Dec. 25, 1934. C. A. HUSE 1,985,254

ELECTRIC GUN OR PROJECTILE PROPELLING APPARATUS

Filed June 15, 1933

FIG. 1.

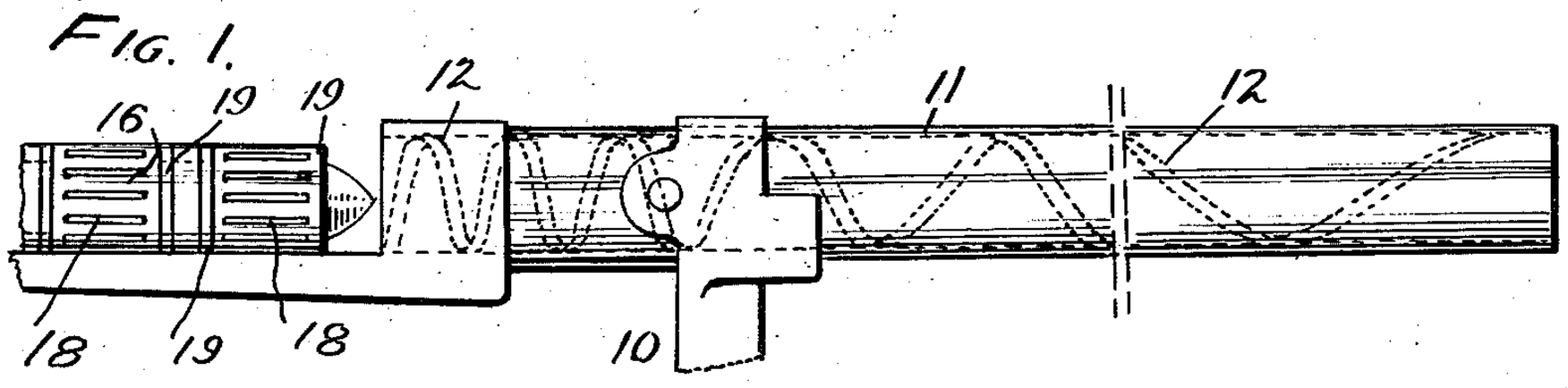


FIG. 2

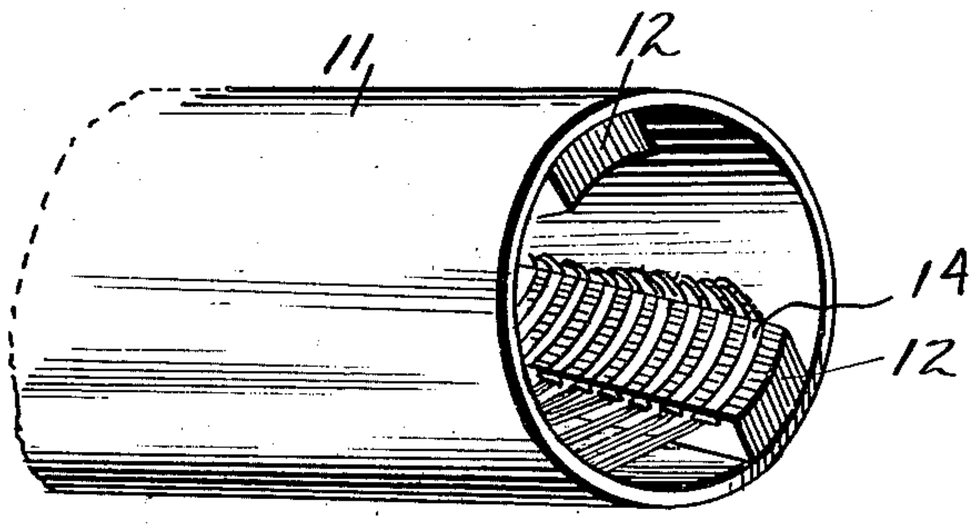


FIG. 3.

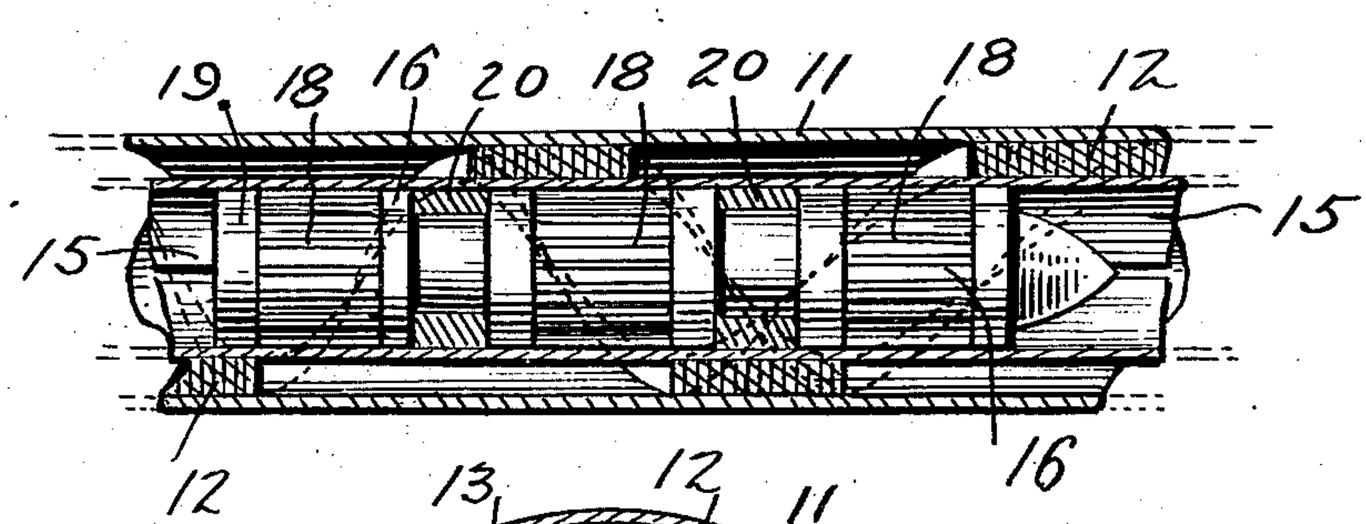
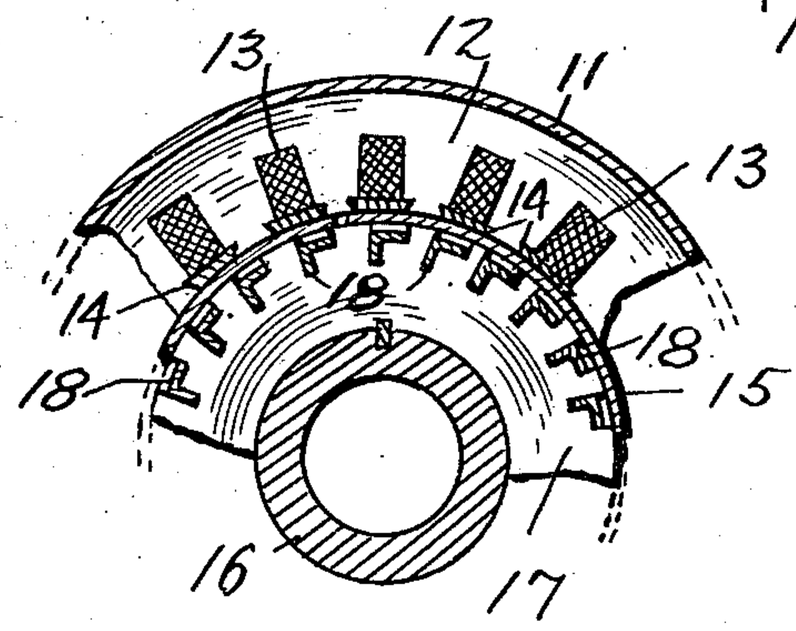


FIG. 4.



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ELECTRIC GUN OR PROJECTILE PROPELLING APPARATUS

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12 Claims. (Cl. 172—290)

I have discovered, and proved by practical demonstration, in what I call an electric gun, that by electro-magnetism utilized with elements corresponding to one producing a magnetic field, and the other element corresponding to the body acted on by said field and caused to move, motion of rotation and translation of such body may be produced such as that of an elongated projectile in rifled ordnance using an explosive. The object of my invention is to utilize that discovery in whatever applications to which it may be susceptible, and in particular, in the provision of a gun using an elongated projectile.

I show in the drawing, and describe in the specification, an embodiment of my invention in a gun or piece of ordnance, and an embodiment in which the characteristics of an alternating current motor are employed, in that what corresponds to the gun barrel provides or produces a traveling magnetic field or stator and the elongated projectile provides or constitutes the rotor.

My invention, however, consists in whatever is described by or is included within the terms or scope of the appended claims.

In the drawing:

Fig. 1 is a side view of an electro-magnetic gun embodying my invention;

Fig. 2 is a perspective view of the muzzle end of such gun;

Fig. 3 is a longitudinal section of a portion of the gun, with the projectile therein, in side elevation;

Fig. 4 is a detail view on a large scale of a cross-section.

Describing my invention in the gun embodiment illustrated in the drawing, it will be found that the field producing element extends in a straight line longitudinally of the gun barrel and in fact is incorporated in the gun barrel and the wiring is such as to provide in effect a plurality of motor fields in a series that extend successively from breech to muzzle of the gun, the successive motor fields having such an arrangement of poles as to produce a magnetic field that travels longitudinally of the gun when alternating current of any desired phase is applied so that the rotor which constitutes the projectile being inserted in the gun breech is given the rotary movement and the axial or longitudinal movement of the gun barrel which characterizes the action of the familiar rifled gun so that the rotor will emerge from the gun muzzle with that rotation necessary to keep it end on to secure accuracy of flight and at a muzzle velocity which will result in the desired range and target or object-striking force called for in a gun or piece of ordnance. The field producing element is in the form of a spiral extending lengthwise of the gun and surrounding or forming the gun bore and each complete or full turn of the spiral constitutes what for convenience I shall term a motor. The winding is such as to provide poles for each motor and by preference, the winding is for polyphase currents. The winding of the several motors may be connected to the current leads to produce any desired number of poles in the respective motors, and the connection with the current leads is in parallel. For example, the motors at the breech end may have six poles, those toward the muzzle may have two poles and the intervening ones may have four poles. Such an arrangement of poles will result in acceleration of the speed of the rotor as it travels through the gun barrel. And by varying the frequency of the current alternations, acceleration of rotor speed may be produced and if the pitch of the spiral be gradually increased from breech to muzzle, that will result in speed acceleration of the rotor or projectile. Different phase windings may be used for the stator. Pitch increase increases pole spacing and rotor speed increases because the time of rotor travel between the differently spaced poles is the same. Preferably the rotor has a squirrel-cage winding, the bars of which extend parallel or substantially parallel with the axis of the gun barrel.

Any one, two or all of the arrangements for assuring that speed of the rotor or projectile which will give it the desired muzzle velocity may be employed.

As shown in the drawing, there is a suitable gun mount 10, by which the barrel 11, is supported for horizontal and vertical movement for training or aiming, but it is not necessary to describe such support in any detail, as it forms no part of the present invention.

The field-producing element is a spiral 12, that extends rib-like from breech to muzzle of the gun and is laminated. As shown in the drawing, the spiral increases in pitch from the breech to the muzzle. The field windings 13, are placed in radial recesses in the plates or lamina, the recesses at their inner ends being closed by wooden wedge-form strips 14. As has been explained, the spiral with the field windings is to be considered as constituting in one full turn of the gun barrel a motor each with its proper number of poles and so that from breech to muzzle of the gun, there is a plurality of such motors in series. The motors may be arranged in groups each group consisting

of a desired number and relative arrangement as to poles.

If, for example, a two-phase current winding is employed, the several motors or groups of motors may be energized by currents that increase in frequency towards the muzzle end of the gun and the frequency changes may be regular in point of number of motors concerned, or irregular.

Within the spiral field-constituting or producing element is a tubular member or shell 15, which extends lengthwise of the barrel and constitutes the bore of the gun and provides a concentric race through which the rotor projectile passes from breech to muzzle. Such race may be of metal in which case, it should be split longitudinally to prevent a closed secondary circuit in the field but if non-metallic, it need not be split longitudinally. Such a secondary circuit would interfere with magnetic current-inducing action on the rotor.

The projectile-forming rotor 16, is of elongated cylindrical form and may be hollow to contain an explosive and provided with suitable explosive igniting means. At intervals of its length the rotor is provided externally with a series of cylindrical sections spaced apart and each composed of side by side spaced apart rings or lamina, 17, of soft iron in the periphery of which are embedded parallel, longitudinal bars 18, of copper, thus providing the rotor with squirrel-cage armatures that prevent hysteresis, the bars, of course, being electrically connected at their ends by circuit closing rings 19, so that a closed secondary circuit is provided.

It will be understood that, in effect, to secure the rectilineal movement, or movement of translation of the rotor, the motor fields extend longitudinally of the gun barrel or tube and the traveling field in securing both rotary motion and motion of translation simultaneously, is in advance of the rotor, this being characteristic of polyphase windings, in common practice, because of a poor power factor that does not give unity.

Inasmuch as the circuit arrangement for the field may be any conventional or customary one whether for a single phase current or for a polyphase current, it has been considered unnecessary to illustrate or describe any field circuit arrangement.

Preferably between the squirrel-cage armatures on portions of the rotor of less diameter, a filling 20, of lubricant is provided which has contact with the interior of the race or gun bore. Of course, the rotor fits with sufficient looseness in the gun bore to assure freedom from frictional resistance that would retard rotation and longitudinal movement of the rotor.

One spiral, or any desired number of spirals may be used for the stator, two being shown in Fig. 2.

While a single squirrel-cage winding may be satisfactorily used, there is an advantage in having a plurality of squirrel-cage windings, as illustrated in the drawing, because the multiplication of the squirrel cages increases the torque and, therefore, the power imparted to the rotor.

I contemplate an embodiment of my invention which will cause reciprocation of the rotor or armature. Thus, the stator may be placed vertically so that the travel of the armature will be upward, and then, by opening the stator circuit, the armature will fall by gravity, and the operation repeated.

What I claim is:

1. Apparatus using electro-magnetism comprising an elongated tubular member and an elongated member positioned to move within said tubular member longitudinally and rotatably, such two members constituting complementary elements of electro-magnetic apparatus which upon the application of current to the tubular member causes rotation and longitudinal movement of the other member therein, the tubular member having a spiral-form magnetic field-producing element.

2. Apparatus using electro-magnetism comprising an elongated tubular member and an elongated member positioned to move within said tubular member longitudinally and rotatably, such two members constituting complementary elements of electro-magnetic apparatus which upon the application of current to the tubular member causes rotation and longitudinal movement of the other member therein and therethrough, the tubular member being a spiral stator provided with windings adapted to produce a traveling magnetic field when supplied with alternating current and the other member having a winding that responds to such magnetic field.

3. Apparatus using electro-magnetism comprising an elongated tubular member and an elongated member positioned to move within said tubular member longitudinally and rotatably, such two members constituting complementary elements of electro-magnetic apparatus which upon the application of current to the tubular member causes rotation and longitudinal movement of the other member therein and therethrough, said tubular member having a spiral form magnetic field producing element.

4. Apparatus using electro-magnetism comprising an elongated tubular member and an elongated member positioned to move within said tubular member longitudinally and rotatably, such two members constituting complementary elements of electro-magnetic apparatus which upon the application of current to the tubular member causes rotation and longitudinal movement of the other member therein and therethrough, said tubular member having a spiral form magnetic field producing element, the spiral being of increasing pitch from one end to the other.

5. Electro-magnetic apparatus that comprises a spiral stator having a field means that constitutes a plurality of motor elements in axial alinement, such field means having magnetic poles that rotate and travel in an axial direction, and a complementary member free for simultaneous rotary and axial movement when the stator is supplied with proper current.

6. Electro-magnetic apparatus having an elongated tubular member that includes a spiral-form stator that establishes a field of force, the spiral enclosing a space, and an element movable longitudinally and rotationally through such space subject to the inductive action of the field.

7. Electro-magnetic apparatus having a tubular member that includes a rectilineally extending spiral stator field member within which is a longitudinally extending space and a complementary elongated armature within such space and movable lengthwise and rotationally thereof when an alternating current is supplied to the stator.

8. Electro-magnetic apparatus comprising an elongated tubular member that includes a stator

and an elongated member with a plurality of squirrel-cage windings subject to inductive action of the stator.

9. Apparatus as in claim 7, having a tubular race for the armature that resists inductive action of the stator.

10. Apparatus as in claim 1 in which the spiral field producing element is laminated with the field windings in recesses in the lamina.

11. Apparatus as in claim 2 in which the spiral field producing element is laminated with the field windings in recesses in the lamina.

12. Apparatus as in claim 4 in which the spiral field producing element is laminated with the field windings in recesses in the lamina.

CHARLES A. HUSE.