(No Model.)

H. S. MAXIM.

GUN.

No. 424,119. Patented Mar. 25, 1890.

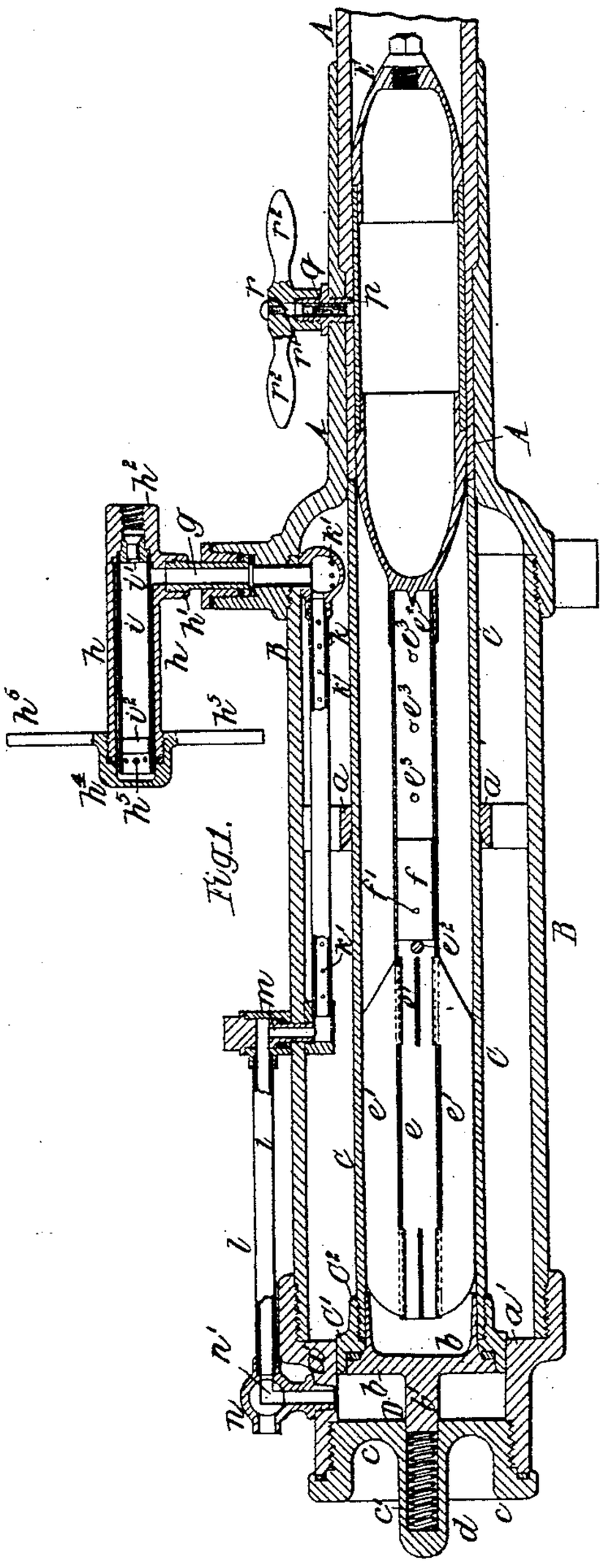

Fig. 1.

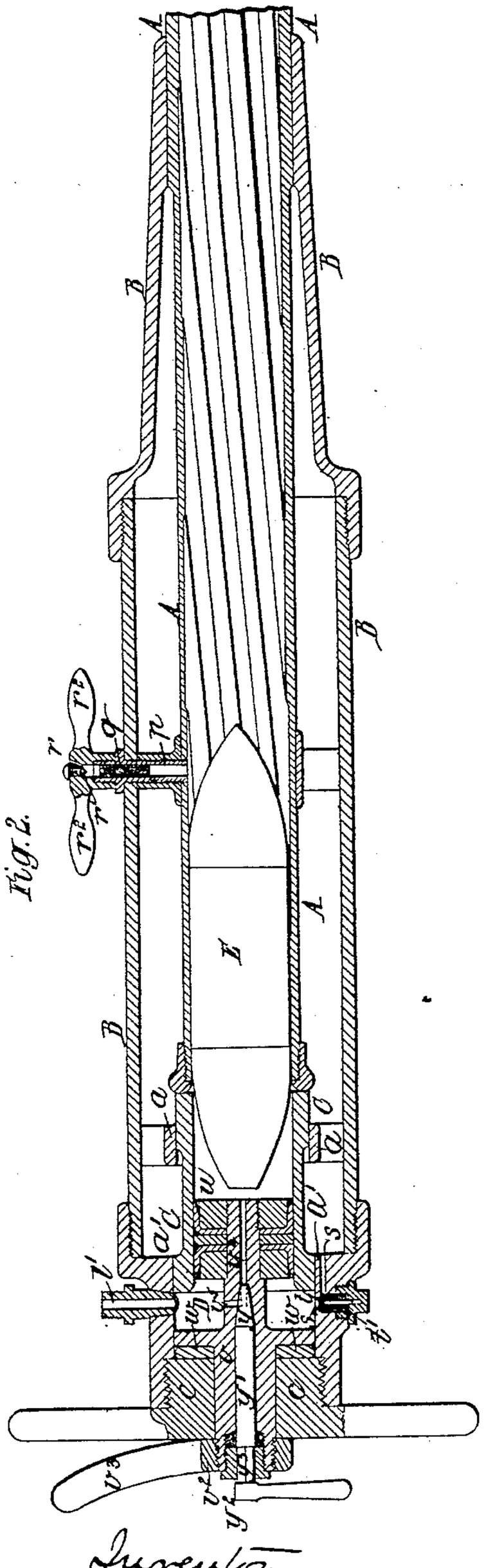

Fig. 2.

Witnesses.
Frank E. Hartley
Frank B. Murphy.

Inventor
Hiram S. Maxim
By Duncan, Curtis & Page
attys.

UNITED STATES PATENT OFFICE.

HIRAM STEVENS MAXIM, OF LONDON, ENGLAND.

GUN.

SPECIFICATION forming part of Letters Patent No. 424,119, dated March 25, 1890.

Application filed March 26, 1888. Serial No. 268,529. (No model.)

To all whom it may concern:

Be it known that I, HIRAM STEVENS MAXIM, mechanical engineer, a citizen of the United States of America, and a resident of London, England, have invented new and useful Improvements in and relating to Guns, chiefly designed for use with projectiles or shells containing blasting-gelatine or similar explosives, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates chiefly to guns designed for use with hollow projectiles or shells charged with blasting-gelatine or similar explosive compounds, and commonly known as "dynamite-guns."

It has heretofore been customary to utilize compressed air in dynamite-guns for discharging the projectiles or shells therefrom, and in order to obtain a high muzzle velocity of the projectile or shell it has been necessary to make such guns with very long barrels and to employ air under very high pressure. By my invention I am enabled to greatly reduce the length of the barrel and the pressure of air employed as compared with the dynamite-guns heretofore used, and at the same time to obtain a very high muzzle velocity of the projectile or shell. Instead of charging the gun with compressed air in the ordinary manner, I charge it with a mixture of compressed air and volatile petroleum or other hydrocarbon or combustible gas. For example, I mix a quantity of gasoline with the charge of compressed air, so that there is just sufficient oxygen in the air to convert the hydrogen of the hydrocarbon into water and the carbon into carbonic-acid gas. This mixture may be used at a pressure equal to about one-half of that ordinarily employed in air-guns or dynamite-guns. In using the gun a quantity of this explosive mixture of hydrocarbon vapor or gas and air is allowed to enter the barrel under pressure. I provide means whereby, when the projectile has been driven forward through, say, from one-quarter to one-half of the entire length of the barrel by the expansive force of the mixture of gas and air, the said mixture will be exploded and the pressure in the barrel thus instantly increased about eight-fold. It will be seen, therefore, that I provide for greatly increasing the pressure applied for propelling the projectile or shell without increasing the weight or the density of the gas used for this purpose. Moreover, the heat generated by the combustion of the mixture of gas and air prevents refrigeration and increases the expansion of the air. It also prevents the formation of vapors in the air at the instant of discharge. For the purpose of igniting the charge I may employ any well-known or suitable device. I prefer, however, to use a detonating-cartridge placed in a chamber or cavity in the side of the barrel at any required distance from the breech. The said cartridge is so arranged that it may be moved outward from the axis of the barrel, as hereinafter described, through a distance of about one-quarter of an inch, and a sharp projection or pointed stud is provided in the said chamber or cavity, against which the primer will strike when the cartridge is thus moved outward. When the said cartridge is placed in the said chamber or cavity and the compressed air and gas are admitted into the barrel to discharge the gun, no effect is produced by means of the said cartridge until after the projectile has passed the aperture of the said chamber or cavity. The compressed air then impinges upon the inner end of the cartridge and forcibly drives the same outward in its chamber or cavity, thus bringing the primer into contact with the said sharp projection or stud, whereby the said cartridge is exploded, so that it ignites the explosive mixture in the barrel of the gun. In this manner a gun is rendered much more efficient than with cold compressed air, while the quantity of air required for each discharge is much less. The quantity of gasoline required for each discharge is very small, the propelling power of one ounce of gasoline when thus used being equivalent to the propelling force of some pounds of gunpowder, while the pressure generated can never exceed a certain limit, which may be predetermined with great exactitude.

I can, if desired, adapt existing dynamite-guns for the purpose of my invention. I prefer, however, to construct a gun as shown in the accompanying drawings, in which—

Figure 1 is a horizontal central section of one form of my improved gun, and Fig. 2 is

a similar view of another form or modification thereof.

Like letters indicate corresponding parts throughout the drawings.

A is the barrel of the gun.

B is a chamber into which the compressed air is to be introduced, as hereinafter described, and which is provided with trunnions B′, whereby the gun is to be supported in a carriage or mounting.

C is a hollow cylinder or tube arranged within the chamber B and fitted to slide longitudinally in guides *a a′*. This tube bears against the rear end of the barrel A and forms an extension or prolongation thereof. The adjacent ends of the barrel A and tube C are made with true plane surfaces to insure tightness of the joint between the same.

D is a chamber formed in the rear end of the gun, for the purposes hereinafter specified.

E is the projectile or shell, which is to be charged with blasting-gelatine or similar explosive compound.

In the gun shown in Fig. 1 the tube C is closed at the rear end by a cap *b*, fitting into the said tube and provided with a guide rod or stem *b′*, fitted to slide in a recess or cavity *c′*, formed in a cap *c*, which is preferably provided with a divided or intermittent screw-thread, and is tightly screwed into the rear end of the chamber D. A spring *d*, placed in this recess or cavity, bears at one end against the cap *c* and at the other end against the said stem *b′*. This spring tends to keep the tube C pressed against the rear end of the barrel A, and will effect or assist in effecting the forward or return movement of the said tube after it has been moved backward, as hereinafter described, and the projectile or shell has been discharged from the gun.

The projectile or shell E is provided with a tail consisting of a tube *e*, having secured therein at or near its rear end vanes or blades *e′*, designed to impart rotation to the said projectile or shell in its flight. A detonating-charge *f* is placed in the tube *e* and held therein by a pin *f′*, which will be broken or sheared by reason of the inertia of the charge *f* when the projectile or shell is discharged from the gun. A strong pin e^2 is, moreover, fixed in the tube *e*, to serve as a stop or abutment for the said charge during the flight of the shell. The tube *e* is perforated, as at e^3, to permit freedom of movement of the charge therein, and a pointed stud e^* is provided at the forward end of the said tube *e* for exploding the detonator when the shell strikes the ship or other object against which it is aimed and the detonator by reason of its momentum moves forward in the said tube.

The chamber B is provided with a pipe *g*, for the admission of the mixture of air and gas under pressure. This pipe is fitted and secured in one of the trunnions B′, which is made hollow for the purpose.

If it is desired to mix gasoline with the compressed air, I prefer to use a device comprising a metal casing *h*, which is formed with a screw-threaded socket *h′*, whereby it is connected with the pipe *g*, as shown. The said casing is also formed with a screw-threaded socket h^2, with which the supply-pipe for the compressed air is to be connected. A tube or tubular chamber or bottle *i*, of brass or other suitable material, is arranged within the said casing *h*, a space being left between the said tube and casing, as shown. This tube *i* is closed at one end by means of a cork or other stopper *i′*, and is to be filled with gasoline or similar hydrocarbon. The other end of the said tube is perforated, as at h^3, and a cork or other plug i^2 is pushed into the said tube beyond the perforations, as shown. The casing *h* is closed by a screw cap or cover h^4, provided with handles h^5, whereby it may be readily removed to permit the removal of the tube or bottle *i* when empty and the insertion of a full bottle.

The pipe *g* communicates with the chamber D by means of the pipe *k*, arranged within the chamber B and the pipe *l* outside the said chamber, the pipes *k l* being connected by a short pipe *m*, extending through the side or wall of the chamber B. The pipe *k* is perforated, as at *k′*, to admit the compressed air and gas into the chamber B. The pipe *l* is connected with a cock *n*, whereby the said chamber D may be put in communication with the said pipe *l* or with the external atmosphere through an aperture or nozzle *n**.

p is a metal tube, which is firmly secured in the barrel A, and in which is inserted an igniting charge or cartridge *q*. The said tube is closed by means of a screw cap or cover *r*, provided on its inner side with a pointed stud or projection *r′*, and the said cartridge is free to slide longitudinally in the said tube *p*, for the purpose hereinafter specified. The cap or cover *r* is provided with handles r^2 to facilitate the removal and replacement thereof.

The operation of the gun above described is as follows, viz: The gun is loaded from the breech end by unscrewing and removing the cap *c*, withdrawing the cap *b* from the tube C, and then inserting the projectile or shell in the said tube. The caps *b c* are then replaced. A cartridge *q* is, moreover, inserted in the tube *p*. Care must be taken before opening the supply-cock for the compressed air that the plug *n′* of the cock *n* is in the position shown in the drawings. On opening the supply-cock for the compressed air the cork *i′* will be forced by the pressure thereof into the tube or bottle *i*, and the said pressure, being transmitted through the gasoline, will push the plug i^2 past the perforations h^3. The gasoline will then be forced through these perforations by the compressed air, which will mingle with the vapor of the gasoline, thus forming an explosive mixture. This mixture of air and gas will enter the chamber B through the perforations *k′* in the pipe *k*. These perforations

are arranged on one side only of the said pipe to insure the proper mixing of the air and gas by causing the same to circulate rapidly around the tube C within the chamber B. The mixture of air and gas also enters the chamber D through the pipe *l* and cock *n*. The said chamber being of much smaller capacity than the chamber B, the pressure in it will rise more rapidly than in the latter, and will therefore forcibly press the tube C against the rear end of the barrel A. When the gun is charged with air and gas, in the manner above described, and the required pressure has been attained in the chamber B, the gun is ready to be discharged, and the supply of compressed air may be shut off. To discharge the gun, it is only requisite to turn the plug *n'* of the cock *n*, so as to permit the escape of the compressed air and gas from the chamber D, while cutting off the communication between the said chamber and the pipe *l*. The pressure in the chamber B will then be much greater than that in the chamber D, and the tube C will be moved backward away from the barrel A by the pressure exerted upon the surfaces C' C^2 of the said tube. The air and gas will then expand, and, entering the tube C and barrel A, will drive forward the projectile or shell E. As soon as the said projectile or shell has passed the open end of the tube *p*, the pressure of the air and gas will drive the cartridge *q* against the pointed stud *r'*, and thus explode the said cartridge, which in turn will ignite and explode the mixture of air and gas. The projectile or shell will therefore be started and moved a short distance along the barrel by the expansive force of the compressed air and gas, and, after a considerable momentum has thus been imparted to it, will have its momentum largely increased by the explosive force of the mixture of air and gas acting in conjunction with the expansive force thereof. In this manner the projectile or shell may be caused to leave the muzzle at a very high velocity without being subjected to any dangerous shock or concussion, such as would be imparted to it if the mixture were exploded before the projectile or shell began to move forward. In the backward movement of the tube C, as soon as its rear end has passed the aperture or passage n^2 of the cock *n*, the air remaining in the chamber D will be imprisoned or confined and compressed, and will therefore act as a cushion for diminishing the shock or concussion, and will, by its reaction or expansion, assist in effecting the return movement of the tube C.

The gun shown in Fig. 2 is rifled to insure the rotation of the projectile or shell in its flight. In this gun the chamber D is connected with the chamber B by a small orifice or passage *s*, closed by check-valve *t*, which is provided with a spring *t'*, and which permits the passage of the compressed air and gas from the chamber D into the chamber B, but prevents its return through the said orifice. The tube C is closed by a piston *u*, firmly secured to a rod *v*, extending through the screw-cap *c* and formed with a collar *v'*, between which and the said cap is placed a ring or washer *w* of leather or other suitable material. The outer end of the rod *v* is screw-threaded externally and has fitted thereon a nut v^2, formed with an arm v^3, whereby the said nut may be readily turned. By tightening this nut the ring or washer *w* may be compressed between the collar *v'* and the cap *c*, so that it bears tightly against the sides or walls of the chamber D and effectually prevents leakage of the air and gas therefrom. The mixture of air and gas admitted into the chamber D will, moreover, by the pressure which it exerts upon the collar *v'*, tend to still further compress the said ring or washer. The screw cap or plug *c* is provided with handles c^2 to facilitate its removal and replacement. A passage v^4 is formed longitudinally through the center of the rod *v*, and is connected by a transverse passage v^5 with the chamber D. The passage v^4 is closed by means of a conical valve *y*, formed with a stem or spindle *y'*. A collar or sleeve y^2 is fitted upon a square part y^3 of the said stem or spindle. This collar or sleeve is screw-threaded externally and fitted into a correspondingly screw-threaded hole in the rod *v*. The stem or spindle *y'* is provided with a handle y^4, whereby it may be turned together with its collar or sleeve y^2 to open or close the passage v^4. The chamber D can thus, when required, be put in communication with the interior of the tube C through the said passages v^5 and v^4, for the purpose hereinafter specified.

To load the gun, the cap *c* is unscrewed and removed, together with the rod *v* and piston *u*. The projectile or shell is then inserted and the said cap and other parts are replaced and the cap screwed tightly into the rear end of the chamber D. The passage v^4 is closed by means of the valve *y*. A cartridge *q* is, moreover, placed in the tube *p*. The mixture of air and gas under the desired pressure is admitted to the chamber D through the pipe *l'* as the pressure rises in the said chamber. The valve *t* is opened and the spring *t'* compressed, and the mixture of air and gas passes through the orifice or passage *s* into the chamber B. When the required pressure has been attained in the chamber B, the valve *t* is closed by the reaction of its spring *t'*. The supply of air and gas is then cut off and the gun is ready to be discharged.

To discharge the gun, the chamber D is put in communication with the interior of the tube C by opening the valve *y*, as above described. The mixture of air and gas in the chamber D then expands and enters the tube C. An initial pressure is thus obtained in the said tube, and the pressure in the chamber D is diminished until it is considerably below that in the chamber B. The tube C is then moved backward by the pressure in the chamber B acting upon the surface C' of the

said tube. The mixture of gas and air expands and enters the tube C and barrel A and moves forward the projectile or shell E. As soon as the said projectile or shell has passed the tube *p*, the cartridge *q* is exploded, as above described with reference to Fig. 1, and ignites the mixture of air and gas.

A casing containing a bottle filled with gasoline or other volatile hydrocarbon is, if desired, connected with the pipe *l'*. The air and gas may, however, be mixed and compressed in a suitable reservoir, instead of mixing them as above described. In this case the aforesaid device for containing the gasoline is dispensed with.

By the construction and arrangement of the barrel A, chamber B, and tube C as above described, I provide for admitting the compressed air to the barrel directly—that is to say, the compressed air does not require to pass through bent or curved passages, which would be liable to impede its movement and diminish the velocity with which it enters the barrel. Moreover, the compressed air is admitted to the barrel simultaneously at all points around the rear end thereof, instead of being admitted through a contracted aperture or passage. If desired, I employ a solid rod, plug, or valve, instead of the said tube C.

What I claim is—

1. In a gun of the kind described, the combination, with the barrel, of a receiver for containing an explosive gas under pressure and communicating with the rear of the projectile-chamber, and an ignitor for exploding the gas admitted to the projectile-chamber from the receiver, located in a chamber communicating with the barrel and adapted to be operated by the admission of the compressed gas to the said chamber, as set forth.

2. The combination, with a gun, of a receiver containing an explosive gas under pressure and communicating with the rear of the projectile-chamber, mechanism for controlling the admission of said gas into the chamber for starting the projectile, and an ignitor for exploding the expanded gases, located in a chamber communicating with the barrel forward of the projectile-chamber, as set forth.

3. The combination, with a gun-barrel, of a receiver or chamber for containing an explosive gas under pressure and communicating with the rear of the projectile-chamber in said barrel, valves or mechanism for controlling the admission of the gas into the barrel, and a detonator located in a chamber communicating with the barrel forward of the projectile-chamber and adapted by its explosion to ignite the expanded gas behind the moving projectile, as set forth.

4. The combination, with a gun-barrel, of a receiver for or containing an explosive mixture of air and gas under pressure, and passages of communication between said receiver and the rear of the projectile-chamber, valve mechanism in said passages for controlling the admission of the explosive gas to the projectile-chamber, and a detonator in a chamber forward of the projectile and adapted to be fired by the pressure thereon of the gas after the projectile has left its chamber, as set forth.

5. The combination, with a gun-barrel, of a receiver or chamber for or containing a gas under pressure and into which the barrel opens, a valve capable of sliding in said chamber to and from the breech or rear end of the barrel, and means for causing an excess of pressure upon either side of the valve, whereby it may be held by said pressure in position to close the breech or forced backward to open the same, as set forth.

6. The combination, with a gun-barrel, of the main receiver for containing a gas under pressure and into which the breech end of the barrel extends or opens, a tube or valve capable of sliding in said receiver to and from the breech, so as to close or open the same, a chamber in the rear of the receiver, into which the valve extends, a passage of communication between the said chamber and the main receiver, and a valve contained in the passage with ports adapted to connect the two or to close the main receiver and open the said chamber to the air, as set forth.

7. The combination, with the barrel, the gas receiver or chamber at the breech end thereof, and the tube or valve capable of moving in said chamber to and from the breech, of the detachable cap *c* at the rear of the gas-chamber, by the removal of which the valve may be withdrawn and the gun loaded, as set forth.

8. The combination, in a gun adapted to be discharged by the expansion and explosion of a compressed gas, with the tube or passage for admitting compressed air to the interior of the same, of a case or bottle containing a volatile hydrocarbon and placed in said passage, and adapted to be opened by the pressure of the air upon the stoppers closing the same, as set forth.

9. The combination, with the barrel and receiver for containing an explosive gas under pressure, of a tube leading from the device for containing the air and gas composing the explosive mixture and extending through the receiver, the said tube being provided within the receiver with a series of perforations on one side only to produce a circulation within the receiver of the air and gas, as described.

10. The combination, with the barrel of a gun adapted to be discharged by the expansion and subsequent explosion of a compressed gas, of a tube or receptacle communicating with the interior of the barrel forward of the chamber or portion of the bore for containing the projectile, and a detonating-charge placed in said receptacle and adapted to be moved and discharged by the action thereon of the compressed gas when the projectile has moved beyond the orifice of said receptacle, as set forth.

11. The combination, with the barrel A, of the receiver B, into which said barrel opens, the sliding tube or valve C, mounted within the receiver, the chamber D at the rear of the valve C, and the spring *d*, upon which the valve impinges when forced back from the breech, as set forth.

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses.

HIRAM STEVENS MAXIM.

Witnesses:

W. LOWMAN,

C. OLDERSHAW.