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DEVICES FOR FIRING OBJECTS OF THE CLASS OF PROJECTILES, PLUGS, PINS AND NAILS

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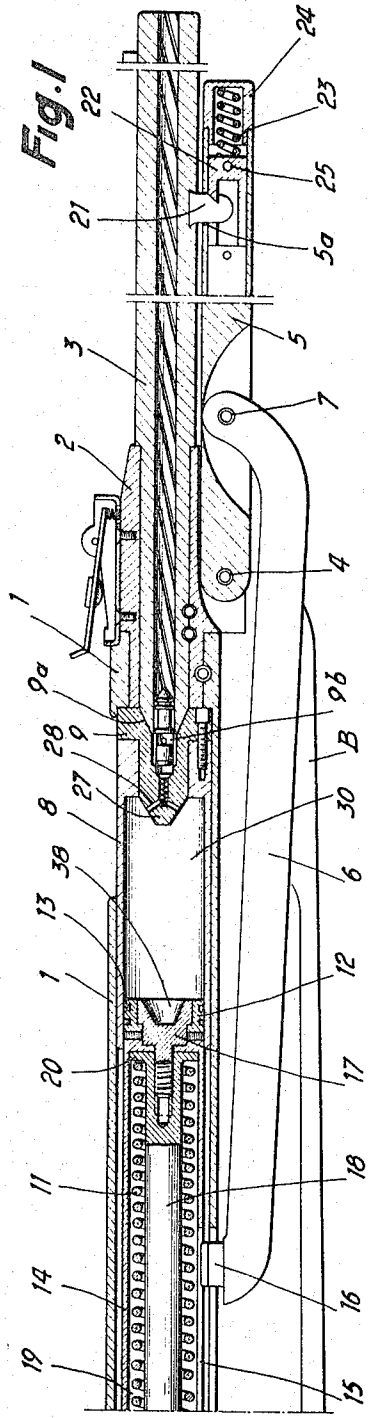
Fig. 1



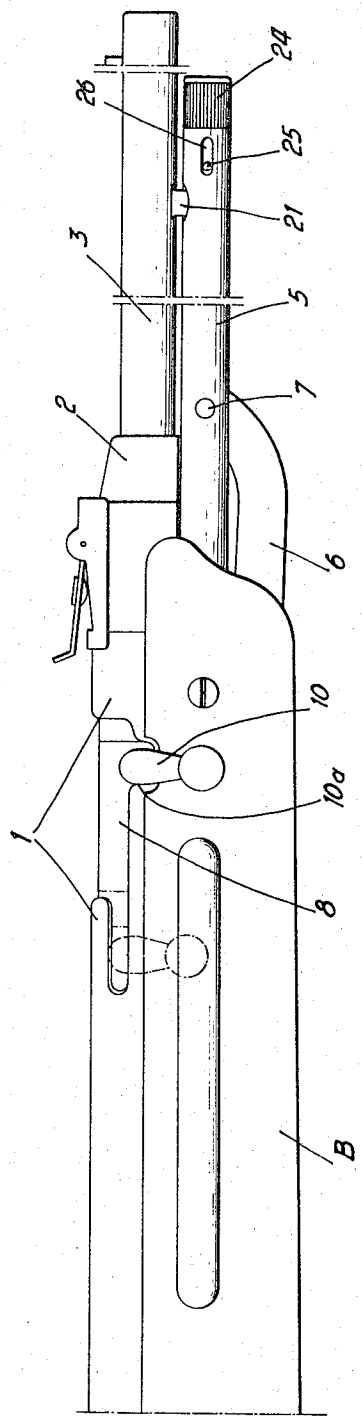




Fig. 2

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Fig. 3

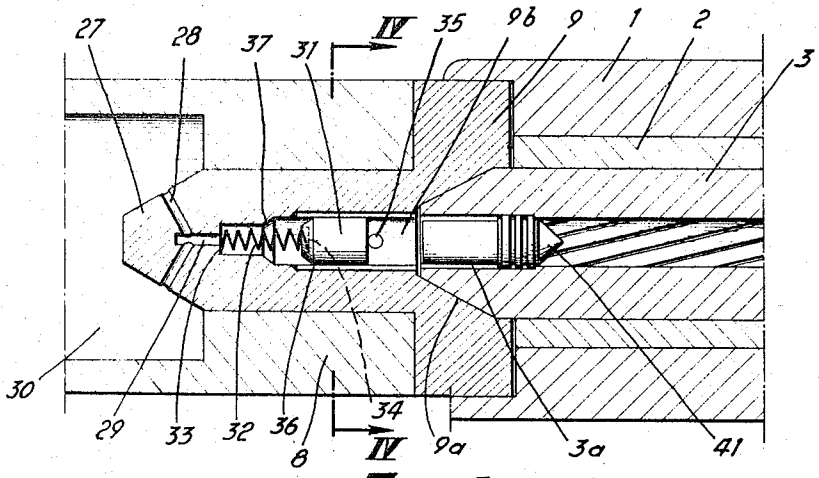



Fig. 4

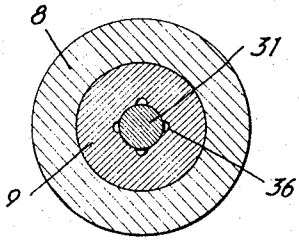



Fig. 7

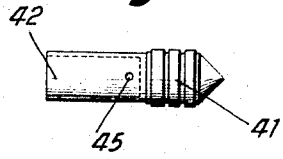



Fig. 5

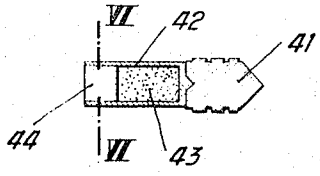



Fig. 8

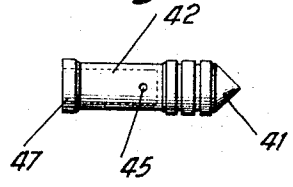
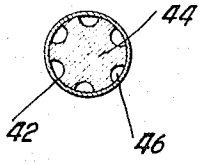



Fig. 6



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3,302,319

# DEVICES FOR FIRING OBJECTS OF THE CLASS OF PROJECTILES, PLUGS, PINS AND NAILS

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2 Claims. (Cl. 42—1)

The present invention has for its object a device for firing objects of the class of projectiles, plugs, pins, nails, etc., which are intended to be propelled under the action of an explosive charge of the type in which the ignition of the charge takes place spontaneously under the action of an increase in pressure, that is to say which does not require any priming product but which takes place under the action which is known by the name of "diesel effect."

The device in accordance with the invention, which can be a fire-arm, sealing-gun, etc., is characerized in that the loading chamber which is located behind a barrel and which is intended to receive the explosive charge together with the object to be fired communicates with a compressed-air pump having a piston so designed as to be capable of being brought manually into the cocked position in opposition to the thrust exerted by elastic means and to carry out a suction stroke, the commencement of the working stroke or delivery stroke of said piston which is produced by said elastic means being controlled by releasing means in such a manner as to compress the air within the pump cylinder and to discharge said compressed air into the loading chamber with a view to igniting the explosive charge.

In one preferred form of embodiment of the novel firing device, said device is further characterized by the following points and combinations thereof:

The compressed-air pump is coaxial with the gun barrel and movable relatively to said barrel so as to provide access to the loading chamber;

The piston is integral with a skirt and with an axial rod which delimits with said skirt an annular space in which the elastic means are disposed, the said elastic means advantageously consisting of a coil spring which surrounds said axial rod;

The piston is provided on the front face thereof with an axial recess of substantially frusto-conical shape to which there corresponds a boss of complementary shape which is provided at the end of the pump cylinder and in which are formed ducting means for permitting said cylinder to communicate with the loading chamber;

The ducting means comprise at least one duct which has its outlet in the frusto-conical surface of the cylinder-end boss;

The aforesaid duct encloses a valve which is normally open but which is designed to seal off said duct under the action of the high pressure of the combustion gases produced by the ignited explosive charge;

The pump cylinder which is adapted to slide with respect to the gun barrel is lockable in the position in which said cylinder-end is in contact with the rear end of said gun barrel;

The cocking stroke of the piston is controlled by means of a hand-operated toggle lever which is articulated at a fixed point of the device and is engaged with the skirt of the piston;

That portion of the toggle lever which is engaged with the skirt of the piston is adapted to slide within a longitudinal groove of said skirt;

That portion of the toggle lever which is operable by hand comprises releasable locking means for maintaining said lever in the rest position.



The invention also has for its object an ammunition unit which is designed for use in the device hereinabove referred-to, said ammunition unit being characterized in that the object to be fired which forms part of said unit (namely a projectile, plug, pin, nail and the like) is adapted to form, prior to the propulsion thereof, a valving means for sealing off the rear end of the gun barrel and that said object is integral at the rear end thereof with a receptacle which contains the explosive charge, said receptacle having preferably the shape of a skirt which is open at the rear end.

In the preferred forms of embodiment thereof, the novel ammunition unit is further characterized in that the charge which is placed within the skirt is so shaped as to have a large free surface and thus to provide a large area of contact with the compressed air which is intended to initiate the ignition of said charge. The large free surface referred-to is preferably obtained by means of longitudinal splines formed at the periphery of the charge.

Further particular features and characteristics of the invention will be brought out by the following description of one embodiment in the form of a rifle to which this invention applies, said embodiment being given solely by way of example and not in any limiting sense in view of the fact that this novel device can also be designed in other forms such as a sealing gun or pistol (or any other propulsion devices of like nature), the following description being made in reference to the accompanying drawings, wherein:

FIG. 1 is a partial longitudinal sectional view of a portion of the rifle in which neither the trigger nor the firing mechanism have been shown for the sake of clarity;

FIG. 2 is a view in elevation of that portion of the rifle which is shown in partial cross-section in FIG. 1;

FIG. 3 is a sectional view on a larger scale showing that portion of the rifle which includes the rear portion of the barrel and the front portion of the compressed-air pump;

FIG. 4 is a sectional view taken along the line IV—IV of FIG. 3;

FIG. 5 is a longitudinal sectional view of an ammunition unit which is intended to be employed with the rifle;

FIG. 6 is a transverse sectional view taken along the line VI—VI of FIG. 5;

FIG. 7 is a view in elevation of an alternative form of ammunition unit;

FIG. 8 is a view which is similar to the preceding, showing another alternative form of the ammunition unit.

In accordance with the invention, the rifle which is designed for the practical application of the invention consists of a receiver **1**, the front end of which is made integral by any suitable means with an annular support **2** in which is fixed the rear portion of the gun barrel **3**. The assembly **1**, **2**, **3** is mounted in the usual manner on the stock B.

Beneath the gun barrel is pivotally mounted on the pin **4** carried by the stock an operating arm **5** to which is pivotally coupled at **7** the re-cocking linked-rod **6** which forms a toggle-lever with the arm **5**.

A pump cylinder **8** is adapted to slide freely within the receiver **1** and the front end of said pump cylinder is formed by a cylinder head **9** in the front face of which is formed a frusto-conical recess **9***a* which is adapted to cover and close off in gas-tight manner the rear end of complementary frusto-conical shape of the gun barrel **3**, the rear end of the bore of which opens into the loading chamber **3***a*.

The assembly which is formed by the cylinder **8** and the head **9** which is integral therewith forms a movable breech bolt which is slidable within the receiver **1** and which is integral with the operating handle **10**. Said

operating handle controls the opening (shown in chain-dotted lines) and closing of the breech bolt and serves to secure the breech bolt in the locked position when said lever is locked against the shoulder 10*a* of the receiver.

Within the pump cylinder 8 is located a moving system 19 which is adapted to slide therein and which is associated with the cocking and firing mechanism which can be of any suitable type and which has not been shown in the drawings. The moving system 19 consists of a piston 12 provided with annular grooves in which are fitted piston-rings 13. The piston has a rearward extension in the form of a sleeve or skirt 14 in which is formed along a generator-line a longitudinal slot 15 in which is engaged the heel 16 of the cocking link-rod 6.

The piston 12 is also rigidly fixed to an axial rod 18, for example by screwing the portion 17 of said piston into said rod, there being fitted over said axial rod a coil spring 11 which works in compression and one end of which is applied against the end 20 of the sleeve 14 whilst the other end is applied against an abutment shoulder provided at the rear of the receiver 1.

When the moving system 19 is located in the forward position thereof, the heel 16 of the link-rod 6 is located at the rear end of the slot 15 with the result that, when the operating arm 5 is caused to pivot about its pin 4 so as to move said arm away from the barrel 3, the displacement of the heel 16 initiates the rearward displacement of the moving system 19. Said moving system can be maintained in this cocked position by means of a firing mechanism controlled by a trigger, said mechanism being capable of producing action on the rod 18 which is rigidly fixed to the piston 12.

In order to maintain the arm 5 in the rest position underneath the barrel 3 (as shown in FIGS. 1 and 2), provision has been made for a fastening lug 21 or catch which is integral with said barrel and which is capable of penetrating through a hole 5*a* into a socket 22 which is thrust back in the closed position (position of engagement with the catch 21) by a spring 23 which is applied against the bottom of a cap 24 which is screwed onto the extremity of the arm 5.

The socket 22 is provided with a stud 25 which is capable of sliding freely within a slot 26 formed for this purpose in the arm 5. When the stud is thrust forward inside the cap 24 in opposition to the spring 23, the socket 22 can accordingly be released from the catch 21, thus making it possible to release the arm 5, and then to carry out the cocking movement.

The cylinder head 9 has a frusto-conical boss 27 which projects into the interior or compression chamber 30 of the pump and onto the frusto-conical surface of which open ducts 28 providing communication with an axial duct 29 which connects said compression chamber 30 of the pump to the loading chamber 3*a* which is located to the rear of the gun barrel 3.

Within the axial duct 29 is fitted a valve 31 which is preferably maintained in the open position against a stop 35 by a spring 32 which bears against an annular shoulder 33 of the duct 29 and against the base 34 of the valve 31. The spring 32 is thus protected by the valve 31 against the temperature rise which occurs at the time of ignition of the explosive charge contained in the loading chamber 3*a*.

The loading chamber 3*a* and its extension 9*b* which is formed within the cylinder head 9 are provided with longitudinal grooves 36 (as shown in FIGS. 3 and 4) which permit the air to pass in both directions when the valve is open, which takes place continuously except at the moment of explosion of the charge when said valve is violently applied against an annular seating 37 which is formed at the rear end of the extension 9*b* of the loading chamber.

During the suction stroke of the piston 12, the spring 32 prevents the valve 31 from being applied against the seating 37.



The obturation which is ensured by the valve 31 at the time of explosion of the charge is completed by the obturation which is produced owing to the fact that the front face of the piston 12 has a frusto-conical depression or recess 38 having a shape which is complementary to that of the boss 27, with the result that, when the piston 12 has reached the limit of its working stroke, it seals off the openings of the ducts 28 by virtue of its recess 38.

FIG. 5 represents a preferred from of embodiment of the ammunition unit which is designed for use with the rifle for the practical application of this invention.

The ammunition unit referred-to comprises at the front end the projectile 41 proper (which forms a temporary valve at the front portion of the loading chamber 3*a* when the pressure initially rises). Said projectile or body is provided at the rear end with a skirt 42 having a diameter which is smaller than that of said projectile in order that the high pressure which is generated when a shot is fired can be balanced both inside and outside the skirt which is thus not liable to burst.

Inside the skirt 42 is placed a first explosive charge 43 of a standard type commonly employed and a second charge 44 having a base of stabilized and treated gun-cotton (or any other compound which is capable of igniting under the action of a diesel effect) which is designed to ignite the first charge 43.

In an alternative form, the two charges 43 and 44 can be mixed so as to form a single charge which is capable of igniting spontaneously by diesel effect.

The alternative form of ammunition unit shown in FIG. 7 differs from the first in that the skirt 42 has an aperture 45 which permits the escape of gases with a view to balancing the pressure outside and inside the skirt.

The ammunition unit shown in FIG. 8, in which the skirt is again provided with a communication aperture 45, differs from the preceding units in that the skirt 42 is provided at its rear extremity with an annular mass 47 with a view to ensuring better guiding of the projectile.

Irrespective of the type of ammunition unit employed, the positioning of said unit within the loading chamber 3*b* is obtained by inserting said unit inside said chamber under a light pressure applied by the cylinder head 9 at the moment of closure of the breech, the front portion of the projectile being accordingly engaged within the inlet of the bore of the gun barrel 3 so as to form a leak-tight seal therein at the moment of pressurization of the compressed air, said seal thus forming at that moment a sufficient brake to prevent any displacement of the projectile when the diesel effect is produced.

When the user proceeds to fire the gun, the moving system 19 which has previously been placed in the cocked position is projected forward, thereby producing the rapid compression of the air which is present within the work chamber 30 of the pump, this compression being propagated into the loading chamber 3*a*–9*b* for the firing of the charge.

Furthermore, when the piston 12 has reached the limit of its working stroke, there is present between the boss 27 and the corresponding recess 38 of the piston 12 a damping air cushion which reduces the hammering action between the moving and stationary elements of the pump to a considerable extent. The filling of the chamber 30 with fresh air during the cocking operation can be facilitated by means of a duct formed within the piston 12 and controlled by a valve.

It will be noted that this mode of ignition by compression of the charge makes it possible to dispense with the striker-pin of conventional firearms and with the usual cartridge case of ammunition units in view of the fact that the novel ammunition unit according to the invention does not require the use of any primer with fulminate base.

It will be apparent that the example of embodiment of the rifle which has been described hereinabove and illustrated in the accompanying drawings is not given in any

limiting sense and that any and all detail modifications can be made in said embodiment without thereby departing from the spirit of the invention, which also includes within its scope all other devices for the propulsion of objects other than a rifle and entailing the application of general means which form the basis of the invention as defined in the appended claims.

What I claim is:

1. In a device for firing objects of the class of projectiles, plugs, pins and nails which are intended to be propelled under the action of an explosive charge of the type in which the ignition of said charge takes place under the action of a pressure rise, said device comprising a supporting stock, a gun barrel mounted in said stock, a compressed-air pump which is disposed to the rear of said barrel so as to provide therewith a space forming a loading chamber and which has a cylinder and a piston movable within said cylinder, there being formed in that end of said pump cylinder which is directed towards said barrel at least one duct providing a communication between the loading chamber and the interior of said cylinder, elastic control means for said piston which are placed against the rear face of the piston and tend to drive said piston into the cylinder so as to compress the air contained therein and to deliver the air under pressure into the loading chamber, and cocking means for withdrawing the piston relatively to the cylinder-end and at the same time for compressing the elastic control means, the fact that the working face of the piston is provided with a substantially frustoconical axial recess, whilst the cylinder-end is provided with a frusto-conical boss having a shape which is complementary to that of said recess and with means for admitting air through said boss so as to enable the pump cylinder to communicate with the loading chamber.



2. Firing device as defined in claim 1, wherein the air-admission means comprise at least one duct of which one extremity has its opening on the frusto-conical surface of the cylinder-end boss, a valve disposed within said duct and capable of sealing off said duct when an overpressure is produced within the loading chamber, and a spring which produces action on the valve so as to maintain said valve in the normally open position.


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