(No Model.) 4 Sheets—Sheet 1

H. A. KINGSLAND & J. S. SANGER.

EXPLOSION MOTOR.

No. 551,036. Patented Dec. 10, 1895.

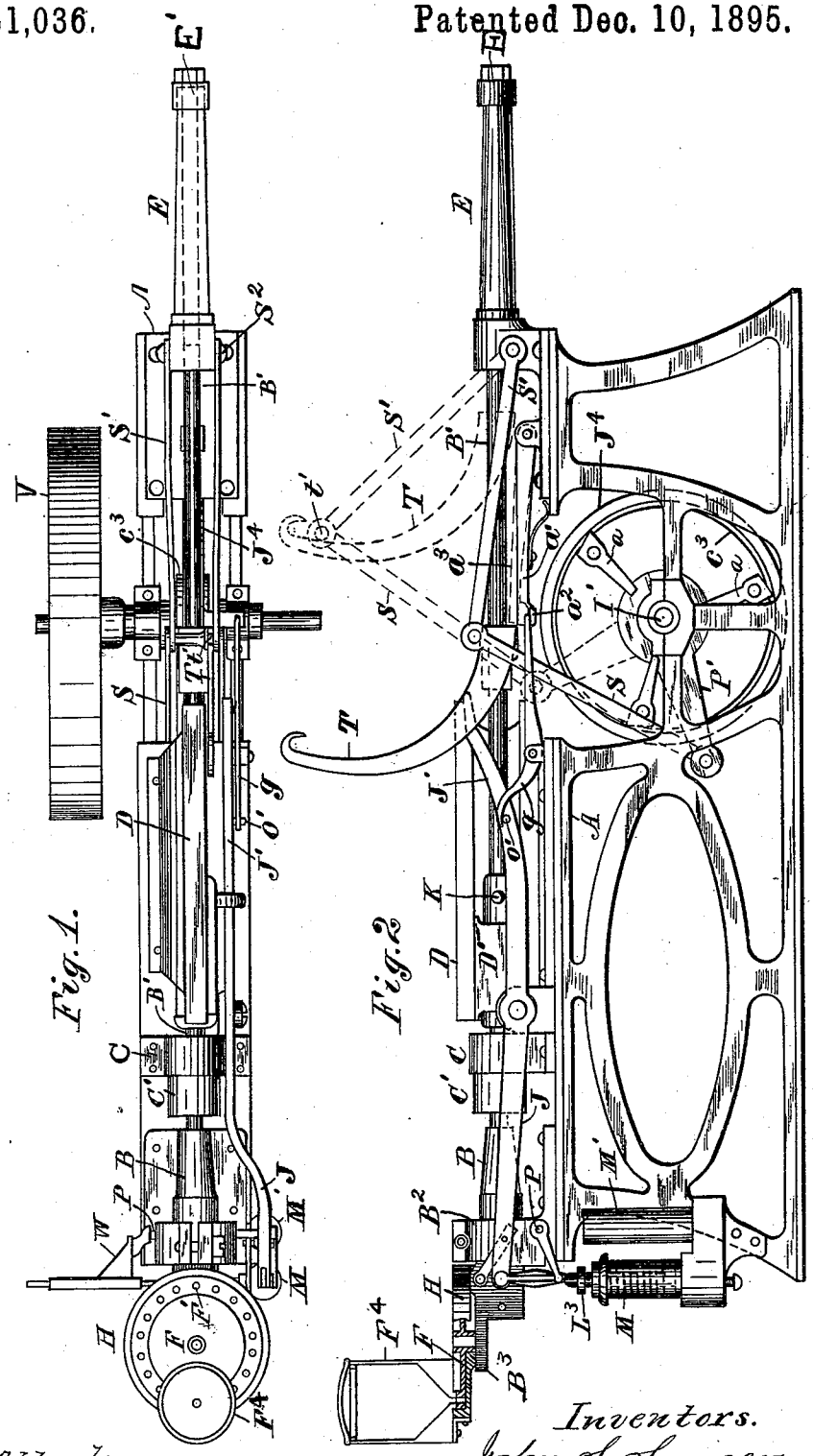

Fig. 1.

Fig. 2.

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H. A. KINGSLAND & J. S. SANGER.

EXPLOSION MOTOR.

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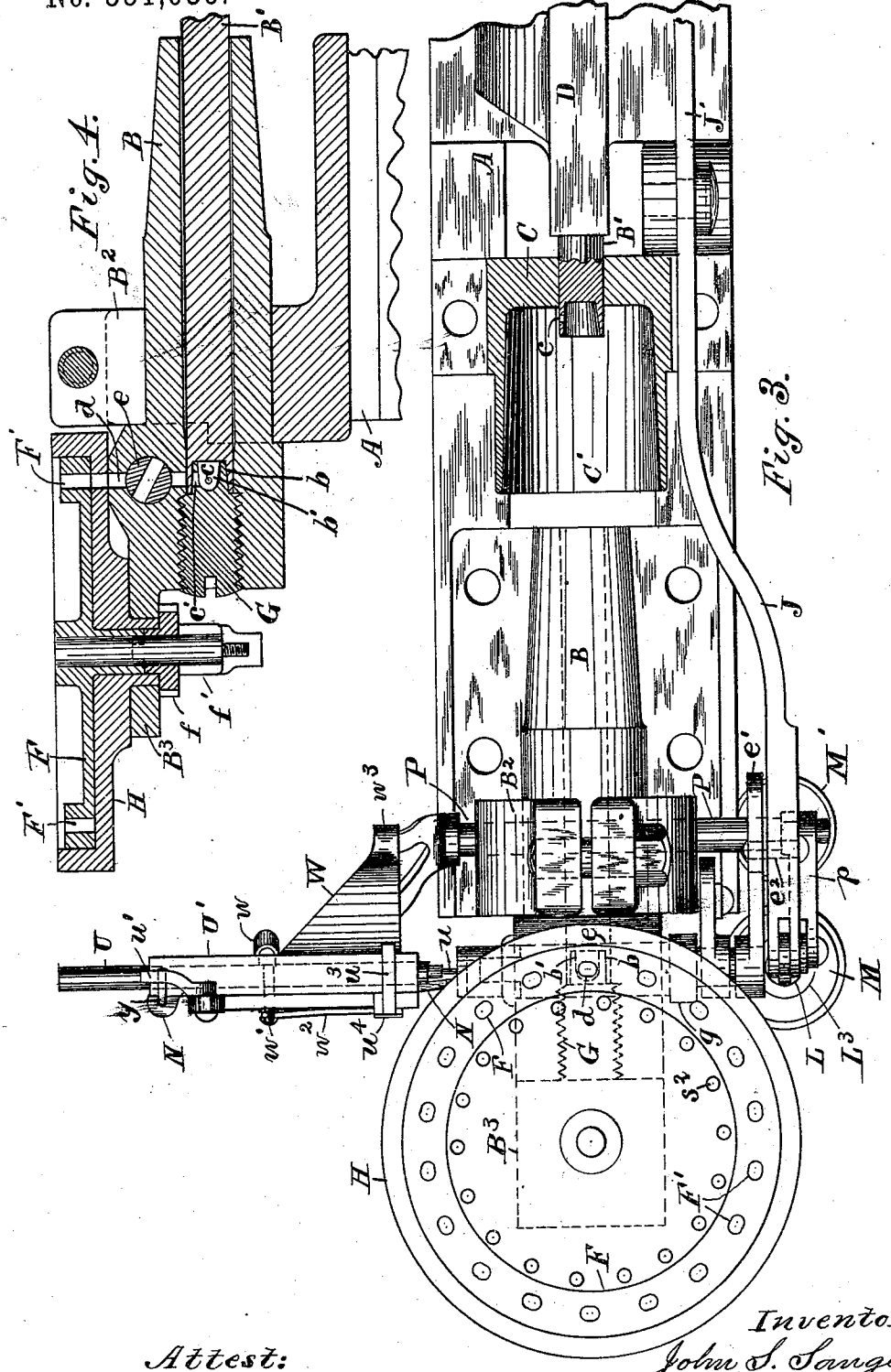

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EXPLOSION MOTOR.

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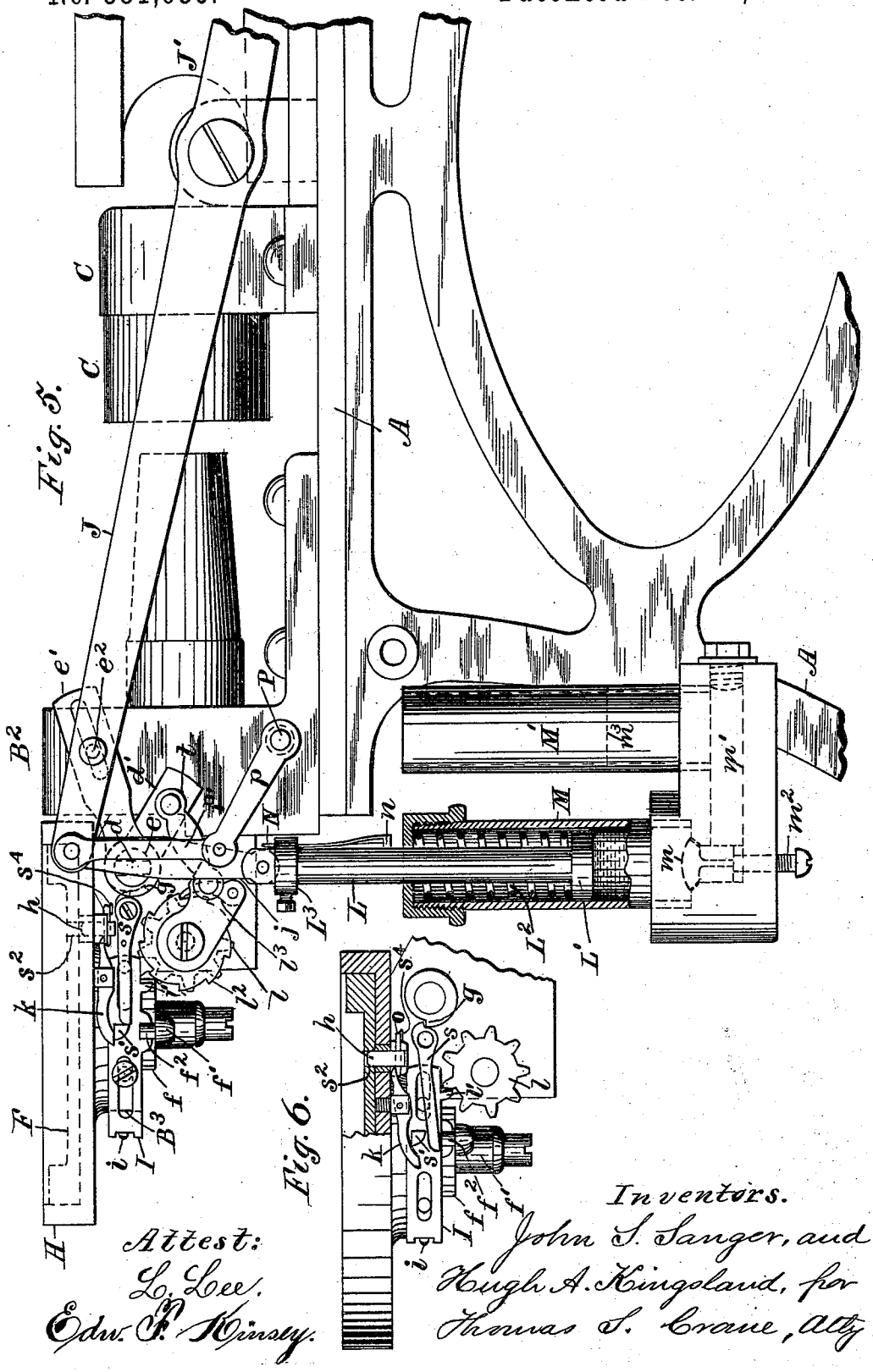

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EXPLOSION MOTOR.

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Fig. 7.

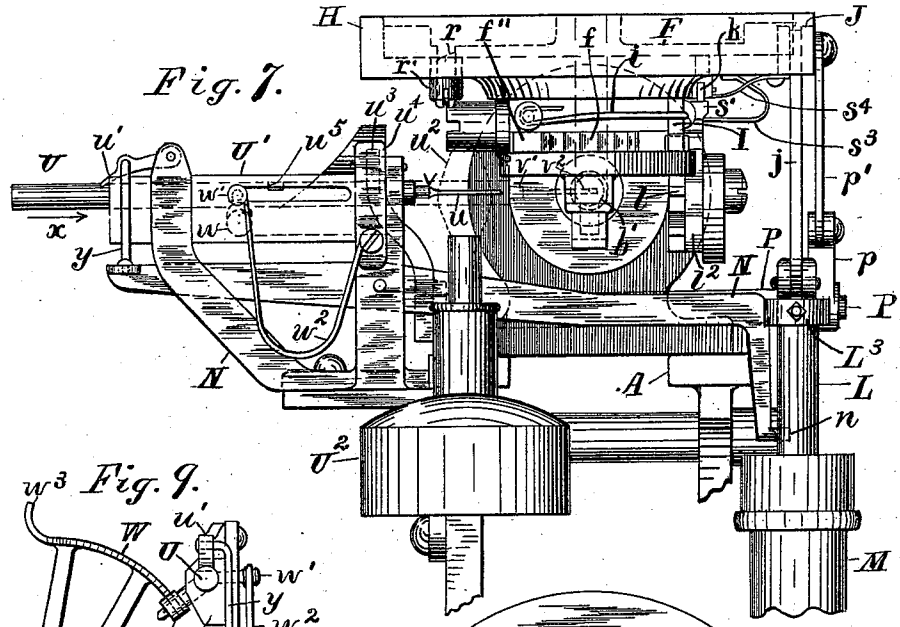
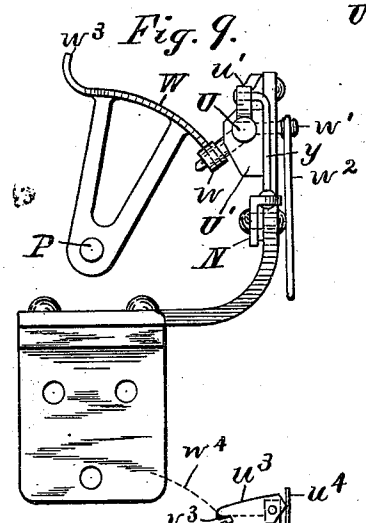


Fig. 9.



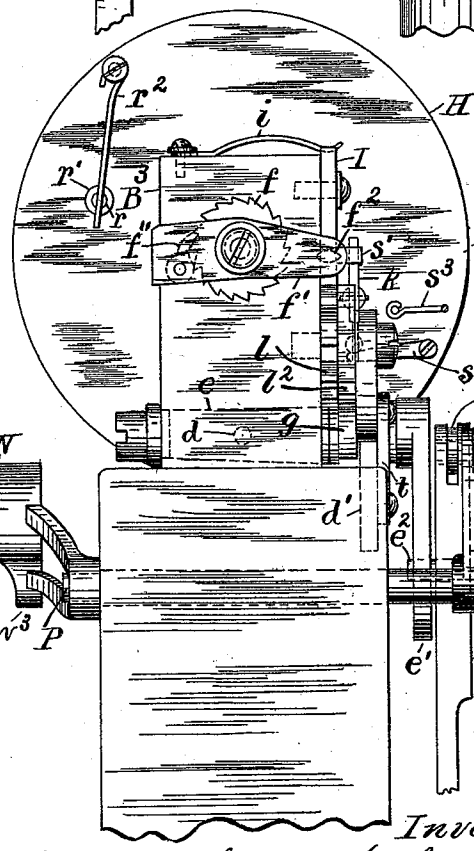


Fig. 8.

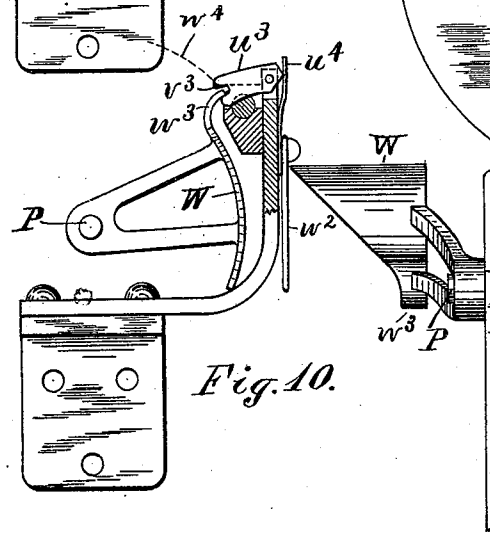


Fig. 10.

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Hugh A. Kingsland,
per Thomas S. Crane, Atty.

UNITED STATES PATENT OFFICE.

HUGH A. KINGSLAND, OF BELLEVILLE, AND JOHN S. SANGER, OF ORANGE, NEW JERSEY.

EXPLOSION-MOTOR.

SPECIFICATION forming part of Letters Patent No. 551,036, dated December 10, 1895.

Application filed March 12, 1895. Serial No. 541,434. (No model.)

To all whom it may concern:

Be it known that we, HUGH A. KINGSLAND, of Belleville, and JOHN S. SANGER, of Orange, Essex county, New Jersey, citizens of the United States, have invented certain new and useful Improvements in Explosion-Motors, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates especially to that class of motors in which explosives of high power, like gunpowder and fulminate, are employed, the mechanism embracing a power cylinder or gun, a piston-rod fitted to the bore of the same, feeding mechanism for supplying a series of charges to the base of the gun through a feed-duct, means for closing such feed-duct before each explosion, and means for firing the charge. The piston-rod is preferably checked in its forward motion by an air-cushion which operates to return it to its initial position. The reciprocating motion of the piston-rod is converted into a continuous rotary motion by means of an intermittently-acting clutch, which is applied to the power-shaft and oscillated by a link having a cam connection to the rod, such connection being adapted to greatly reduce the violent intermittent movement of the rod. A heated needle is shown herein for firing the charge, and mechanism adapted by the tension of a spring to operate voluntarily when released is provided to actuate the feed mechanism, the gate in the feed-duct, and the firing-needle. A setting-lever arranged obliquely at the side of the piston-rod is moved by a pin upon the latter during its forward stroke, and such lever operates to set and lock these voluntary mechanisms, which are subsequently released in successive order by an actuating-spring which is simultaneously compressed by the lever. A fluid-regulator or other suitable brake controls the reaction of the spring, and thus determines the velocity of the movements. Means for varying the effect of the brake or regulator serves to determine the rapidity of the explosions.

These improvements are embodied in one form in the annexed drawings, in which—

Figure 1 is a plan of an explosion-motor. Fig. 2 is a side elevation of the same; Fig. 3, a plan, partly in section at the center line where hatched, of the charging and firing apparatus with the piston-rod wholly projected. Fig. 4 is a vertical section, where hatched, of the power-cylinder and its feeding mechanism with the piston-rod retracted within the cylinder. Fig. 5 is a side elevation of the parts shown in Fig. 3 with the feeding mechanism set and locked by the positive motion of the setting-lever and the actuating-spring cylinder partly in section where hatched. Fig. 6 is an elevation of the rotary carrier for feeding the charges with its actuating mechanism unlocked, the parts being shown in section where hatched at the center line of the locking-pin. Fig. 7 is a rear elevation of the motor, excepting the lower part, where broken away for want of room, the needle and its carrier being retracted. Fig. 8 shows the under side of the parts exhibited in Fig. 5, with the frame and the spring-cylinder removed and the stop-lever *s* omitted to expose the lever *k*. Fig. 9 is an end elevation of the needle-carrier retracted and its attachments. Fig. 10 is an end elevation of the same with the needle-carrier guide in section at the dog for securing the carrier.

A designates the frame of the motor, which may be of any suitable character; B, the power-cylinder; B′, the piston-rod, fitted loosely to the cylinder; C, a guide adjacent to the same, carrying a hollow shield C′; D, guides for the piston cross-head D′; E, an air-cushion cylinder into which the outer end of the rod B′ extends when discharged from the power-cylinder. The cushion-cylinder is adjustably closed at its outer end by cap E′ to vary the effect of the air-cushion.

The breech of the cylinder B is clamped in a bearing B^2 and is formed with projection B^3 behind the bearing to sustain a round support H, containing a rotary carrier F, which is provided with a series of powder-chambers F′. These chambers are supplied in succession from a hopper F^4.

The breech of the cylinder B is closed by a plug G, which is formed upon its front end with a nipple *b*, containing an explosion-chamber *b*′. A passage *c*′ is formed in the top side of the nipple to admit the charge, and a needle-hole *c* is formed in the side of the nipple to

admit a heated needle for firing the same. A feed-duct d extends from the passage c' upward through the breech and support H into coincidence with the chambers F'. The butt of the piston-rod is fitted loosely to the cylinder B, as shown in Fig. 4, and is recessed to fit the exterior of the nipple, preferably with a taper-joint, as shown in said figure. The butt thus serves to close the passage c' and to confine the charge in a closed chamber when exploded. The needle-inlet or needle-hole c extends laterally through the recessed butt of the piston, as shown in Fig. 7, to receive the firing-needle. A plug-valve e is inserted in the duct d and provided with arm d' to close the same, as shown in Fig. 4, prior to the explosion. Such arm is moved by an actuating-spring, which is set by the setting-lever.

A ratchet-wheel f is attached to the spindle F^2 of the rotary carrier F, and a pawl f^4 and arm f' are provided to shift the chambers in succession over the duct. A tooth f^2 upon the arm f' engages a notch in a slide I, mounted upon the projection B^3. (See Figs. 5, 7, and 8.) The slide is pressed by a spring i, so as to normally actuate the pawl f^4 and voluntarily turn the carrier F. A stop-lever s is pivoted adjacent to the outer end of the rotary plug e, and when the slide I is retracted and the spring i under tension the stop engages a stud s' upon the slide, as shown in Fig. 5. The plug e is furnished with a cam g, (shown in Fig. 6,) which when the plug is turned, as shown in Fig. 4, engages a tooth upon the lever s and turns the stop away from the stud s', thus unlocking the slide and permitting the spring i to project the slide forward, and thus actuate the lever and pawl f^4 to turn the rotary carrier F. The carrier is provided with a series of latch-holes s^2, and when thus turned a locking-pin h is pressed by a spring s^4, Figs. 6 and 8, into one of said holes. A ratchet-pin having beveled end r is also inserted through the support H to engage the holes S^2 in succession. Both pins are fitted through bushings r', inserted through the support H, as shown in Figs. 6, 7, and 8, and the ratchet-pin r is pressed normally upward by a spring r^2, Fig. 8, the end of which plays in a notch in the outer end of the bushings. A lever k, pivoted to the support H, adjacent to the locking-pin h, Figs. 5 and 6, has one arm arranged to rest upon the stud s' and the opposite arm engaged with the pin or head o of the locking-pin h. When the slide I is retracted, as shown in Fig. 5, the stud s' actuates the lever k to retract the locking-pin, and thus permits the rotation of the carrier F upon the subsequent automatic movement of the slide, which is effected by the shifting of the stop-lever s by the rotation of the plug e, as above described. The setting-lever, which is pivoted by the side of the piston-rod, has its rear arm J extended in proximity to the arm d' and its front arm J' inclined upwardly, so that a pin K upon the cross-head D' depresses the outer end of the lever when the rod is projected. A slotted arm e', attached to the valve-plug e, is actuated by a pin e^2 upon the arm J, which thus turns the plug to open the duct, as indicated by the dotted lines d in Fig. 5. Such movement also operates to retract and lock the slide I by means of a pinion l, with teeth arranged to engage a tooth l' upon the under side of the slide. The pinion is secured to a ratchet-wheel l^2, which is rotated intermittingly by an arm and pawl l^3, which are connected by link t with the arm d'. The slide is shown unlocked and projected forward in Fig. 6 with a tooth of the pinion in readiness to retract the slide, while such retraction is shown completed in Fig. 5 and the slide locked by the stop-lever s. A spring s^3, Figs. 7 and 8, is provided to raise the stop s, the upper half only of the spring being shown in Fig. 8, and only the hole by which its end is fitted to the stop being shown in Fig. 5. The pinion remains stationary during the movement of the slide and its teeth are made a sufficient distance apart to clear the lug l' when the latter is carried forward by the slide, as shown in Fig. 6. The pawl l^3 rotates the pinion intermittingly, in conjunction with the rotation of the plug-valve e, by means of its connection through link t with the arm d'. The arm J is connected by link j to a plunger L, having a piston L' fitted to a cylinder M. A spiral spring L^2 is confined between such piston and the upper head of the cylinder, and the movement of the arm J, effected by the pin k, operates to compress the spring, as shown in Fig. 5.

The cylinder M is provided at its lower end with an escape-valve m, which connects by a passage m' with an adjacent cylinder M'. The cylinder M below the piston is filled with fluid m^3, which extends through the passage m' and upward a suitable distance into the cylinder M', and the valve m is held slightly open by an adjustable screw m^2 to permit the fluid to escape from the cylinder M at a regulated velocity.

A shaft P is connected by arm p and a link p' to the arm J to set the firing device for automatic operation. Such device consists of a needle u, held by carrier U in a guide U' at the side of the breech. The carrier is shown held in a retracted position by a pawl u', with the needle surrounded by the flame u^2 of a spirit-lamp U^2. The needle is formed with a tapering shank v, and a socket v' is formed in the side of the breech, which is plugged by such shank when the needle is projected into the explosion-chamber, as indicated by the dotted lines v^2. A roll w is projected from one side of the needle-carrier to engage a spirally-faced cam W, fitted to the rear end of the shaft P. A spring w^2 is attached to the support of the needle-carrier and operates to press the carrier forward, as indicated by the arrow x, and is thus adapted to project the needle automatically into the

explosion-chamber. Such projection is effected, after the charge is in the chamber and the plug-valve closed, by means of a lever N, Figs. 5 and 7, which is connected at one end with the pawl u' by a link y and at the other end is provided with a toe n to engage a collar L^3 upon the plunger L. The collar is made adjustable by means of a set-screw and is so set as to actuate the lever N at the extremity of the plunger's spring movement. A notch u^5 is formed in the needle-carrier, and when the same is projected the notch is engaged by a dog u^3. The dog is formed with a tooth adjacent to its pivot to engage a spring u^4 and swings above and below its point of contact therewith as the dog is raised and lowered. The latch is formed in its outer end with a notch v^3, and the cam W is formed at its upper end with a tooth w^3 to fit such notch and to give the dog a limited movement in either direction.

In Fig. 10 the cam is shown turned in the reverse position to that shown in Figs. 7 and 9, which show the needle-bar retracted and locked. In such reverse position the tooth w^3 turns the dog down into contact with the needle-bar, against which it is subsequently pressed by the spring u^4 until the notch u^5 comes beneath the dog, which immediately falls into the notch and secures the needle in the hole c during the explosion. The first movement of the cam caused by the first motion of the setting-lever after the explosion lifts the dog from the notch u^3 and then retracts the needle-carrier, as shown in Fig. 7. The power generated by the explosion is transmitted to the shaft I' by a clutch-wheel J^4, which is intermittingly impelled by dogs a, attached to a clutch-plate C^3. The plate is oscillated by an arm P', to which a gradually-accelerated motion is imparted from the piston-rod by a curved bar T, attached tangentially to the rod and acting upon a roller or rider t'. Such rider is connected by a link S with the arm P' and by a link S' with a fixed center S^2. The bar T is curved backwardly and upwardly, and the rider at the beginning of the discharge-stroke rests upon the lowest point of the bar, where its curve is nearly parallel with the piston-rod. The rider is carried by the link S' around the center S^2, and, as the bar is forced forward with the piston-rod, moves upward around such center, being raised with accelerated velocity as the bar curves gradually at a greater angle to the rod. The parts are shown in Fig. 2 in dotted lines at the extreme of their movement. The rotary power-shaft is thus protected from the primary shock of the explosion, and a motion which is slow at first and afterward rapidly increased in velocity is imparted to the power-shaft by the curved bearing-bar and its rider. The curved bearing-bar and the rider thus form an intermediate mechanism which transmits the violent motion of the piston-rod with gradually-increasing velocity to the power-shaft and avoids the danger of shocks and concussions which would result from a direct connection.

The cap E', when loosened, permits a partial or graduated escape of the air, and the compression of the air in the cushion-cylinder E may thus be regulated by the cap to secure the return of the piston-rod to the proper point within the power-cylinder B, and means is provided to prevent the rebound of the rod from such cylinder when thrown into contact with the charging-nipple in the base of the same. Such means consists of a catch a', hinged upon the frame A, to engage the front end of the hub, which connects the bar T to the piston-rod when such rod is in the bottom of the power-cylinder. A lever g is pivoted to the frame adjacent to a pin o' upon the setting-lever and is extended over a lug a^2 upon the end of the catch a'. When the setting-lever is depressed by the forward movement of the pin K, the catch springs upward, as indicated by dotted lines a^3 in Fig. 2, to lock the piston-rod in the cylinder B; but when the setting-lever is reversed by the auxiliary actuating-spring L^2, as indicated in Fig. 2, the pin o' operates upon the lever g' to retract the catch, as shown in full lines a' in Fig. 2. The piston-rod is thus unlocked prior to the explosion and is free to move forward, as required.

The hollow shield C' before the power-cylinder serves, with the guide C, adjacent thereto, to intercept the products of the explosion and to prevent the fouling of the mechanism beyond such shield.

In practical operation the firing of the charge sets and locks the slide I and the needle-carrier U and opens the plug-valve e. The expansion of the auxiliary actuating-spring L^2, controlled by the fluid m^3, first retracts the stop s from the slide I by means of the cam g, (see Figs. 5 and 6,) thus turning the powder-carrier F and depositing a charge in the duct d. The locking-pin h, when the slide moves forward, is pressed upward by the spring s^4, (see Fig. 6,) and thus arrests the motion of the carrier at the proper point by springing into the latch-hole s^2. The ratchet-pin, having beveled end r, (see Fig. 7,) is forced downward by the forward rotation of the carrier and by its automatic engagement with the succeeding hole prevents any reaction of the carrier. The valve e is next closed and the latch a' depressed, as shown in Fig. 2, and finally the collar L^3 engages the toe n upon the lever N, thus releasing the needle and permitting it to fire the charge. The forward movement of the piston-rod produces the same effects upon the setting-lever, and the rapidity of the charges is regulated by adjusting the valve m by the screw m^2. The impulses of the piston-rod are transmitted successively to the rotary power-shaft, which is shown in Fig. 1 provided with a fly-wheel V to maintain the motion between such impulses. The cross-head of the piston-rod is preferably provided with a spring or

air-cushion, as claimed in United States Patent No. 497,246, dated May 9, 1893, by which, in conjunction with the curved tangential bar and its rider, power may be generated with very great economy from gunpowder and a continuous rotary motion obtained without shock or jar. The fluid which is forced past the valve *m* by the piston beneath the spring l^2 operates as a brake upon the reaction movement of the spring, and it is obviously immaterial what form of brake be used to perform this function.

Many of the improvements described herein—as, for instance, the means of firing the charge and of controlling the automatic movements of the feeding and firing mechanisms—may be applied to gas-motors or motors of other descriptions than that shown herein, and we do not, therefore, limit ourselves to the precise application shown herein for the improvements described.

Having thus set forth the nature of the invention, what is claimed herein is—

1. In an explosion motor, the combination, with the power cylinder, the piston rod and an air cushion to arrest and return the rod, of a catch to lock the piston rod on its rebound, and means for unlatching such catch.

2. In an explosion motor, the combination, with the power cylinder, the piston rod and an air cushion to arrest and return the rod, of a catch to lock the piston rod on its rebound, automatic mechanism for charging the power cylinder, for unlatching such catch, and firing the charge.

3. In an explosion motor, the combination, with the breech of the power cylinder, of a hollow nipple to hold the charge, and a piston rod having its butt recessed to cover such nipple.

4. In an explosion motor, the combination, with the breech of the power cylinder, of a hollow nipple having a charging-hole in the upper side and a piston rod having its butt fitted to the exterior of the nipple to cover such charging-hole.

5. In an explosion motor, the combination, with the breech of the power cylinder, of a hollow nipple having a charging-hole in the upper side, and a piston rod with socket to fit over the nipple and having a firing-hole formed through the same.

6. In an explosion motor, the combination, with a power cylinder and a piston rod with suitable guides, of a rotary carrier for feeding successive charges to the cylinder, spring mechanism for shifting the carrier, a lock to restrain such mechanism, and means actuated by the forward movement of the piston rod for compressing the spring and locking the spring mechanism.

7. In an explosion motor, the combination, with a power cylinder and a piston rod with suitable guides, of a rotary carrier for feeding successive charges to the cylinder, spring mechanism for shifting the carrier, a lock to restrain such mechanism, a lever arm inclined to the path of the piston rod, with a pin carried by the rod to press the lever, a connection from the lever to set and lock the spring feeding mechanism, and an actuating spring set by the lever, with brake or fluid regulator to control the reaction of the same, for subsequently unlocking the spring feeding mechanism.

8. In an explosion motor, the combination, with a power cylinder and its piston rod, of automatic means for feeding a series of charges and firing the same, means actuated by the piston to set and lock the feeding and firing devices, and means independent of the piston rod to subsequently unlock the same.

9. In an explosion motor, the combination, with a power cylinder and a piston rod with suitable guides, of a rotary carrier for feeding successive charges to the cylinder, mechanism for shifting the carrier, a lock to restrain such mechanism, a heated needle with carrier and means to move the same to and from the explosion chamber, a lock to engage the carrier when the needle is retracted, and means actuated by the forward movement of the piston rod for setting the needle and feeding mechanism, an actuating spring set by the forward movement of the piston rod, and a regulator to control the reaction of the same, with connections for subsequently releasing in suitable order the feeding mechanism and the firing needle.

10. In an explosion motor, the combination, with a power cylinder and its piston rod, of automatic means for feeding a series of charges to the explosion chamber for closing the feed duct to such chamber after feeding each charge, and for firing each charge, means actuated by the piston to set and lock such automatic means, and an actuating means independent of the piston rod to subsequently unlock the said automatic means in successive order.

11. In an explosion motor, the combination, with a power cylinder and its piston rod, of automatic means for feeding a series of charges to the explosion chamber for closing the feed duct to such chamber after feeding each charge, and for firing each charge, means actuated by the piston to set and lock such automatic means, and an actuating spring compressed by the discharge movement of the piston rod to subsequently unlock the said automatic means in successive order, with a fluid regulator to control the reaction of such actuating spring.

12. In an explosion motor, the combination, with a power cylinder and its piston rod, of automatic means for feeding a series of charges and for firing the same, a lever actuated by the piston rod upon its forward movement to set and lock such automatic means, an actuating spring provided with connections to the said lever, and with connections to the said automatic means to release them

in succession upon its reaction, and a regulator or brake to control the subsequent movement of the spring.

13. In an explosion motor, the intermediate mechanism for transmitting the violent motion of the piston rod gradually to a rotary shaft, consisting of the arm oscillated upon the said shaft, means for clutching the arm intermittingly to the shaft, a curved bearing bar attached tangentially to the piston rod, and a rider actuated by the bearing bar to oscillate such arm, substantially as set forth.

14. In an explosion motor, the combination, with a power cylinder, its piston rod and the rotary power shaft for transmitting the motion, of an intermediate mechanism for transmitting the motion of the rod to the shaft, consisting of an arm oscillating upon the power shaft, means for automatically clutching the arm to such shaft, a curved bearing bar attached tangentially to the piston rod, and a roller riding upon the bearing bar with connection to the oscillating arm, substantially as herein set forth.

15. In an explosion motor, the combination, with a power cylinder, its piston rod, and rotary power shaft for transmitting the motion, of the oscillating arm P′, means for clutching it intermittingly to the shaft, the curved bearing bar T attached tangentially to the rod, the guide link S with fixed center S^2 to link S connecting with the arm P′, and the rider t' fitted to such curved bar, substantially as set forth.

16. In an explosion motor, the combination, with the power cylinder, of a rotary carrier provided with the ratchet wheel *f*, the series of charging pockets, and the series of latch holes s^2, the slide I, spring *i* and stop *s*, the lever and pawl f^4 actuated by the slide, the locking pin *h* and the stud *s′* and lever *k* for actuating the same, the whole arranged and operated substantially as set forth.

17. In an explosion motor, the combination, with the power cylinder, of a rotary carrier provided with the ratchet wheel *f*, the series of charging pockets, and the series of latch holes s^2, the locking pin *h* with means substantially as described for retracting the same when the carrier is moved, and the ratchet pin *r* spring pressed toward the latch holes, as and for the purpose set forth.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

HUGH A. KINGSLAND.
JOHN S. SANGER.

Witnesses:
THOMAS GORMAN,
THOMAS S. CRANE.