well answered for the three respective systems of hot air, steam heat and hot water.

PROBLEMS IN PLANNING THE GROUNDS OF A SMALL COUNTRY PLACE, by Charles D Lay. Mr. Lay has explained in a very concise form how the grounds around a small country place may be planted at a very low cost, and enumerates the best and most effective shrubs and plants to be used.

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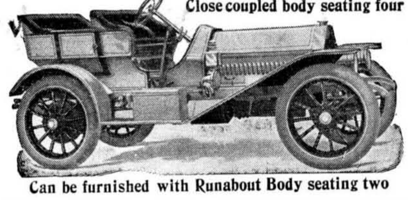

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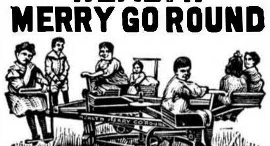

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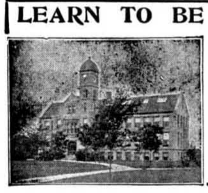

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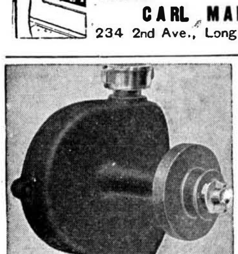

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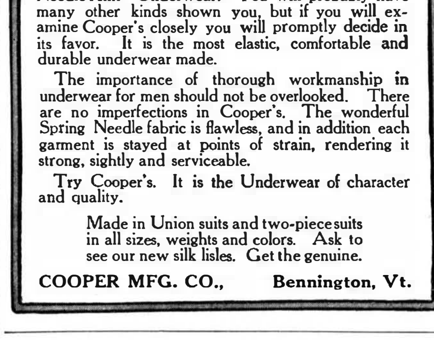

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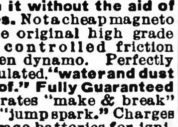

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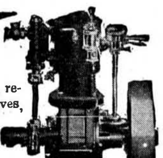

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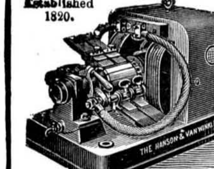

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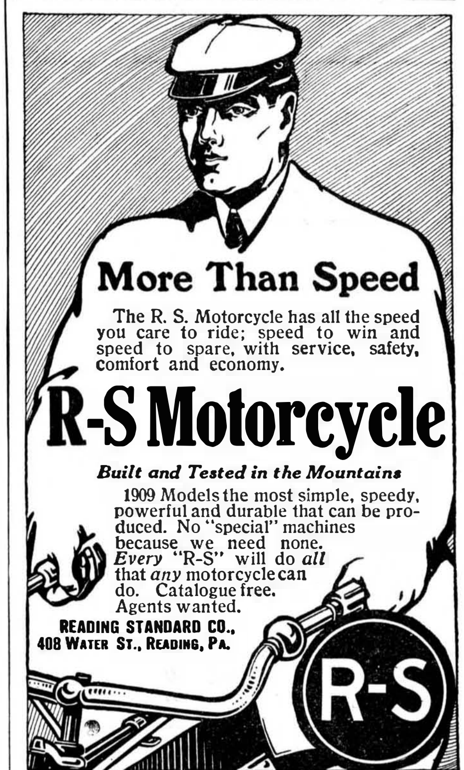

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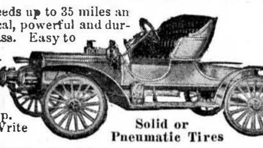

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