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The Electro-Magnetic Gun and Its Possibilities

WHILE we have heard of many different kinds of life destroying guns and other weapons during the present European conflict in all its magnitude, there are probably not many of us who have stopped to think of the possibilities of a somewhat unknown invention which relates to nothing less than the hurtling of large projectiles through space by means of electro-magnetism properly applied to a gun or cannon barrel.

There have been several patents issued on such devices, but to our knowledge none of these have been adopted by any of the world powers. As an introductory explanation reference may be made in this connection to Fig. 1, and undoubtedly the reader will then be able to grasp, with the aid of the following explanatory remarks, about how the various inventors of the electro-magnetic guns intend hurling their projectiles at the enemy with hair-raising rapidity and accuracy.

Referring to Fig. 1, and for the sake of simplicity, we may consider that but three electro-magnetic coils are in use as at 1, 2 and 3 along the gun barrel. It may be said that invariably such a gun barrel should have an inner lining of brass or bronze, so that the projectile which is usually made of a magnetic material (such as iron or steel), will not bind within the barrel. The barrel proper can be made of iron properly divided, but an all-brass barrel is common. Now consider that the three magnet coils, 1, 2 and 3, are connected up to a switch as shown. If, then, an iron projectile is placed in the position A, and the current caused to flow through the coil 1, the electro-magnetic field of force set up within the gun barrel will tend to pull the projectile forward in the direction of the arrow. It should be mentioned before going further that the iron barrel (if used) of the cannon or gun is divided up into several distinct sections so as to localize and intensify the magnetic pull on the projectile at each new impulse.

Of course, this scheme outlined at Fig. 1 is only mentioned to bring out the general theory of how these guns are supposed to operate. To continue: when the projectile has reached the position of coil 1 the control switch is moved so as to cut out coil 1 and to connect coil 2 into circuit. If this is done quickly the projectile will have been sucked forward on a line with coil 2. The operation is again repeated and the switch is moved so that coil 3 will be put into the circuit and coils 1 and 2 opened. Thus the projectile will again be pulled forward to section 3, and at the instant it reaches the center of the *final coil* the current is cut off and the momentum acquired by the projectile is relied upon to carry it on and out of the muzzle of the gun at B. This design is the basis of most of the patents on this unique device, which has yet, we may say, to be proven in a practical sense for modern warfare requirements, although it seems indeed to possess possibilities if the details are properly worked out.

The wash drawing illustration here presented at Fig. 2 shows how we may conduct warfare in the future if the powers that be still think that the only way to settle an argument is by main strength and ignorance. In our illustration is shown a probable development of a large electro-magnetic field gun mounted on a massive iron frame-work fitted with large caterpillar wheels, as observed, so that it is mobile enough to be quickly hauled from one place to another on the battlefield or for siege purposes. When used for portable requirements it will invariably be necessary, if such guns are ever adopted, to provide a complete portable electric generating plant as is shown in the picture. This would comprise a powerful gasoline engine direct connected to a suitable electric dynamo.

Some idea of the probable size of such guns may be obtained when it is stated that one of the best designs ever worked out on this principle, and due to Prof. Birkeland, has a barrel 90 *feet in length*. The projectiles used in this gun would be about 9 feet long and have a diameter of 19 inches. Also to gain the maximum magnetic pull by this arrangement it is recommended that the projectile be wound with coils of wire so as to be electro-magnetically reactive in conjunction with the regular magnetic disc coils placed along the barrel of the gun as perceived. In order to facilitate the passage of the projectile through the barrel of the gun with the least friction we strongly suggest that suitable lubrication be provided by means of grease or oil cups placed along the barrel at intervals; these may be observed in our illustration Fig. 2.

It must be remembered that these guns would not heat to any appreciable extent and not at all compared to the heat produced in the modern high powered guns using explosive charges of powder. Due to this and other obvious reasons such a gun as this can fire a great number of larger caliber shells per minute, possibly fifty to seventy-five shells in one minute. It will be seen from the foregoing that such a discharge of 19-inch shells, each of which contains a very high explosive powder charge, would serve to quickly rout the enemy, no matter how well he might be entrenched or ensconced behind fortified embankments. A rain of such monster shells would batter down almost any fortification whether natural or built by man. A method is suggested in the illustration of this electro-magnetic gun of the future whereby a constant supply of shells for rapid firing can be always maintained before the open breach of the gun. The shells might be hoisted by means of a gasoline engine and run on the platform at the left and then allowed to slide by gravity down the inclined chute. As fast as one of the shells is sucked into the breach of the gun barrel it is followed by another one right after it successively. It is easily possible to have means of firing the shells as far apart, in respect to time, as is deemed advisable, of course. The electric current supplied through the coils along the gun barrel can be controlled through a suitable switch by the man aiming the gun and who may be located alongside of the breach of same as perceived in our illustration.

Such guns as these firing 19-inch explosive shells may have a range of twenty-five miles or more. The shells may carry time fuses, or they may be of the concussive explosion type, whereby they do not explode or burst until they hit the ground or the wall of a fort, etc.

Of course, these magnetic guns are practically noiseless and naturally also absolutely smokeless. Furthermore the wear and tear or depreciation, in so far as the gun barrel lining is concerned, is very low compared with modern cannon and other arms using explosive charges to expel the bullet or shell from the barrel of same. The shells or bullets in such cases must fit very tightly so as to prevent the exploding charge in the gun barrel from leaking out and at the same time to force the shell outward with all available power. In magnetic cannon the shell does not

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necessarily have to fit the barrel tightly and thus friction can be vastly reduced. Moreover, there is no pitting or other wear on the inside of the barrel, due to powder explosions as just mentioned.

At Fig. 3 is shown a patent issued to S. T. Foster, Jr., (No. 811,913) on an electro-magnetic gun. This patent will serve to give a fair idea as to the general make-up of these devices intended to supplant the modern artillery now in use by world powers. Mr. Foster arranges a series of powerful electro-magnetic coil windings along the non-magnetic gun barrel 11-12. The magnetic projectile made of iron or steel is placed in the breach at 11, just far enough to reach the electric contact 1. When this contact is depressed by the shell it closes the electric circuit through the magnetic coil 15. This causes the shell to be pulled forward, and as the forward section of the projectile then engages the cut-out switch 2, it depresses same and excites the magnet coil 16. The projectile is then pulled forward electro-magnetically until it is in line with coil 16, and simultaneously actuates the cut-out switch 1, which opens the circuit to coil 15. At this instant, generally speaking, the shell in sliding forward into line with coil 16 has engaged the cut-out switch No. 3 and this closes the coil circuit 17, thus the shell is pulled forward into line with that coil and coil 16 is cut out of circuit, owing to the contact 2 having reset itself automatically.

Thus it will be seen how the iron projectile is propagated through the barrel toward the muzzle 12. The operation previously described repeats itself until the shell reaches the position of coil 23, and here it strikes a cut-out switch 10, which opens the current circuit. No magnetic pull is further exerted on the projectile and it leaves the muzzle of the gun under its own momentum. The inventor in this case claims that the shell is supposed to gain velocity repeatedly and successively as it moves from each coil to the succeeding coil. This arrangement for cutting out the coils as the shell moves through the barrel is followed out in several other patents and seems to be a general idea with most of the inventions in this direction.

It would take up too much space here to describe in detail the very ingenious mathematical and engineering deductions cited in the wonderful patent of Prof. Kristian Birkeland of Sweden. In his patent (U. S. Patent No. 754,637) he brings out some very fine points with regard to the development of the electro-magnetic gun. A few of the considerations there advocated,

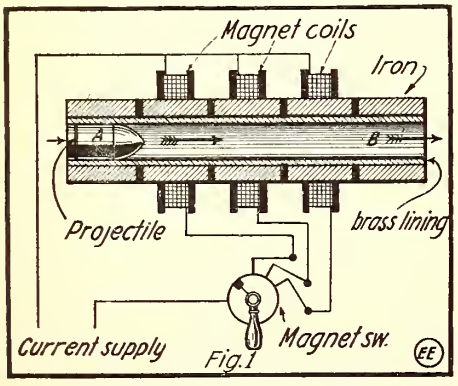


Fig. 1. Elementary Diagram Showing Action of an Electro-magnetic Gun.

hypothetically and otherwise, are outlined below.

In the first place, it has been found difficult to make an electro-magnetic gun of ordinary size which will exert a sufficient pull on the projectile to gain the effects now produced by the modern explosive charge type of cannon. Therefore this inventor proposes to arrange the switches, etc., on his gun so that the current through the coils will only be left on for a very small fraction of a second in any case. Also in considering the regular approved engineering design of such magnetic coils

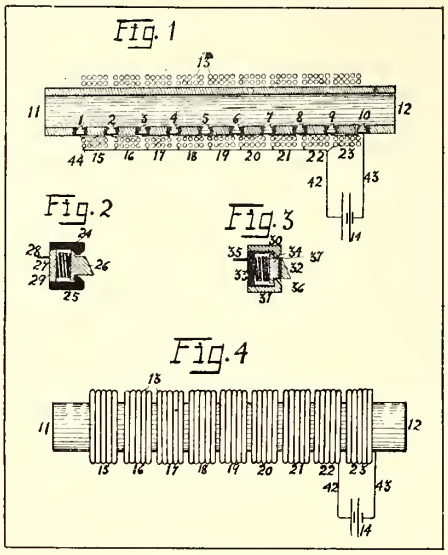


Fig. 3. Electro-magnetic Gun Patent Issued to S. T. Foster, Jr.

he proposes not only to pass a *normal current* through the coil, but a current even *ten times* as heavy, or more, and thereby momentarily (for the fraction of a second), a terrific magnetic pull can be exerted on the iron shell within the barrel. He mentions further (and this is a capital idea) in order to increase the magnetic action in such a gun it is preferable to make the projectile of iron surrounded by magnetic coils instead of iron alone.

Further schemes outlined in Prof. Birkeland's patent cover the arrangement whereby it is possible to open the magnetic coil circuit without any spark occurring at the break of the contacts. This is accomplished by taking advantage of the fact that the projectile moving through the barrel will induce electric currents in the magnet coils and at the instant when this induced current is approximately equal to the current flowing through the coil and which, of course, passes through the coil in the opposite direction to the normal current, then the cut-out switch is operated with no sparking at same.

He goes on to say: "As to the dimensions which may be given to guns constructed according to my invention, the following example may be mentioned: For throwing an iron projectile weighing two tons and containing one thousand pounds of nitro-gelatin at an initial speed of one thousand feet per second I propose the use of a gun with a length of about ninety feet, the projectile being about nine feet long and having a diameter of about nineteen inches. The gun solenoids may be made up of square wire, each solenoid containing seven hundred and twenty windings of a total resistance of fifteen ohms. The length of each solenoid is made about three-eighths of an inch and the height (radial dimension) about eight inches. With an electromotive force of three thousand volts this will give a current of two hundred amperes. If the current is set up simultaneously in all the solenoids (there will be about three thousand elementary solenoids), this will require altogether six hundred thousand amperes, and the suction acting on the projectile will be about two thousand five hundred pounds per square inch of the cross-sectional area of the projectile. A calculation shows that when a firing is to take place the current should be set up one-seventh of a second before the firing. The projectile is then set free, and will pass the barrel in the course of one-fifth of a second. The current has then been on the outermost solenoid about one-third of a second. If, however, a construction is used in which all the groups of solenoids are not at once excited less than half the current will be used for the same effect, and the generation of heat in the outermost solenoids will be reduced."

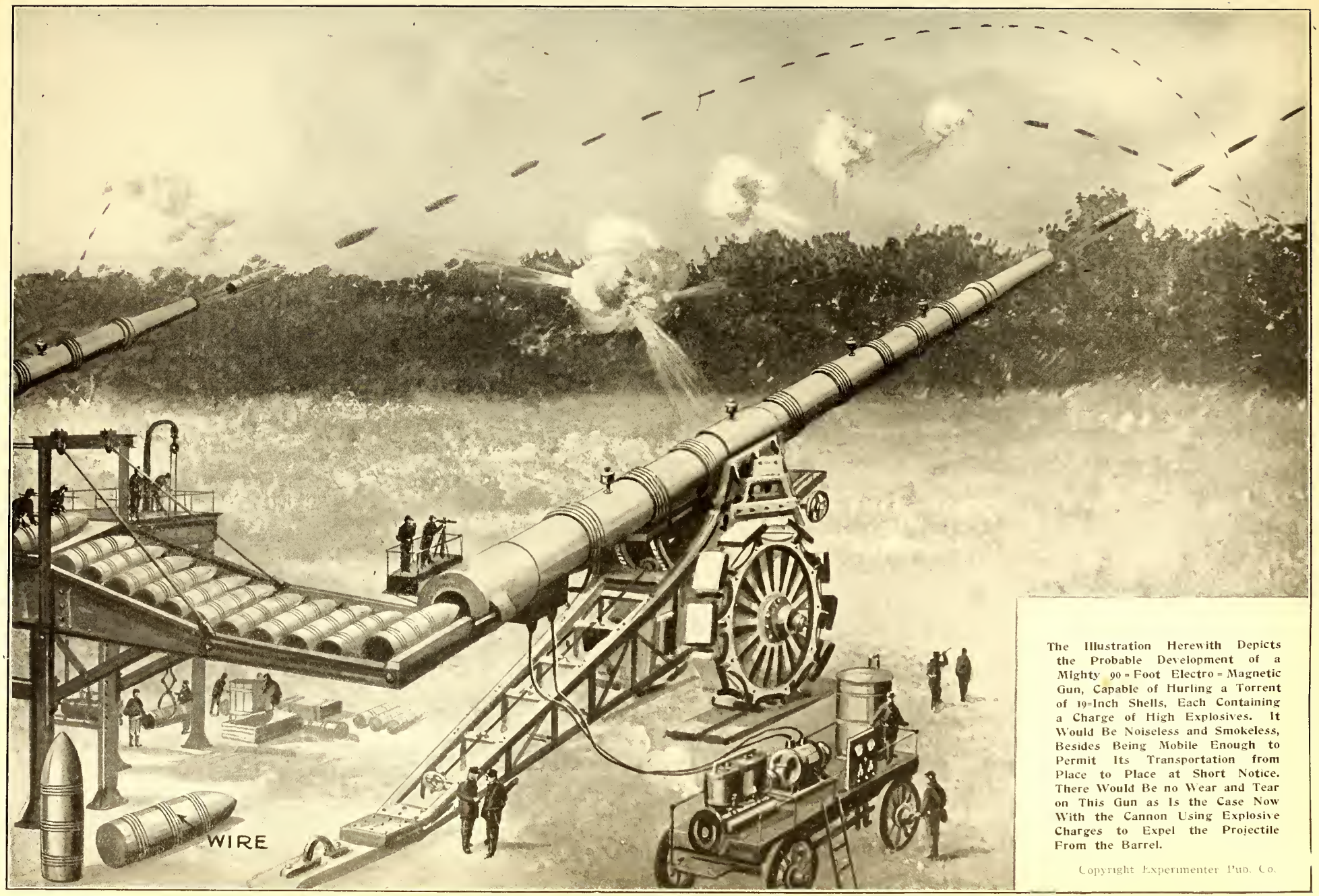
ENGINEERS FORMING RESERVE CORPS.

The movement begun in a tentative way last spring to form a reserve corps of engineers to be available in case of war has assumed definite form, according to announcements made by Bion J. Arnold, of Chicago, chairman of the A. I. E. E. committee of the proposed reserve corps of engineers.

Some time ago the suggestion was taken up by the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Consulting Engineers. Each of these organizations appointed committees to further the movement, which has now become more closely consolidated by the appointment, just announced, of the chairman of various committees as members of a joint committee to take charge of the work in co-operation with the War Department. The members of the committee are as follows: William Barclay Parsons, New York, chairman, and Henry S. Drinker, Pennsylvania; William H. Wiley, New York; B. J. Arnold, Illinois, and Ralph D. Mershon, New York.

INCREASING WIRELESS RANGE BY KITES.

The recent manoeuvres in northeastern Massachusetts were of particular interest because of successful experiments by the Signal Corps in maintaining a wireless aerial at a great altitude by means of kites, and thereby increasing the efficiency of an ordinary field radio set from six to sixteen times. At the invitation of Adjutant-General Cole of the Massachusetts Volunteer Militia, Samuel F. Perkins, a maker and flyer of man-lifting kites, went to Newbury and experimented with the Signal Corps. As there happened to be fairly strong winds at the time, Mr. Perkins was able to send up a string of kites to a height of 1,600 feet. The messages transmitted from the kite-supported aerial are said to have been received 150 miles away with distinctness, although the field wireless set used would only transmit messages 25 miles ordinarily. The results were obtained because the kites flew so steadily that the aerial was always maintained at a constant altitude. The receiving qualities of the kite-supported aerial were remarkable. Messages were received from the battleship Georgia, off Newport, and from the Government stations at Arlington, Va., and Bermuda. Code messages being exchanged between two British warships out in the Atlantic Ocean were received with accuracy. Further experiments by the United States Government and Marconi officials are now being conducted, and it is expected that in a short time the range of sending from an ordinary field wireless set will be increased.



The Illustration Herewith Depicts the Probable Development of a Mighty 90-Foot Electro-Magnetic Gun, Capable of Hurling a Torrent of 19-Inch Shells, Each Containing a Charge of High Explosives. It Would Be Noiseless and Smokeless, Besides Being Mobile Enough to Permit Its Transportation from Place to Place at Short Notice. There Would Be no Wear and Tear on This Gun as Is the Case Now With the Cannon Using Explosive Charges to Expel the Projectile From the Barrel.

Fig. 2. Electro-Magnetic Gun of the Future, Which Can Hurl 19-Inch High Explosive Shells 25 Miles and More. It Could Fire a Perfect String of Shells, Sufficient to Batter Down the Strongest Forts.