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2,834,332

TOY GUN

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Fig. 1.

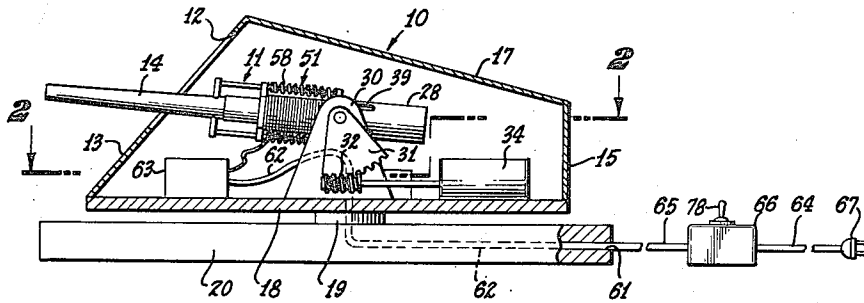


Fig. 2.

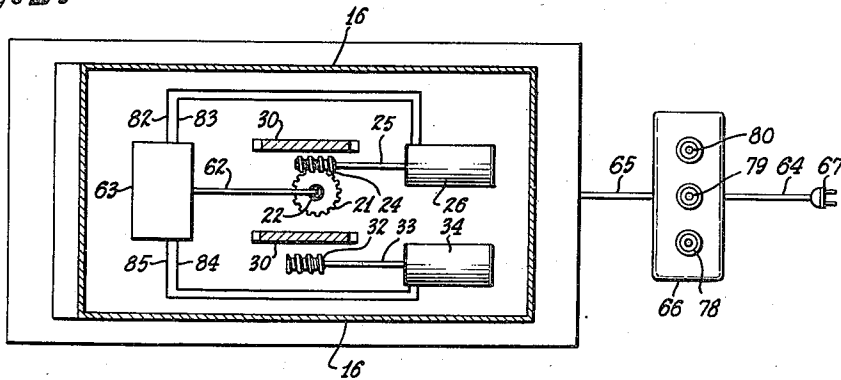


Fig. 3.

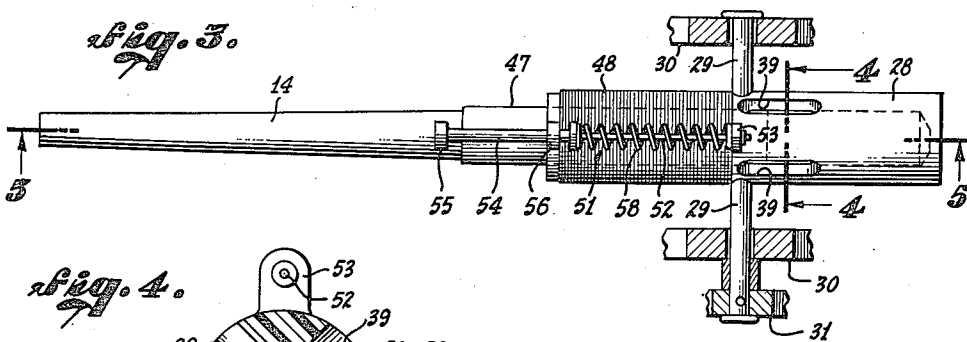
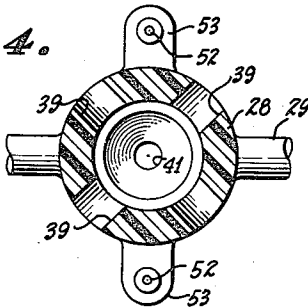


Fig. 4.



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Fig. 5.

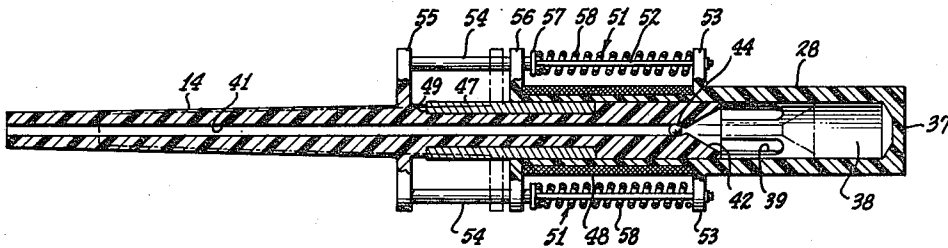


Fig. 6.

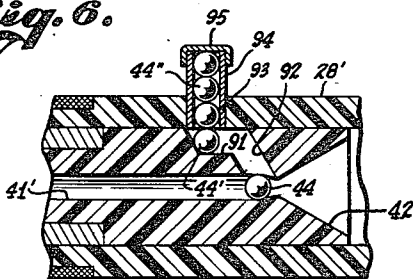
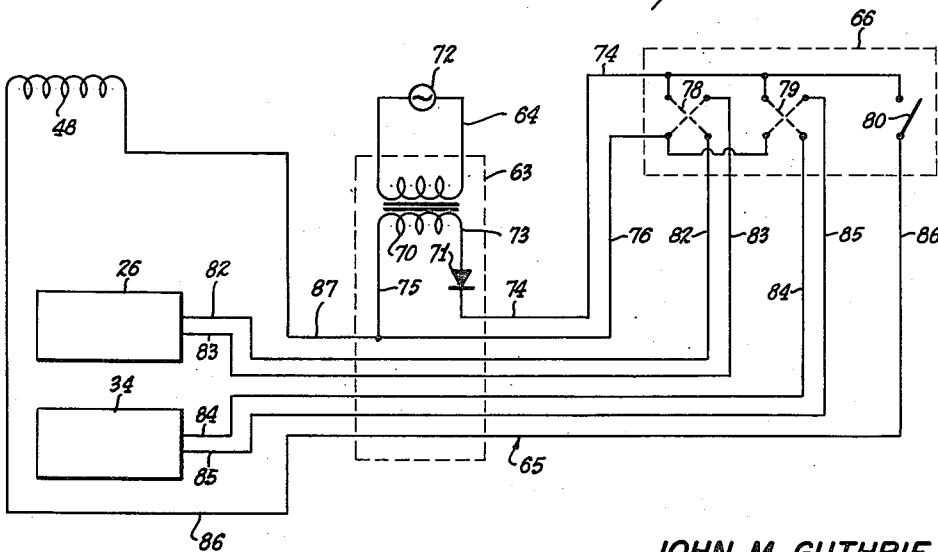


Fig. 7.

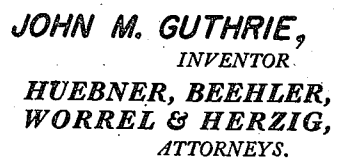


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TOY GUN

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Application July 18, 1955, Serial No. 522,649

11 Claims. (Cl. 124—13)

This invention relates to guns and more particularly to a toy gun constructed and arranged to propel a projectile by means of air pressure developed in the breech end of the gun.

The gun of this invention, when constructed as a toy cannon, is particularly well suited for remote control operation thereof. Also, it may be constructed as a toy pistol, for example, having a self-contained source of electrical power for actuating the same.

It is an object of this invention to provide a gun which propels a projectile from the barrel thereof as a result of movement of the barrel in the gun housing.

A further object of the invention is to provide a gun having certain electrical elements therein by which the gun barrel is actuated to cause pneumatic propulsion of a projectile.

It is another object of the invention to provide an electrically actuated toy gun which may be elevated, traversed, and fired by remote control.

Still another object of the invention is to provide a toy gun of the above mentioned character in which the barrel thereof is automatically loaded with a projectile after each firing thereof.

Further objects and advantages of the invention will appear during the course of the following part of this specification, wherein the details of construction and mode of operation of several embodiments thereof are described with reference to the accompanying drawing, in which:

Fig. 1 is a side elevation of a toy cannon embodying the invention, the cannon being housed in a turret, which is shown in vertical longitudinal section;

Fig. 2 is a section through the gun turret taken substantially on line 2—2 of Fig. 1;

Fig. 3 is a plan view of the barrel and gun-breech portion of the cannon on an enlarged scale;

Fig. 4 is a section on a still further enlarged scale through the barrel and gun-breech taken on line 4—4 of Fig. 3;

Fig. 5 is a central longitudinal section through the barrel and gun-breech portion;

Fig. 6 is a detail section on an enlarged scale through the projectile loading portion of a gun barrel and gun-breech of modified form;

Fig. 7 is a schematic wiring diagram of an electrical circuit for actuating and controlling the toy cannon; and

Fig. 8 is a section through a pistol embodying the invention.

Referring to the drawing more in detail and with the use of reference numerals, a gun turret, shown in Fig. 1, is designated generally by reference numeral 10, having a gun 11, embodying the invention, mounted therein. There is an elongate opening 12 formed in the front wall 13 of the turret through which the muzzle end of a gun barrel 14 projects. The principal axis of the opening 12 extends in a direction from top to bottom of the front wall to permit elevation and depression of the barrel as desired.

In addition to the front wall 13, the turret comprises a

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back wall 15, side walls 16, top wall 17, and a floor 18. The turret is rotatably mounted on a standard 19 extending upright from a stationary base 20. Fixed flat against the upper surface of the floor 18 and in the center thereof is a worm wheel 21, having a tubular pin 22 projecting downwardly from the center of the wheel to extend into the standard for rotatably supporting the turret on the standard.

For imparting traversing movement to the turret and thus to the gun, there is a worm gear 24 in mesh with the worm wheel 21. The worm gear is fixed on the end of a shaft 25 of an electric motor represented diagrammatically at 26 which is connected into an electric circuit for energization thereof, as will be described hereinafter.

The gun 11 includes a hollow gun-breech 28, open at its forward end for slidably receiving the gun barrel. Projecting from opposite sides of the gun-breech are two trunnions 29, which pivotally mount the gun on a gun carriage. The gun carriage comprises two uprights 30 fixed to the floor 18. One of the trunnions projects through the upright in which it is journaled to rotatably support a worm wheel section 31 for elevating and depressing the gun. The wheel section 31 meshes with a worm gear 32 which is fixed on the end of a shaft 33 of another electric motor, represented diagrammatically at 34.

The gun barrel is formed of non-magnetic material, e. g. hard plastic, and is cylindrical in the breech end portion thereof to fit snugly, but axially slidable in the cylinder walls of the gun-breech 28, which is also formed of non-magnetic material. In the illustrated embodiment the breech end of the barrel and the inside wall of the gun-breech are circular in cross section. The rearward end of the gun-breech is closed by an end wall 37, which with the cylinder walls of the gun-breech defines an air chamber 38 rearwardly of the barrel. Spaced from the end wall 37 is a circumferentially arranged series of elongate ports 39 formed in the walls of the gun-breech. The principal axis of each of these ports extends longitudinally with respect to the gun-breech. These ports allow air to be exhausted from the chamber when the barrel is moved rearwardly in the gun-breech to a position where the barrel covers the ports.

Reference numeral 41 designates the bore of the barrel extending axially through the barrel. The bore 41 is conical as shown at 42 in the breech end thereof, and there is an annular restriction 43 in the bore at the inside end of the conical portion 42 for retaining a pellet 44 in the gun bore.

As thus far described, it will be apparent that as the gun barrel is moved rearwardly in the gun-breech from the full line position thereof, shown in Fig. 5, toward the broken line position thereof, air in the chamber 38 will be exhausted through the ports 39 until the barrel reaches a position where it covers the ports. Continued rearward movement of the barrel past the ports will compress the air in chamber 38, and as the then only remaining opening for exhaust of air from the chamber is through the gun bore, the air from the chamber will be forced out through the gun bore, blowing the pellet out from the barrel.

To impart rearward movement of the barrel in the gun-breech, the gun is provided with a solenoid assembly comprising a cylindrical plunger sleeve 47 of magnetic metal and a coil 48. The plunger is fixed around the barrel by being received in an annular recess 49 formed in the outside surface of the barrel and spaced from the breech end of the barrel, while the coil is wrapped around the gun-breech. In the illustrated embodiment the plunger and the coil are substantially equal in axial length and they are spaced from the breech end of the barrel and gun-breech, respectively, by a common distance, whereby

the plunger will be positioned coaxially within the coil when the barrel is moved to a position where the breech end face of the barrel is closely adjacent the inside face of the end wall 37.

For returning the barrel in the gun-breech to the full line position, shown in Fig. 5, the gun is provided with a recoil mechanism comprising a pair of spring assemblies 51 disposed opposite to each other on the gun-breech. Each such assembly comprises a rod 52 fixed at one end thereof to a lug 53 projecting radially outwardly from the gun-breech. At its forward end the rod is telescopically received in a tube or sleeve 54, which in turn is fixed at the forward end thereof to a lug 55 projecting radially outwardly from the gun barrel. The sleeve 54 is axially slidable in a lug 56 projecting outwardly from the gun-breech and spaced between lugs 53 and 55. At its rearward end the sleeve 54 has an annular head 57 for compressing a coil spring 58 arranged around the rod and engageable at its ends with the head 57 and the lug 53. The recoil mechanism serves to return the plunger 47 to a position where the plunger extends forwardly from the coil.

When the coil is energized, it will pull the plunger axially into the coil to decrease the reluctance of the solenoid, thereby compressing the springs 58. Upon de-energization of the coil, the springs 58 will return the barrel to the full line position thereof, shown in Fig. 5. Because of the inertia of the barrel, the rearward movement thereof in the gun-breech will be relatively slow immediately upon energizing the coil, and as the barrel slides rearwardly it accelerates in speed. The ports 39 serve to allow flow of air from the chamber 38 during the initial stage of movement of the barrel. The ports do not become closed by the barrel until the speed of the barrel is relatively fast. Thus the pellet 44 will be blown from the gun bore at a time when the barrel is moving speedily in the gun-breech. If no provision were made for exhaust of air from the air chamber during the initial stage of the rearward movement of the barrel from its rest position, the air in the chamber would be compressed only relatively slowly and the pellet would be blown weakly from the gun.

The toy represented in Fig. 1 is adapted to be connected to a house circuit of alternating current. To this end, a passage 61 is formed in the base and through the standard 19. A cable 62 containing a plurality of conductors extends through this passage and out through the tubular pin 22 for electrical connection in an instrument and terminal box 63 fixed on the floor of the turret. The cable 62 includes a cord 64 and a multi-conductor cable 65 leading to a switch box 66. The cord 64 has a conventional plug 67 on its free end for connection in a conventional outlet to a source of alternating current.

Referring now to the wiring diagram of Fig. 7, the instrument and terminal box 63 is represented therein as a broken line forming a rectangle. This box contains a transformer 70, rectifier 71, and conventional terminal posts, not shown, for connecting the ends of the conductors which are shown as passing through the box. The primary coil of the transformer is connected across the conductors of the cord 64 leading to a source of power 72. The secondary coil of the transformer is connected by conductor 73 to the rectifier 71, which in turn is connected with a lead 74 to the switch box 66. The other end of the secondary coil of the transformer is connected by conductor 75 to a lead 76, also leading to the switch box 66.

In the switch box there are two reversing switches 78 and 79 and a push button switch 80. The two reversing switches 78 and 79 are connected in parallel relationship between the leads 74 and 76. The switch 78 has two terminals thereof to which leads 82 and 83 are connected. These leads pass through the terminal box 63 to the reversible motor 26 for controlling the traverse of the turret. Two terminals of the reversing switch 79 are con-

nected by conductors 84 and 85 through the terminal box 63 to the reversible motor 34 which controls the degree of elevation of the gun.

The push button switch 80 has one terminal thereof connected to the lead 74. Its other terminal is connected by lead 86 through the terminal box to one end of the solenoid coil 48. The circuit through the coil is completed by a conductor 87 which is connected in the terminal box 63 to conductor 75 of the secondary coil of the transformer. The leads 74, 76, 82, 83, 84, 85, and 86 are assembled together to form the cable 65.

From the above it will be clear that closing the switch 78 in one direction will cause current to pass to the motor 26, thereby energizing the motor and causing the shaft 25 thereof to rotate in one direction, driving the worm gear 24 and worm wheel 21 to rotate the turret on the standard 19 in a first direction. Closing of the switch 78 to the opposite set of terminals thereof will cause reversal of the direction of the rotation of the shaft 25, thereby reversing the direction of the traverse of the turret. Likewise, closing of the reversing switch 79 in a first and then a second direction will cause reversal of direction of the shaft 33 of motor 34 for elevating or depressing the gun 11 as desired. When it is desired to fire the gun, an operator will close the switch 80, thereby energizing the coil 48 to move the barrel rearwardly in the gun-breech and thus propel the pellet 44 from the gun, as described above. The parallel arrangement of the switches 78, 79 and 80 permits the simultaneous elevation and traversing of the gun. Also, since the coil switch 80 is in parallel arrangement with the two motor switches, the coil may be energized to fire the gun at any time.

Referring now to Fig. 6 of the drawing, there is shown a construction by which pellets may be dropped successively into the gun bore following each firing of the gun. To this end, the gun barrel 14' has a short longitudinally extending recess 91 formed therein proximate its breech-end. This recess communicates with the gun bore 41' through an inclined passage 92. The gun-breech 28' has an opening 93 formed in the wall thereof rearwardly of its solenoid coil for receiving a tube 94, having a cap 95, the tube serving as a magazine for holding a plurality of pellets 44''. From the tube the pellet 44' drops into the recess 91 when the recess becomes positioned directly under the tube, and this alignment of recess and tube occurs when the gun barrel has moved rearwardly in the gun-breech causing pellet 44 to be blown out through the muzzle end of the barrel as explained above. The then recoil of the gun barrel forwardly in the gun-breech causes pellet 41', due to the inertia of such pellet, to travel relatively rearwardly in the recess to the passage 92 and thence into position for being expelled from the gun bore when next the switch 80 is closed. The recoil mechanism prevents rotation of the barrel in the gun-breech, to the end that the recess will remain in upwardly facing direction.

In Fig. 8 of the drawing, a toy pistol, designated generally by reference numeral 100, is shown in a form embodying the invention. It comprises a hollow stock 101 having a hollow pistol grip 102 for containing a conventional dry cell 103. Mounted co-axially in the body of the gun stock and secured as by means of a screw 104, is a barrel and gun-breech assembly, generally similar in construction and mode of operation thereof to the corresponding assembly in the above described cannon.

The pistol barrel is designated by numeral 106 and its bore by numeral 107. Reference numeral 108 designates the gun-breech assembly of the pistol in which the barrel is slidable. A solenoid coil 109 is wrapped around the gun-breech, and a tubular plunger 110 is fixed around the barrel for movement axially into the coil when the coil is energized. The muzzle end of the barrel extends out through an opening 112 in the front wall of the gun stock. Also, there is a barrel recoil assembly 113 for the pistol, such assembly being substantially similar to that of the toy cannon.

The pistol has a pivotally mounted trigger 115 to which a resilient conductor 116 is fixed and electrically connected by a lead 117 to one end of the coil 109. The conductor 116 constitutes a contact element of a switch for selectively closing the electrical circuit to the coil upon pulling of the trigger. The other contact element of such switch is constituted of a spring strip 118 mounted on the underside of the breech structure 108 and engageable with the center post 119 of the dry cell 103. Another spring strip 120 engages the bottom of the dry cell and is connected through lead 121 to the other end of the coil 109.

To fire the pistol, a pellet 123 is dropped into the muzzle end of the gun bore and the pellet comes to rest against the restriction in the breech end of the barrel. The trigger 115 is then pulled rearwardly in the direction of the pistol grip to close the switch (116—118). When the switch is closed, current will flow from the dry cell to the solenoid coil 109, thereby producing a magnetic field in and around the coil which pulls the plunger 110 into the coil to a position of minimum reluctance. Rearward movement of the plunger and barrel compresses the air in the chamber behind the barrel and forces the air first out through the ports in the gun-breech and then out through the gun bore to blow the pellet 123 from the pistol. Upon release of the trigger, a spring 124 moves the spring strip conductor 116 away from the contact element 118 to open the electrical circuit and allow recoil of the barrel forwardly in the gun-breech.

While I have herein shown and described my invention in what I have conceived to be the most practical and preferred embodiments, it is recognized that departures may be made therefrom within the scope of my invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent structures.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A gun comprising an elongate barrel formed of non-magnetic material having a breech end, a muzzle end and an open passage extending longitudinally therethrough, a breech member having a cylindrical cavity formed therein, said cavity being open at one end thereof to the outside surface of the breech member, the barrel being slidable in the breech end portion thereof axially in the cavity, the barrel having at least a longitudinal length of its breech end portion conforming in cross section in the outside surface thereof substantially to the cross section of the cavity so that the barrel slides snugly in the cavity to cause air within the cavity to pass out through the barrel passage when the barrel is moved in a direction inwardly in the cavity, a plunger formed of magnetic material integral with the barrel, and a coil in the breech member around the barrel, the coil being connectable to a source of electric power and being arranged in the breech member with relation to the plunger to cause the barrel to move inwardly of the cavity as a result of the plunger being pulled in a direction toward a position of minimum reluctance in the coil when the coil is electrically energized.

2. A gun comprising an elongate barrel formed of non-magnetic material having a breech end, a muzzle end, and an open passage extending longitudinally therethrough, a breech member having a cylindrical cavity formed therein, said cavity having a bottom end and being open at the other end thereof to the outside surface of the breech member, the barrel being cylindrical in the breech end portion thereof, said breech end portion having a cross section which is substantially equal in area and configuration to the cross section of the cavity so that the breech end portion of the barrel is slidable axially in the cavity and fits snugly enough in the cavity to cause air within the cavity to pass out through the barrel passage when the barrel is moved in a direction inwardly in the cavity, an elongate plunger formed of magnetic material

integral with the barrel and extending in a direction longitudinally of the barrel, an elongate coil in the breech member around the barrel and connectable to a source of electric power, the center of the plunger being spaced from the breech end of the barrel by a first distance, the center of the coil being spaced from the bottom end of the cavity by a second distance, said first distance being at least as great as the second distance whereby when the barrel is positioned in the cavity with the barrel breech end spaced from the bottom end of the cavity to define an air chamber in the cavity, the barrel will be moved inwardly of the cavity as a result of energizing of the coil which pulls the plunger inwardly of the coil toward a position of minimum reluctance.

3. A gun comprising an elongate barrel formed of non-magnetic material having a breech end, a muzzle end and a straight and open ended passage extending longitudinally therein for receiving a projectile, the outside surface of the barrel adjacent the breech end thereof being cylindrical, stop means in said passage adjacent the breech end for preventing movement of said projectile out from the breech end of the barrel, a plunger of magnetic metal fixed to and extending in a direction around the barrel and being of predetermined length measured longitudinally of the barrel, said plunger being spaced from the breech end of the barrel; and a breech member having a forward end, a rearward end and a cylindrical cavity formed therein, the cavity being open in the forward end and closed in the rearward end, the area and configuration of the cavity in cross-section being substantially equal to that of the cylindrical breech end portion of the barrel whereby the barrel breech end portion is slidable longitudinally in the cavity, a coil in the breech member and extending around the cavity adjacent the forward end portion thereof, said coil being arranged for connection to a source of electric power, whereby when the coil is energized it will pull the plunger in a direction toward a position of minimum reluctance in the coil thus to slide the breech end portion of the barrel rearwardly in the cavity.

4. A gun comprising an elongate barrel formed of non-magnetic material having a breech end, a muzzle end and a bore extending longitudinally therethrough for receiving a projectile, the barrel being cylindrical and circular in cross section in a portion thereof adjacent its breech end, stop means in said bore adjacent the breech end thereof for preventing movement of said projectile out from the breech end, a tubular plunger of magnetic material in the barrel around the bore, the center of the plunger being spaced from the breech end of the barrel by a first distance, a breech member having a cylindrical cavity of circular cross section formed therein, the cavity having a bottom end and a forward end, the breech end portion of the barrel extending into the cavity and being snugly slidable axially therein, an elongate coil in the breech member extending longitudinally around the barrel, the center of the coil being spaced from the bottom end of the cavity by a second distance, said first distance being at least as great as the second distance, recoil means operatively associated with the barrel and breech member normally biasing the barrel in a direction outwardly from the cavity to a ready-to-fire position, the breech end of the barrel defining a forward end of an air chamber within the cavity from which air is expelled through the bore when the coil is electrically energized to move the plunger inwardly of the coil in a direction toward a position of minimum reluctance.

5. A gun according to claim 4 in which the breech end of the bore is conical.

6. A gun according to claim 4 in which the breech member has an air port formed therein in communication with the forward end portion of said chamber.

7. A gun according to claim 4 in which the barrel has a longitudinally extending recess formed therein, the recess being open to the outside surface of the barrel, and the

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barrel having a passageway formed therein interconnecting said recess and bore for passage of projectiles into the bore.

8. A gun comprising an elongate barrel having a breech end, a muzzle end and a bore extending axially therethrough, a tubular breech member having a cylindrical wall defining a cavity therein, said cavity having a forward end and a rearward end, a bottom wall extending transversely of the axis of the cavity to define said rearward end, said forward end being open, the barrel being of greater length than the cavity and being axially snugly slidable in the cavity whereby an air chamber is defined in the cavity between the breech end of the barrel and the bottom wall of the cavity, recoil means on the barrel and breech member normally biasing the barrel to a ready-to-fire position in which the breech end of the barrel is spaced from the bottom wall of the cavity, solenoid means in the breech member and barrel for moving the barrel in a direction toward the bottom wall of the cavity upon energization of the solenoid means, the wall of the breech member having a port formed therein and extending therethrough and spaced from said bottom wall to accommodate flow of air from the air chamber through said port and to the outside of the breech member during the initial stage of movement of the barrel into the cavity.

9. A gun comprising an elongate barrel having a breech end, a muzzle end and a bore extending axially therethrough, a tubular breech member having a cylindrical cavity formed therein, said cavity having a forward end and a rearward end, a bottom wall extending transversely of the axis of the cavity defining the rearward end, said forward end being open, the barrel being of greater length than the cavity and being axially slidable in the cavity whereby an air chamber is defined in the cavity between the breech end of the barrel and the bottom wall of the cavity, recoil means on the barrel and breech member normally biasing the barrel to a ready-to-fire position in which the breech end of the barrel is spaced from the bottom wall of the cavity to define an air chamber in the cavity behind the barrel, solenoid means in the breech member and barrel for moving the barrel in a direction toward the bottom wall of the cavity upon energization of the solenoid means, a projectile receiving recess formed in the outside surface of the barrel and communicating with said bore adjacent the breech end of the bore, stop means in the bore adjacent the breech

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end of the bore for preventing a projectile from sliding out from the breech end of the bore, and magazine means on the breech member for receiving a supply of projectiles, said breech member having an opening formed therein located for passage of a projectile from the magazine means to said recess when the barrel is in ready-to-fire position.

10. A toy gun comprising a hollow gun stock having a forward end and a rearward end, an opening formed in said forward end, a tubular breech member having a cylindrical cavity formed therein, said cavity having a forward end and a rearward end, the forward end of the cavity being open, a bottom wall extending transversely of the axis of the cavity to define the rearward end of the cavity, the breech member being fixed in the stock with the open end of the cavity facing toward said opening in the stock, the cavity being axially aligned with said opening in the stock, an elongate barrel having a breech end, a muzzle end and a bore extending longitudinally therethrough, the barrel being snugly slidable longitudinally in the cavity, recoil means on the barrel and breech member normally biasing the barrel to a ready-to-fire position in which the breech end of the barrel is spaced from the bottom wall of the cavity to define an air chamber in the cavity behind the barrel, solenoid means in the breech member and barrel for moving the barrel in a direction toward the bottom wall of the cavity upon energization of the solenoid means, a source of electrical energy in the stock, circuit means connecting said source to said solenoid means, and a trigger switch in said circuit means for selectively closing and opening the circuit means.

11. A toy gun according to claim 10 in which said stock is formed as a pistol and the muzzle end of the barrel projects out through said opening in the stock.

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