zontal plane; the ropes are roved around various pulleys, and finally as they pass through a "top" at the upper part of the machine they are twisted together to form the cable, and then after being roved around grooved sheaves to obtain the necessary pull are reeled up by a power-reel. When a sufficient length of cable is obtained, it is ready for shipment. In this plant there is a large horizontal rope and drilling-cable laying machine, but the principle does not differ materially from the vertical machine.

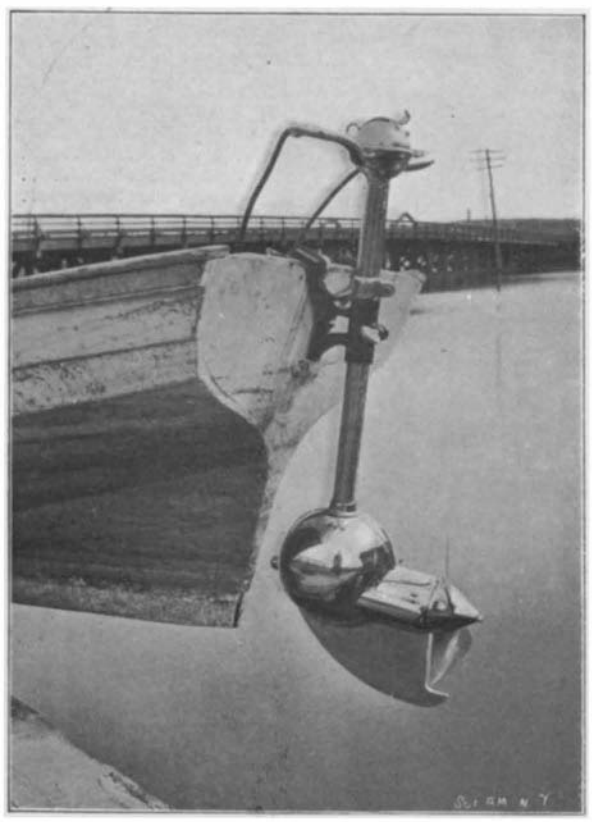
Ropes of considerable size, towing lines and ships' cables of the largest dimensions are made on the ropewalk, which is 1,100 feet long and which passes under one cross street. The yarn is rewound on larger bobbins, and the number used depends on the size of the rope. These bobbins are put on a framework of wood, located near one end of the ropewalk, and the ends of the yarn are passed through holes in an iron gage-plate shown in our first engraving of the ropewalk, and which is known as the face plate. It then passes through cast-iron tubes, and the yarn is fastened on hooks of the forming machine, which consists of a truck which travels on a track the entire length of the walk. There are as many hooks as there are strands. As the former moves away from the face plate it draws the yarn with it, and at the same time each hook revolves by means of gears, twisting the yarn left-handed into a strand. The machine is actuated by a cable which lies along the floor of the ropewalk. The cable passes over a large wheel at the left and serves to operate the mechanism which turns the hooks, and at the same time winds up a cable attached to the end of a ropewalk, thus making its motion positive. When the forming machine has reached the upper end of the ropewalk, as shown in our second engraving of the walk, the strands, each 1,100 feet in length, are completed. They are now taken and laid over on the other side of the walk, and the strands are then ready to be "laid" or made into rope. Two laying machines are required, one at each end of the walk, and are known as the "upper" and "lower" machines. They also give the rope what is known as a fore turn and an aft turn. As many of these strands as are required for the rope are stretched to full length and are attached to hooks on the laying machine. The upper machine has several hooks, but only one is used. All the strands are fastened to this hook and they turn left-handed in laying, and the lower machine has as many hooks as there are likely to be strands and operates in the opposite direction. The strands are meantime placed in the grooves of a conical wooden block called a "top," through which is passed an iron bar which is fastened to an upright post of a car called a "top sled." Pieces of rope called "tails" are fastened on the bar and wound round the rope to be laid. They help regulate the lay and assist in giving the rope a finish-gloss. The top having been mitered between the strands as closely as possible to the top, the sled is gradually forced along as the twisting proceeds in a right-handed direction. The lower machine keeps all the strands from untwisting. The top sled finally arrives at the lower end of the walk, with the full length of completed rope behind it. It is then compactly coiled by a reeling machine, covered with burlap and shipped to its destination.

At Postel in the district of Militch a cemetery 3,000 years old has been discovered. Two hundred graves have been unearthed under the supervision of the director of the Berlin Museum. The coffins are of stone, square in shape, and date from the bronze period.

A NEW SUBMERGED ELECTRIC MOTOR AND PROPELLER.

A propelling mechanism which can be transferred from one boat to another in a few minutes' time will be welcomed by many who use boats either for business or pleasure. The device which we illustrate only weighs from 30 to 45 pounds and can be removed at a moment's notice, and if desired can be taken into a boathouse for safety. The batteries weigh from 35 to 55 pounds each, according to their size. The motor and propeller occupy the place of the rudder, and the boat is steered by turning the sternpost. The motor itself is under water and is inclosed in a water-tight globe or shell, the storage batteries being placed in the boat. The motor not only propels the boat, but steers it as well, and the boat answers the propeller as readily as it does a rudder. It can be run at any speed up to four miles an hour using two crates of four cells, and a run of from 20 to 30 miles can be made on each charge. The motor is a series-wound, two-pole machine of slow-speed type. The armature is of the tunnel type with a smooth periphery and is capped with spun-heads so as to present a smooth and uniform surface to the water when revolving. The motor is entirely inclosed in a spun case made in two parts, and is supported from the tube above and held and protected by an aluminium pin below, which also protects the blade. The switch provides for two speeds in either direction and is located at the top of the tube. A bracket is clamped to the stern of the boat by thumb screws and allows the motor to be turned in any direction for steering. The tiller-head, which contains the switch, is connected to the battery by wires. These wires act as tiller cords. Brackets are supplied for either double-ended or flat-sterned boats, as may be desired. The wires to the batteries are provided at their ends with terminals which snap into sockets. There are no binding screws nor adjusting fastenings, so that it is impossible to connect the battery wrongly. The elements are placed in rubber cells which are secured in wooden boxes. The entire machine is nickel-plated. This very ingenious boat-propeller is made by the Submerged Electric Motor Company of Menomonie, Dunn County, Wis.

THE SUBMERGED ELECTRIC PROPELLER AT WORK.



SUBMERGED ELECTRIC BOAT PROPELLER.

A NEW AUTOMATIC TELEGRAPH REPEATER

A device for repeating telegraphic messages both with and without the use of sounders or other receivers at intermediate stations is the subject of an invention for which Mr. Julio E. Cordovez, of Panama, Colombia, has received a United States patent. The contrivance allows the use of the apparatus either for repeating purposes or for those of ordinary communication from station to station. Our description will be confined to the apparatus used with sounders.

In our diagram *A* represents the line-wire from one station, and *B* the line-wire from another station, the wires being connected with the binding-posts, *A'* and *B'*, respectively. The local battery, *C*, is connected by wires, *D* and *E*, with binding-posts, *D'*, *E'*. The poles of the main battery, *C'*, are connected by wires, *F G*, with the binding-posts, *F'*, *G'*. The binding-post, *H'*, is connected by the wire, *H*, with any suitable local apparatus, such as a telephone or a testing instrument. The various binding-posts mentioned are secured upon a board. From the post, *A' B'*, continuation-wires lead to a lightning-arrester, *J*; and the wires connect the lightning-arrester in turn with the switches, *A*4 *B*4, which are shown in engagement with contacts, *K K'*. The switches, however, can also engage another set of contacts, *L L'*, of a central contact, *M*, or rests, *N*, serving to hold the switches out of connection and to prevent them from catching in the various wires. The contact, *M*, is connected with the binding-post, *H'*. The switches can also engage grounding-plates, *O O'*.

The grounding-plate, *O'*, is connected by a wire, *F*2, with the binding-post, *F'*. From the grounding-plate, *O*, a wire, *P*, leads to the coils of a relay-electromagnet, *Q*, connected by a wire, *P'*, with the coils of an opposing electromagnet, *Q'*. A wire, *P*2, connects the coils of the electromagnet, *Q'*, with a contact, *R*, on a telegraphic key. The key has three contacts, *R R' R*2, insulated from one another. The contact, *R*, is normally engaged by a screw on the end of the key-lever. The contact, *R'*, is electrically connected with the key-lever and also with the contact, *L*. The contact, *R*2, is connected by wires, *P*4 *p*4, with the corresponding contact, *r*2, of another telegraph-key. The connec-

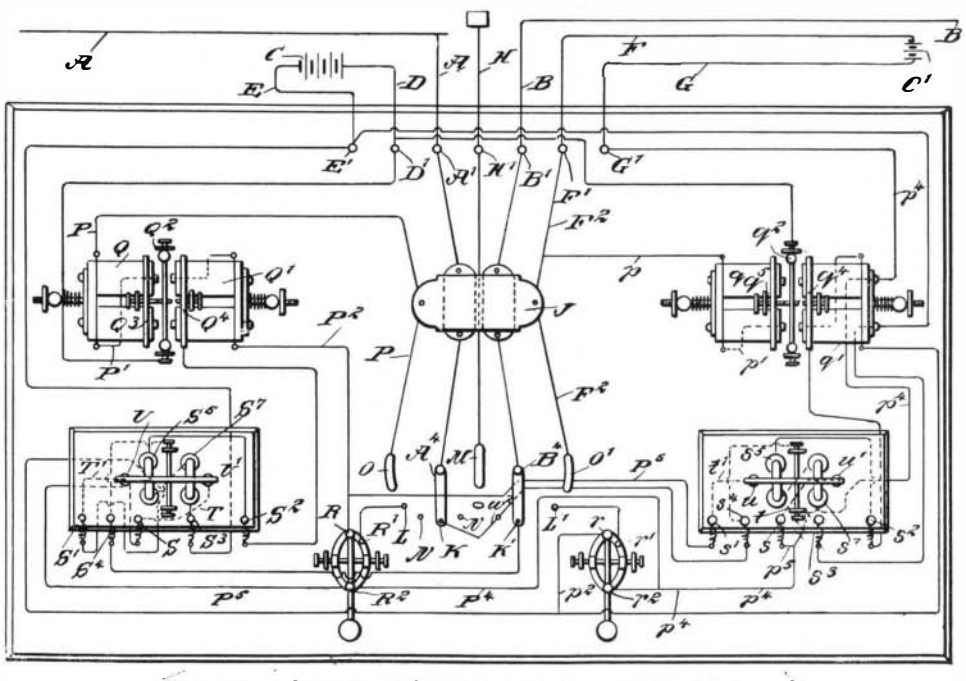
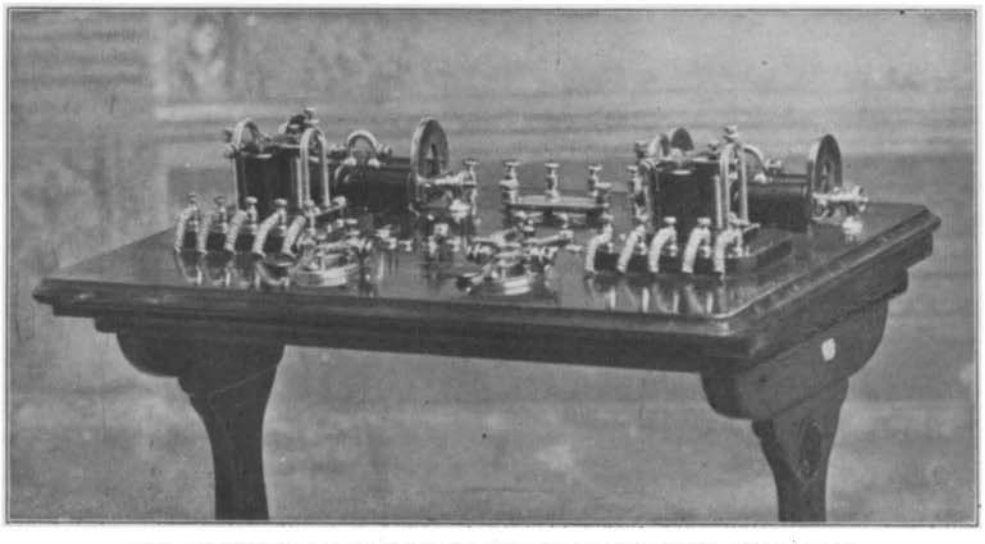


DIAGRAM OF APPARATUS IN WHICH SOUNDERS ARE USED.



THE CORDOVEZ AUTOMATIC TELEGRAPH REPEATING APPARATUS.

tions of this second key are similar to those already described, small reference letters being used similar to those designating the parts on the left-hand side of the apparatus. The wire, *p*4, is connected with the binding-post, *G'*, and also by a wire, *P*5, with a binding post, *s*, of the sounder or circuit closer, which post is connected by a wire, *t*, with a contact, *u'*, arranged to be engaged by the armature of the circuit-closer. The same connections are provided on the left-hand side of the apparatus and are there presented by capital letters. The armatures normally engage the contacts, *u U*, connected by wires, *t' T'*, with binding-posts, *s' S'*, from which wires respectively lead to the wires, *P*2 *p*2. The binding-post, *D'*, is connected by wires with the relay-armatures, *Q*2 *q*2, normally engaging the stops, *Q*3 *q*3. In their other positions the armatures engage contacts, *Q*4 *q*4, connected by wires with binding-posts, *S*2 *s*2, of the circuit closers. From these posts wires lead to the coils, *S*6 *s*6 *S*7 *s*7, from which wires lead to the binding-post, *E'*. Finally the armatures of the circuit closers are wired to the binding-post, *S*4 *s*4, from which wires lead to the contact, *K' K*.

The cores of the relay are arranged on opposite sides of the armature, and with the cores permanent magnets are connected. The magnets and core-coils are so arranged that a current passing through the coils will increase the magnetism of the core on one side of the armature and decrease the magnetism of the core on the other side of the armature. A similar magnetic connection of the cores with the permanent magnets characterizes the circuit closer.

With the switches, *A*4 *B*4 (or one of them) on the grounding-plates, *O O'*, the current passes from the line, *A* (or *B*) to the binding-post, *A'* (*B'*), through the wires to the switch, *A*4 (*B*4) to the ground. This grounding connection could be used, for example, in detecting and locating a leak in the line or for connecting the line with the earth during thunder storms.

With the switch, *A*4 or *B*4, on the central contact, *M*, the current will pass from the line, *A*, for example, to the binding-post, *A'*, through the wires leading to the switch, *A*4, through contact, *M*, through the wire leading to binding-post, *H'*, and through wire, *H*, to any local instrument. This connection is of particular service upon lines where the same wire is used at times for telegraphing and at others for telephoning.

With the switch, *A*4, on the contact, *L*, the current will pass from the line, *A*, to the binding-post, *A'*, switch, *A*4, to the contacts, *L R'*, the key-lever, contact, *R*, the wire, *P*2, coils, *Q'*, wire, *P'*, coils, *Q*, wire, *P*, and to the earth at *O*. This will energize the coils, *Q Q'*, in consequence of which the armature, *Q*2, will leave the stop, *Q*3, and swing against the contact, *Q*4. This closes the following local circuit; from the battery, *C*, by wire, *D*, and binding-post, *D'*, to wire, *W*, armature, *Q*2, contact, *Q*4, binding-post, *S*2, coils, *S*6, coils, *S*7, binding-post, *S*3, binding-post, *E'*, and wire, *E*, back to the battery, *C*. The coils, *S*6 *S*7, being thus energized, will exert the peculiar, described attraction and repulsion on the circuit-closer armature to swing it into engagement with the contact, *U'*. This engagement does not close any circuit, but produces the customary click, this part of the apparatus acting as a sounder in the particular case under consideration. When the circuit is broken at the distant station, the armatures of the relay and circuit-closer will return to their original positions. This describes the action when the station illustrated receives the message. When the message is sent from the station shown, the action at the distant station will be as has just been described, while at the sending station the path of the current will be as follows when the key-lever is depressed to engage the contact, *R*2: From the ground-plate, *O'*, to the wire, *F*2, binding-post, *F''*, wire, *F*, line-battery, *C'*, wire, *D*, binding-post, *G'*, wires, *p*4 *P*4, contact, *R*2, key-lever, contact, *R'*, contact, *L*, switch, *A*4, binding-post, *A'*, and line, *A*.

With the switches, *A*4, *B*4, engaging the contacts, *K K'*, as shown, a message sent over the line, *A*, will be automatically repeated and forwarded over the line or *vice versa*.

Our article has been confined for lack of space to a description of the apparatus when sounders are employed. Mr. Cordovez has, however, devised a modified arrangement in which the local battery, *C*, is dispensed with and in which only one armature is used on each side of the apparatus. His apparatus has been very successfully used with stations forty miles distant on each side of a central station.

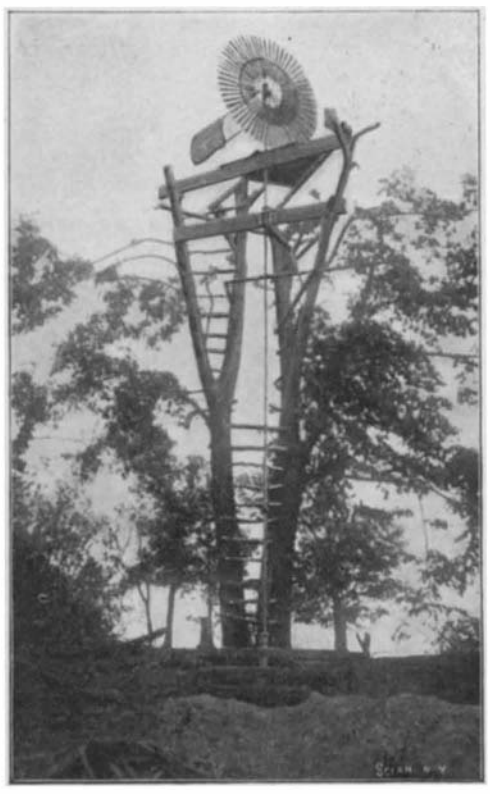
Population of Civilized Countries.

Within the last two or three years most of the civilized nations of the earth have made enumerations of their inhabitants, says Bradstreet's. The results of these censuses are beginning to appear, and comparisons of them with one another and with that of the United States are instructive. The following table shows the total population of a number of countries, as derived from recent censuses, with the rate of decennial increase and the density of population, expressed in terms of the number of inhabitants per square mile, the third column representing the percentage of increase for the decade, while the outside one shows the density of population per square mile:

Countries.	Date.	Population.		
United States	1900	76,303,387	21	26
England and Wales	1901	32,523,242	12	557
Germany	1900	56,345,014	14	269
France	1896	38,517,975	—	189
Spain	1900	18,078,497	3	92
Switzerland	1900	3,212,551	10	207
Norway	1900	2,231,395	12	18
Belgium	1900	6,744,532	11	593
Netherlands	1899	5,103,924	13	403
Austria	1900	26,107,304	9	225
Hungary	1900	19,200,000	11	153
Russia	1897	128,922,173	—	15
Sweden	1899	5,097,402	7	30
India	1901	294,266,701	2	188
Japan	1898	43,760,754	—	296
Chili	1895	2,712,145	7	9
Peru	1896	4,610,000	—	7
Denmark	1901	2,447,441	13	160

A CURIOUS WINDMILL.

A windmill is apt to be a very prosaic and ugly construction, but many attempts have been made with varying success to beautify these very useful and economical power producers. Our engraving illustrates how nature and mechanics are sometimes blended. The trees serve only as a support for the platform at the top, and as side rails of a ladder, it being necessary only to provide rounds. The trees serve also to stay the iron supports. The windmill, which was built by J. G. Benster, of Moline, Ill., is of peculiar construction, there being no gear wheels nor



A TREE WINDMILL.

crank, the power being transmitted by an involute wheel which is a part of the steel wheel to which the fans are attached. The surface of the involute is perfectly smooth, as is also that of the wheel attached to the pitman carrier, the one rolling upon the other. The mast is of tubing, the pitman being carried down inside. The wires for throwing the mill out of gear are attached to a thimble on the outside of the mast. From this it will be seen that the trees are not needed for actual support.

A number of these mills have been attached to trees and have been giving excellent results. It is also possible to carry the mills around on a wagon and set them to work at any part of a field.

Twentieth Annual Convention of the American Street Railway Association.

The twentieth annual convention of the Association was held in this city, October 9, 10, and 11, at the Madison Square Garden, and at the same time the fourth annual convention of the Street Railway Accountants' Association occurred. Various papers were read; among the most interesting was one on the standard form of convertible car adopted for transition from open to closed or *vice versa*. Another subject of interest was on interurban roads and their relations with city street railway systems. Still another paper described the advantages of having a motor on each car axle of a double-truck car because of the greater tractive power developed in starting and economy in the application of the current.

Probably the most interesting feature of the convention was the exhibits of various kinds connected with the construction of electric street and suburban cars and appliances connected therewith.

Numerous forms of fare registers were displayed along the entrance to the main exhibition room. Entering the main hall, the large exhibit by the General Electric Company of their controller for automatically operating in multiple several motors at a time in a train of electrically equipped cars was practically demonstrated; there were also examples of the type of motor that is to be used on the city elevated railways and the third-rail connections.

Adjoining this exhibit was a large exhibit by the Standard Traction Brake Company, under the supervision of the Westinghouse Company, the principal feature in which was a section of inclined track about one hundred feet long, over which ran a large double-truck car every few minutes, equipped with the Newell magnetic brake, which demonstrated practically its effectiveness in quickly stopping the car. The brake was illustrated in the Scientific American of July 27 last. A special generator is run from the car axles which energizes the electro-magnet over the sliding shoes, causing them to be strongly attracted to the rail at the time of stopping. It has the effect of preventing the flattening of wheel treads due to the sliding of clamped wheels on the rails. Ranged along the railway were examples of air-brake motors, electric, and those connected to car axles, and styles of motors to be used on the New York underground Rapid Transit System. There was also an attractive exhibit of the Nernst lamp, models of the lamp in section and parts illustrating the method of disconnecting the heating circuit automatically when the light electrode becomes incandescent. Several working lamps (arranged in the form of a canopy) of from 50 to 300 C.P. were on exhibition and gave a very brilliant, pleasing light.

The entire eastern end of the hall was occupied with exhibits of the J. G. Brill Company covering their improved forms of car trucks hung with additional springs arranged to counteract the well-known side jolts of trolley cars. They also exhibited examples of wholly convertible cars (from open to closed) very ingeniously constructed, in which the glass windows and flexible side panel are pushed upward and stored in the car ceiling. Even with this there is space provided for the usual open car weather canvas curtain. An example of their semi-convertible car, by which the glass sashes are stored in the ceiling and large seating capacity is provided, was also shown. The cross-seat center aisle system seems to be the favorite plan of interior construction. We noticed a fine example of this type of car on exhibition by the John Stephenson Car Company, in Madison Avenue, wherein the semi-convertible feature consisted in pushing the upper sash into the roof and dropping the large lower sash into the panel below.

There were a number of exhibits of special air brakes for street cars and a very large exhibit of car fenders by the Providence Car Fender Company.

A beautiful working model of the Robins ore or coal conveyer was on exhibition, illustrating a rapid and economical method of distribution.

Numerous forms of electric car heaters were displayed, that called the "Bay State" being perhaps the most novel. It consists of a coil of resistance wire located at one end of the car through which a current of air is passed by means of an electric fan; the warmed air is thus propelled forward from the hot coil through a distribution pipe along the lower part of the car, much the same as hot air from a furnace.

We noticed an exhibit of the Gould storage battery used as an auxiliary in trolley roads. The battery is built up of specially spun lead plates, the active material being formed thereon by the electric current.

An exhibit, part of which was popular with railroad employes, was of various styles of coats, caps and wearing apparel.

There was an example of a snowplow trolley car and electric track sweepers. Several kinds of single and double car trucks were shown. Taken as a whole, the exhibition was most instructive and interesting.

Experiments have been carried out by the Ordnance Board of the British War Office in connection with the new 9-inch wire-wound breech-loading quick-firing guns mounted at Dover to determine the possible maximum rapidity of fire and the life of the weapon. One of the guns was selected for the experiment. Theoretically the life of such a gun is about 80 rounds, but 161 rounds were discharged from this weapon. Heavy projectiles were employed, in some instances weighing 450 pounds. After several rounds had been fired the rifling of the gun was seriously impaired by corrosion, so that the projectiles would not fit. A special mechanism, which the Ordnance engineers have devised for use in connection with worn guns, was then requisitioned, and by its means the shells were fired with the same precision and unerring accuracy which characterized the firing when the gun was first employed. In fact, it was proved that without the mechanism it would be absolutely impossible to shoot straight with a worn gun. The speed records were very satisfactory. The best result was five rounds from the 9-inch guns in 80 seconds. The range of the weapons is 11 miles.