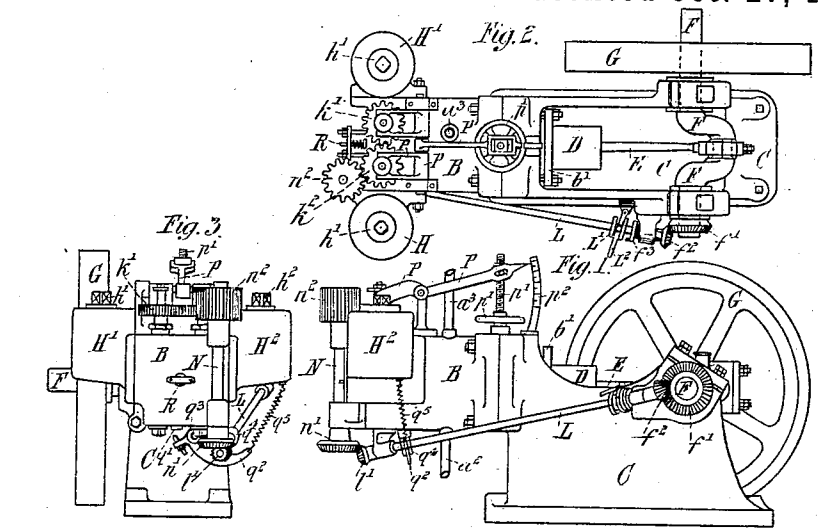
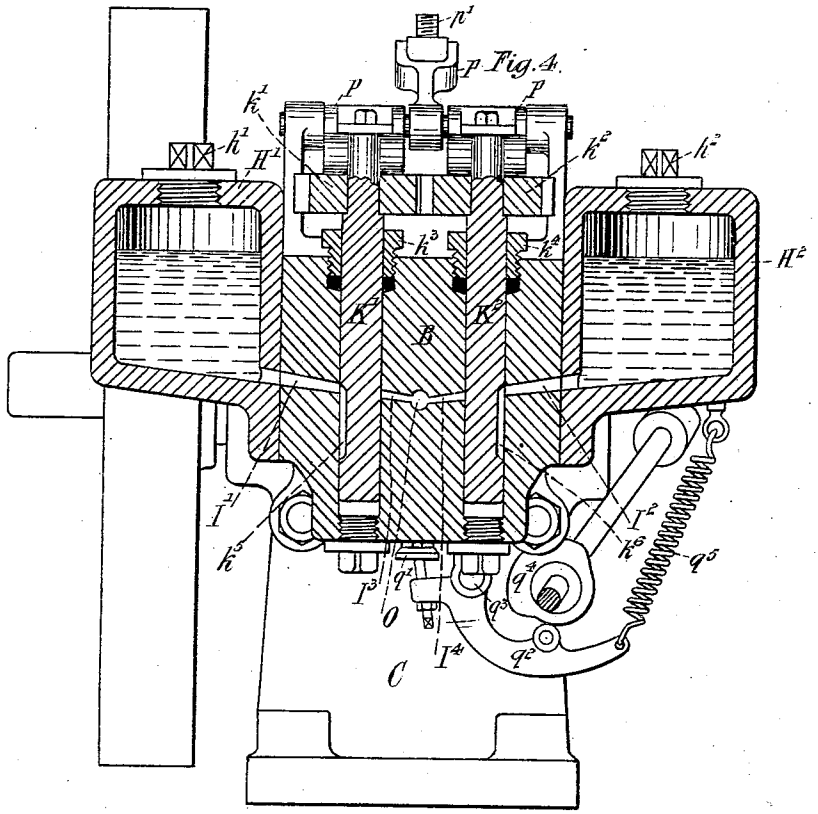
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G. ASHER & J. BUTTRESS.

EXPLOSIVE ENGINE.

No. 329,354. Patented Oct. 27, 1885.





WITNESSES.
Charles Brown Kepley
William Charles Batten

INVENTORS.
George Asher
Edward Buttress

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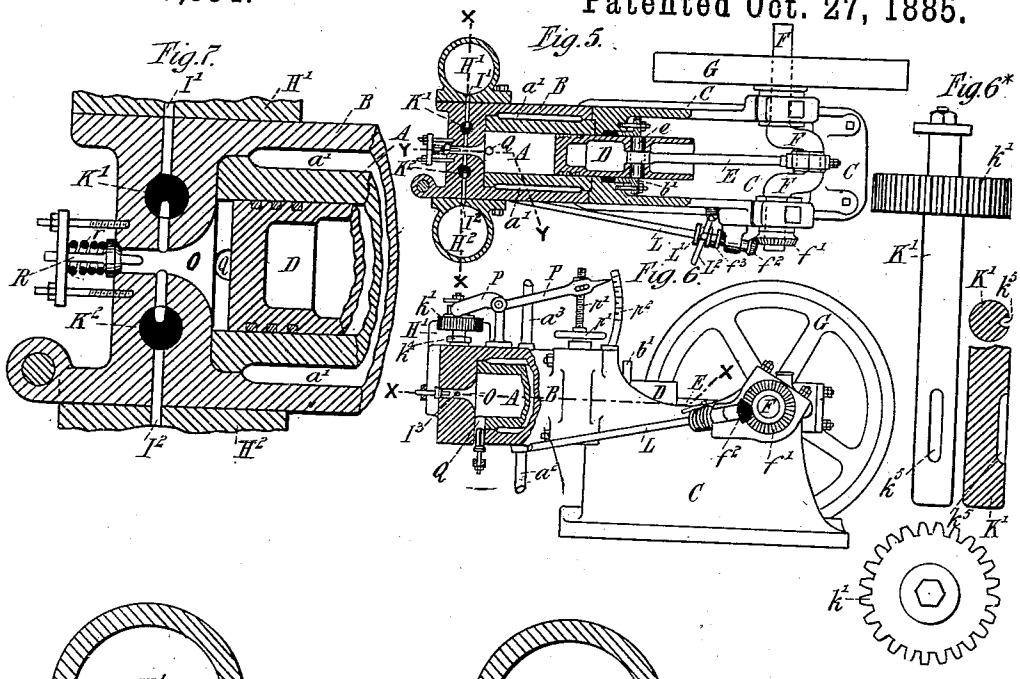
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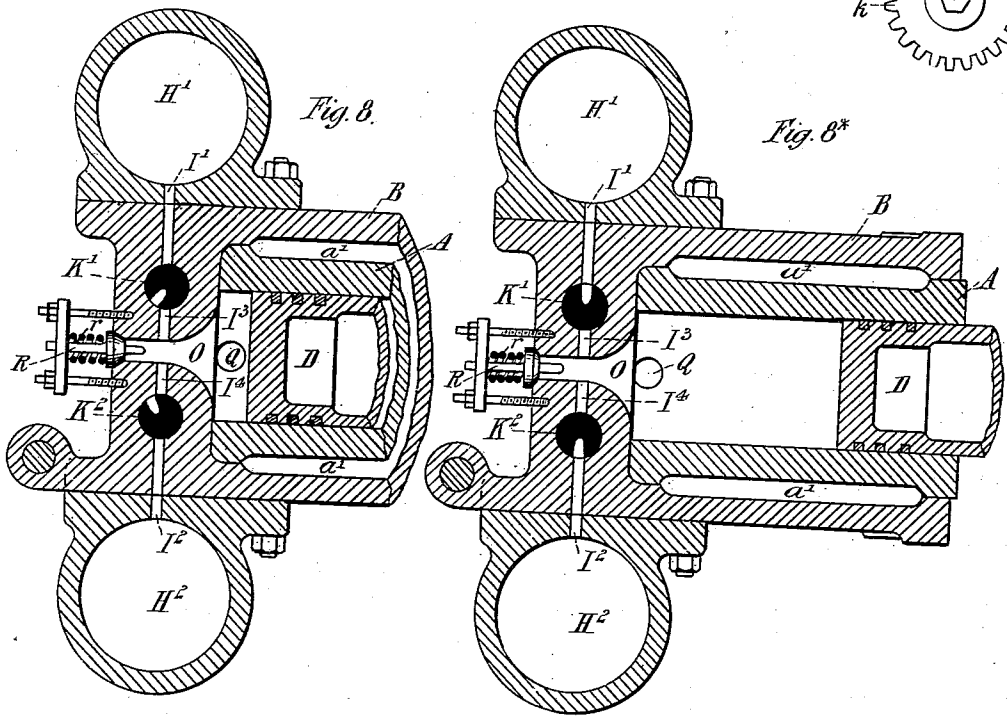
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G. ASHER & J. BUTTRESS.

EXPLOSIVE ENGINE.

No. 329,354. Patented Oct. 27, 1885.





WITNESSES.

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7 Sheets—Sheet 3.

G. ASHER & J. BUTTRESS.

EXPLOSIVE ENGINE.

No. 329,354. Patented Oct. 27, 1885.

Fig. 11.

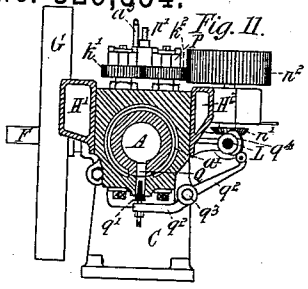


Fig. 9.

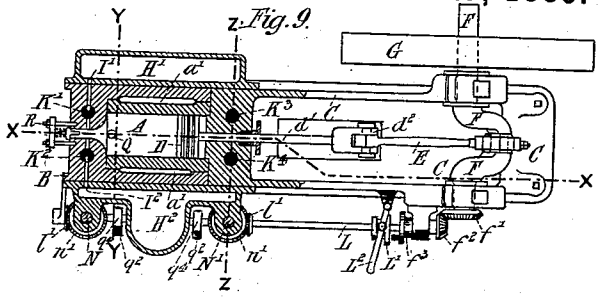


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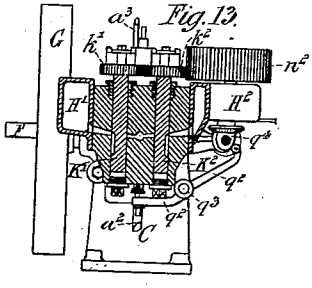


Fig. 10.

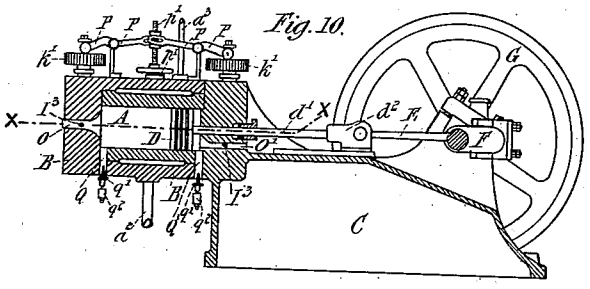


Fig. 12.

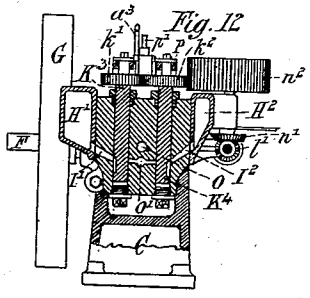


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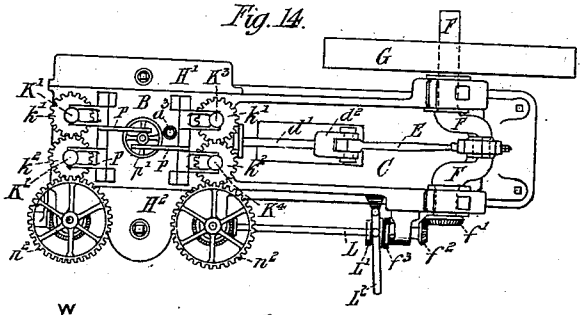


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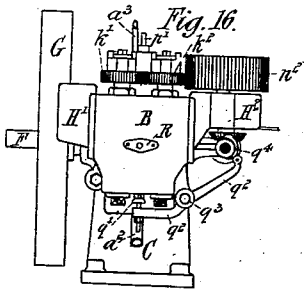
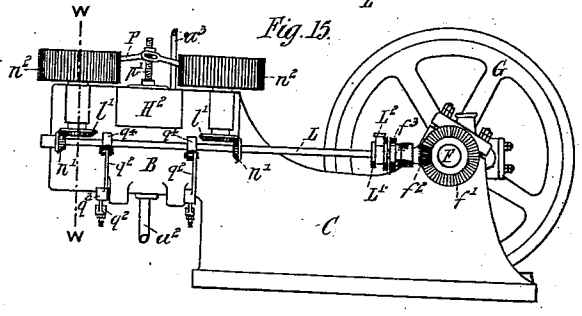


Fig. 15.



WITNESSES.

Charles Bosworth Kebley

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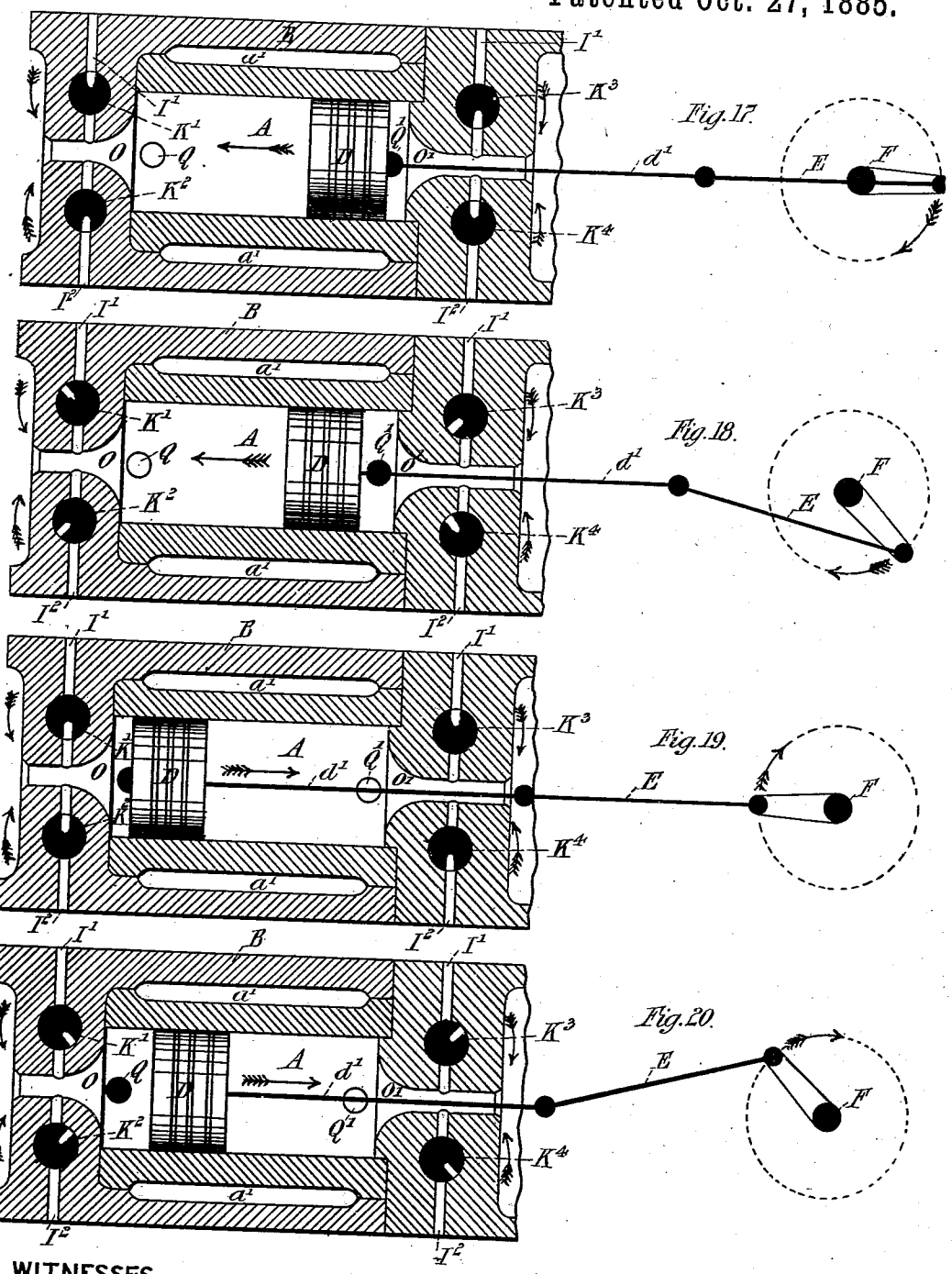
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EXPLOSIVE ENGINE.

No. 329,354. Patented Oct. 27, 1885.



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(No Model.)

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EXPLOSIVE ENGINE.

No. 329,354. Patented Oct. 27, 1885.

Fig. 21.

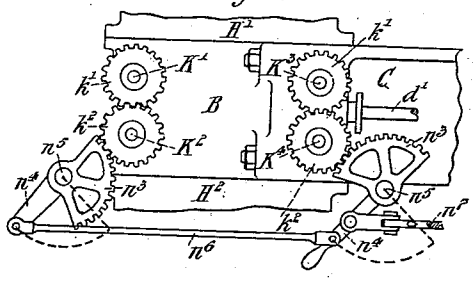


Fig. 24.

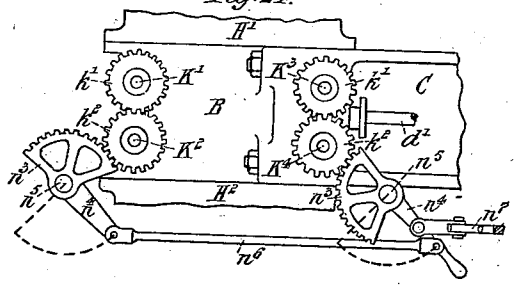


Fig. 22.

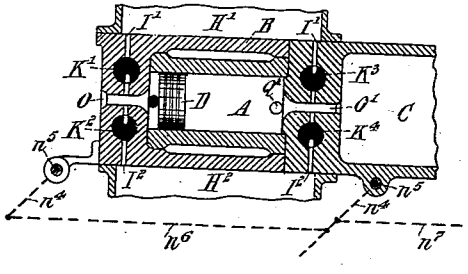


Fig. 25.

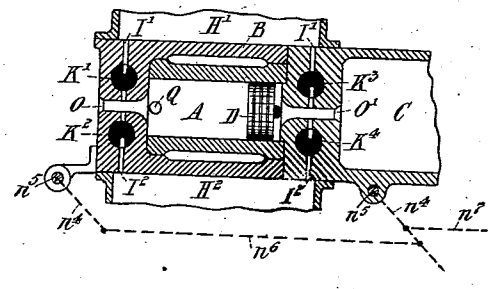


Fig. 23

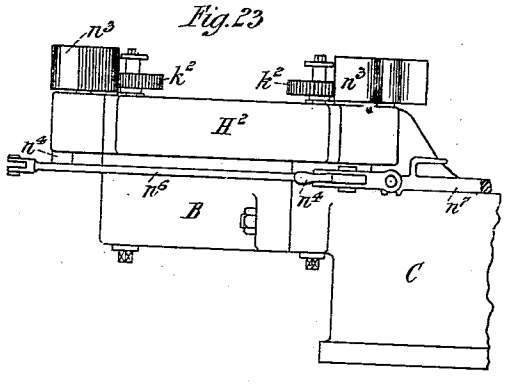
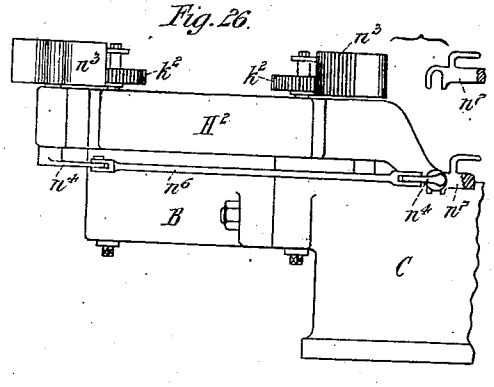


Fig. 26.



WITNESSES.

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EXPLOSIVE ENGINE.

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Fig. 30.

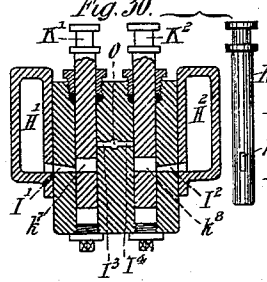


Fig. 31.

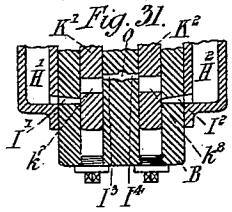


Fig. 32.

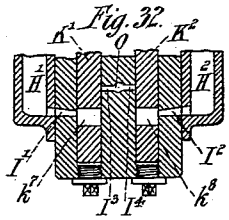


Fig. 33.

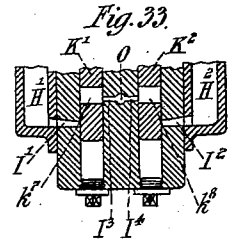


Fig. 34.

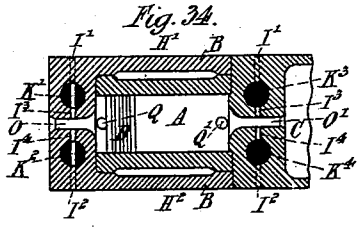


Fig. 27.

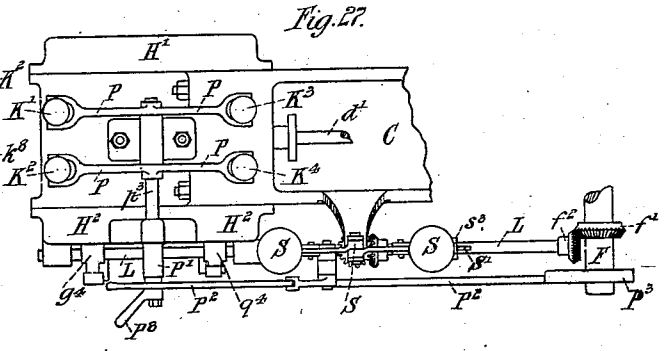


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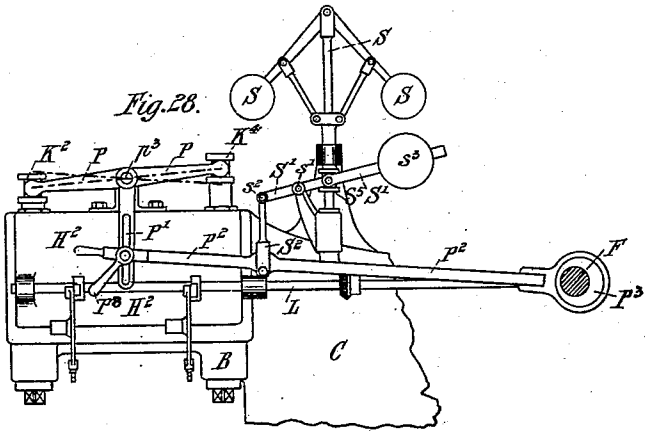
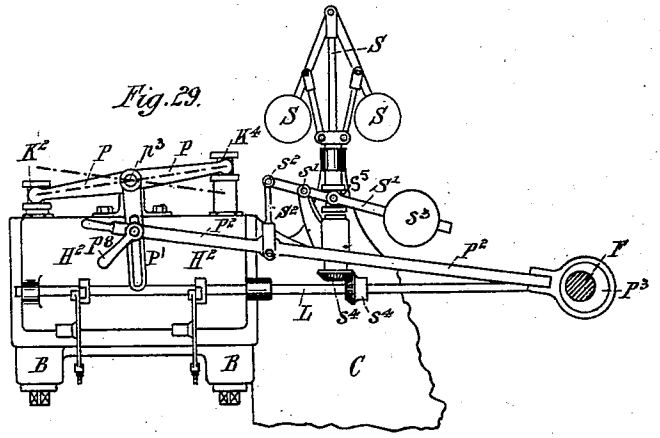


Fig. 29.



WITNESSES.
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G. ASHER & J. BUTTRESS.

EXPLOSIVE ENGINE.

No. 329,354. Patented Oct. 27, 1885.

Fig. 35.

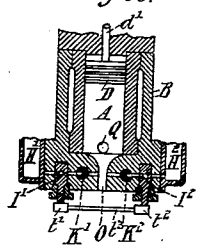


Fig. 36.

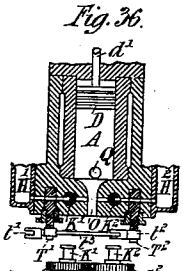


Fig. 38.

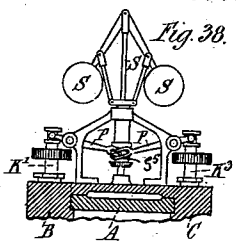


Fig. 39.

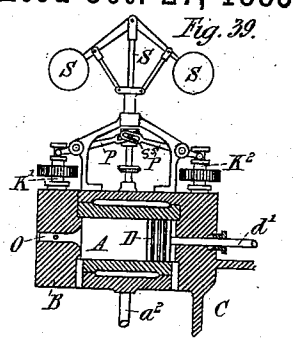


Fig. 37.

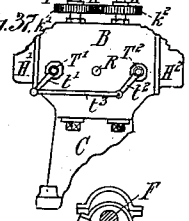


Fig. 44.

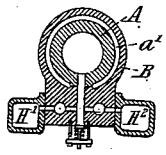


Fig. 43.

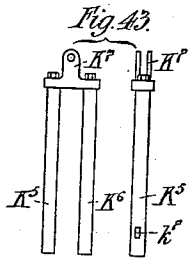


Fig. 42.

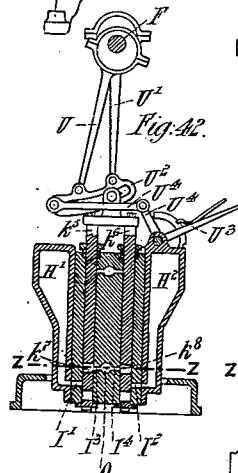


Fig. 41.

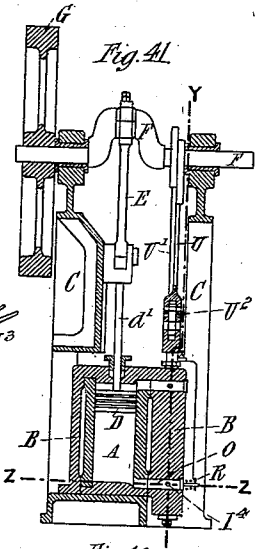


Fig. 40.

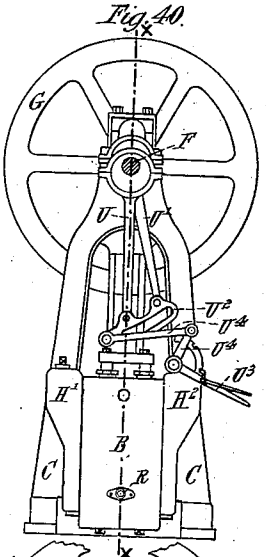


Fig. 46.

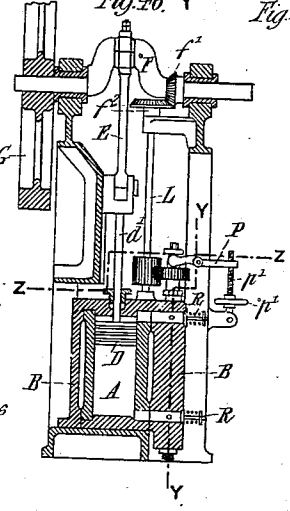


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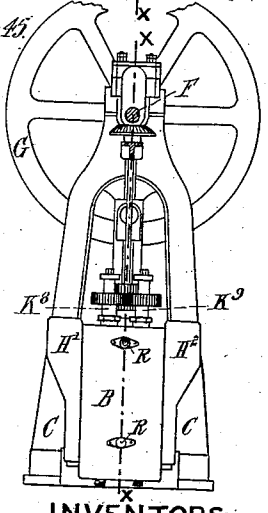


Fig. 48.

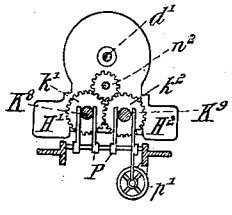
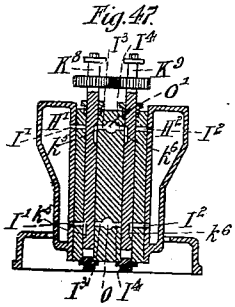


Fig. 47.



WITNESSES.

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INVENTORS.

George Asher

Solomon Buttress

THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

GEORGE ASHER, OF BALSALL HEATH, AND JOHN BUTTRESS, OF SPARKBROOK, COUNTY OF WORCESTER, ENGLAND.

EXPLOSIVE ENGINE.

SPECIFICATION forming part of Letters Patent No. 329,354, dated October 27, 1885.

Application filed April 16, 1885. Serial No. 162,448. (No model.) Patented in England February 2, 1885, No. 1,424, and in Belgium May 27, 1885, No. 69,037.

To all whom it may concern:

Be it known that we, GEORGE ASHER and JOHN BUTTRESS, subjects of Her Majesty the Queen of Great Britain, residing, respectively, at Balsall Heath and Sparkbrook, both in the county of Worcester, England, have invented a certain new or Improved Explosive Engine, of which the following is a specification.

Our invention relates to a new or improved method of obtaining motive power by the explosive combination of substances; and the objects of our invention are, first, to utilize in a motor certain liquids, which, when brought in contact with each other, explode; second, to provide means whereby portions of such liquids may be intermittently brought together from general supplies, so as to cause successive explosions to be utilized in forcing a piston along a cylinder for obtaining motive power; third, to provide means whereby the quantities of such liquids used in each explosion may be varied automatically or by an attendant, so as thereby to regulate the force of the explosions and power of the motor; fourth, to provide means for starting and stopping the motor; and, fifth, to provide means whereby the direction of revolution of the motor may be reversed. We attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of a "single-acting" stationary motor constructed in accordance with our invention, and arranged to be controlled by an attendant. Fig. 2 is a plan, and Fig. 3 an end elevation, of the same motor. Fig. 4 is a cross-sectional elevation on line X X of Fig. 5. Fig. 5 is a plan of the same, partly in section, on line X X of Fig. 6. Fig. 6 is an elevation of the same, partly in section, on line Y Y of Fig. 5. Fig. 6* shows one of the valves separately. Figs. 7, 8, and 8* are sectional views of part of the same motor, illustrating the relative position of the piston and valves, as hereinafter explained. Fig. 9 is a plan (partly in section, on line X X of Fig. 10) of a "double-acting" stationary motor constructed in accordance with our invention. Fig. 10 is a sectional elevation of the same on line X X of Fig. 9. Fig. 11 is a cross-sectional elevation of the same on line Y Y of Fig. 9. Fig. 12 is a cross-sectional elevation of the same on line Z Z of Fig. 9. Fig. 13 is a cross-sectional elevation of the same on line W W of Fig. 15. Fig. 14 is a general plan, and Fig. 15 a general side elevation, of the same, and Fig. 16 is an end elevation of the same. Figs. 17, 18, 19, and 20 are part sections of the cylinder of the double-acting motor represented by Figs. 9 to 16, both inclusive, and they illustrate the action of the valves and their positions relative to the piston at different points of its travel, as hereinafter fully explained. Fig. 21 is a part plan of a modified form of double-acting motor constructed in accordance with our invention, the valve-rod being in its extreme rearward position. Fig. 22 is a part sectional plan, and Fig. 23 is a part elevation, of the same. Fig. 24 is a part plan of the same, the valve-rod being in its extreme forward position. Fig. 25 is a part sectional plan, and Fig. 26 a part elevation, of the same. Fig. 27 is a part plan of a double-acting motor provided with means for automatically regulating its speed and power. Figs. 28 and 29 are part elevations of the same. Figs. 30 to 34, both inclusive, illustrate the action of the valves of the same, as hereinafter fully explained. Figs. 35 and 36 are part sectional plans, and Fig. 37 a part end elevation, of a cylinder of a single-acting motor illustrating a modification of our invention, as hereinafter fully described. Figs. 38 and 39 show the application of means for automatically controlling the double-acting motor illustrated by Figs. 9 to 15, both inclusive. Fig. 40 is a front elevation of a vertical single-acting motor provided with sliding valves and reversing-gear, and constructed in accordance with our invention. Fig. 41 is a sectional elevation of the same on line X X of Fig. 40; and Fig. 42 is a part sectional elevation of the same on line Y Y of Fig. 41. Fig. 43 shows the valves separately, and Fig. 44 is a sectional plan of the cylinder of the same on line Z Z of Figs. 41 and 42. Fig. 45 is a front elevation of a vertical double-acting motor provided with rotary valves, and constructed in accordance with our invention. Fig. 46 is a sec-

tional elevation of the same on line X X of Fig. 45. Fig. 47 is a part sectional elevation of the same on line Y Y of Fig. 46; and Fig. 48 is a sectional plan of the cylinder of the same on line Z Z of Figs. 46 and 47.

Similar letters refer to similar parts throughout the several views.

We will first describe how our invention may be carried into practice in the construction of a single acting motor—that is to say, a motor in which force is applied on one side of the piston only. For this purpose we will describe as a type a horizontal stationary motor, and we shall refer more particularly to Figs. 1 to 8*, both inclusive.

A is a metal cylinder contained within a cylindrical casing, B, fixed in a horizontal position to a frame, C, and having an ordinary piston, D, free to slide therein and working through a stuffing-box and gland, b', and forming in part a trunk to which is jointed by the pin e the ordinary connecting-rod, E, connected to the crank-shaft F, provided with a fly-wheel, G; or other well-known means may be employed for converting the reciprocating motion of the piston into rotary motion of the crank-shaft from which power is required to be taken off. H′ and H² are two vessels, preferably of metal, attached to the outer casing, B, and provided with suitable covers, h' h^2, preferably screwed thereto. One of the vessels—say H′—may contain concentrated nitric and sulphuric acid in about equal portions, and the other vessel, H², may contain oil of turpentine. From the lower part of each of the said vessels H′ H² (see Fig. 4) we provide a passage, I′ I², which communicates with solid plugs or valves K′ K², two in number, one for each vessel, arranged to turn in vertical holes provided in the cylinder-casing B. The plugs or valves K′ K² are each provided with a spur-wheel, k' k^2, which gear so that they revolve together, and they receive rotary motion from the crank-shaft F by means of the bevel-wheels f' f^2, the shaft L, bevel-wheels l' n', vertical shaft N, and spur-wheel n^2. The diameters of the wheels are so arranged that the plugs or valves K′ K² revolve at the same speed as the crank-shaft F. The plugs or valves K′ K² are free to be moved up and down within certain limits through the stuffing-boxes k^3 k^4, by means of the forked lever P and screw and hand-wheel p', for the purpose of controlling the motor, as hereinafter described. The index p^2 shows the position of the valves K′ K². Each plug or valve K′ K² is provided with a groove or recess, k^5 and k^6, (see Fig. 6*,) on one side thereof, corresponding to the passages I′ I², and on the side of each plug or valve opposite to the passages I′ I² we provide two other passages, I³ I⁴, which are directed toward each other and toward the back end of the cylinder A, where they meet, and there, forming a single passage, O, communicate with the cylinder A behind the piston D. On the shaft L is an ordinary clutch, L′, free to slide thereon and operated by a lever, L², and so arranged that it can be thrown out of gear with the clutch f^3, formed with the pinion f^2, so that the valves K′ K² can be revolved for obtaining the first explosion for starting the motor without turning the crank-shaft F, as hereinafter described.

The operation of the parts, as above described, to cause an explosion and so force the piston D along the cylinder A, is as follows: The plugs or valves K′ K² are first turned so that their grooved or recessed parts k^5 k^6 correspond to the passages I′ I², leading to the vessels H′ H², as shown in Figs. 4 and 5. The grooved or recessed part of the plug or valve K′ will thus become filled by the liquid contained in the vessel H′, which may be a mixture of concentrated nitric and sulphuric acid, and the grooved or recessed part of the plug or valve K² will be filled by the liquid contained in the vessel H², which may be oil of turpentine. The plugs or valves K′ K² are now turned round together until their grooved or recessed parts k^5 k^6 correspond to the passages I³ I⁴, leading to the cylinder A, as shown in Fig. 7. A certain part of the contents of the grooves or recesses k^5 k^6 are thus severally discharged and run along the passages until they meet in the passage O, where they explode and drive the piston D along the cylinder A to make its forward stroke. Before the explosion takes place, the plugs or valves have turned far enough round, as shown in Fig. 8, to close the connection between the passages I³ I⁴ and the recessed parts k^5 k^6, so as to prevent their remaining contents exploding also. When the piston D has traveled a certain distance along the cylinder A, as shown in Figs. 5 and 8*, an exhaust-passage, Q, is opened, so that the partially-expanded gases may pass into the atmosphere. The exhaust-passage may be arranged as may be most convenient, according to circumstances; but we prefer to place it at the bottom of the cylinder and to provide a valve, q', so arranged that by means of the lever q^2, centered on the pin q^3, the cam q^4 on the shaft L will maintain it closed while an explosion is taking place and allow it to be opened by the spring q^5 after the piston has traveled a certain distance, as above described. The momentum of the fly-wheel G causes the piston D to make its backward stroke, after which another explosion takes place and the piston is again driven forward, as above described, the successive explosions thus causing continuous rotary motion of the crank-shaft. The widths of the grooves or recesses k^5 k^6 are so arranged that there is at no part of the revolution of the plugs or valves K′ K² any direct communication between the cylinder A and the vessels H′ H² containing the liquids for causing the explosions. The grooves or recesses k^5 k^6 extend below the bottom of the passages I′ I², so that the whole of their contents may not be discharged for a single explosion. It will be seen that if the plugs or valves K′ K² are raised in their holes by means of the lever P and hand-wheel and screw p'

the quantity of the explosive liquid discharged from the grooves k^5 k^6 and used for each explosion will be increased, and that if they are lowered the quantity will be diminished. The force of the explosion and the power and speed of the motor are thus under perfect control. In order to stop the motor the plugs or valves K' K² are lowered so that their grooves or recesses k^5 k^6 are below the passages I' I², and will take in no supply of explosive liquid. We prefer to provide an ordinary valve, R, which is weighted by means of the spring *r* and so arranged that it will open at a pressure lower than the bursting-pressure of the cylinder. In order that the cylinder A may be kept cool we admit water into the space *a'* by means of the inlet-pipe a^2, which circulates around the cylinder A and escapes by the outlet-pipe a^3.

We sometimes protect those parts of the motor which come into contact with the acids by electrically depositing or coating them with aluminium, or other substances not affected by the acids. The proportions of the nitric and sulphuric acids may be varied as desired, and instead of using oil of turpentine, we may use azo-diphenyl-diamine, or chloride of kakodyle; or we may use other liquids which, when brought in contact with each other, cause an explosion.

We will now describe how a double-acting motor—that is to say, a motor in which force is applied on both sides of the piston alternately—may be constructed in accordance with our invention, and for this purpose we shall refer more particularly to Figs. 9 to 20, both inclusive, which illustrate as a type a double-acting horizontal motor. We provide two plugs or valves, K' K², at the back of the cylinder, and two plugs or valves, K³ K⁴, at the front of the cylinder, all similar and operated by similar means to the plugs or valves K' K² in the single-acting motor illustrated by Figs. 1 to 8*, both inclusive, hereinbefore described, and we provide an exhaust-passage, Q, for the back, and an exhaust-passage, Q', for the front, of the cylinder, each having a valve and lever similar, and operated by similar means to the exhaust-passage Q in the aforesaid single-acting motor. The vessels H' H² are preferably made large enough to serve for both the back and front plugs or valves, (see Fig. 9,) and passages I' I² are made from each vessel respectively to the plugs or valves K' K² K³ K⁴, (see Figs. 12 and 13,) and continued to the passages O and O', communicating with the cylinder A. At the outward end of each passage O O' we provide a relief-valve, R. The plugs or valves K' K² K³ K⁴ are so arranged relatively to each other and to the piston D that they cause explosions on each side of the piston D alternately and drive it backward and forward. This is clearly illustrated by Figs. 17 to 20, both inclusive. The passage O' is below the center of the cylinder, as shown in Fig. 12; but in Figs. 17 to 20 it appears as on the center line for the sake of clearness. In Fig. 17 the piston D is just commencing its backward stroke, and the valves K³ and K⁴ have partly discharged their contents, which meet and explode, as hereinbefore described with reference to a single-acting motor, when the piston is about in the position shown in Fig. 18. The exhaust-passage Q is closed, as hereinbefore described, while the explosion takes place, and it may remain closed until the piston arrives at the end of its stroke, as shown in Fig. 19, when it opens and allows the partly-expanded gases to escape. The valves K' K² are now in a position to partly discharge their contents, which may meet and explode when the piston is returning, as shown in Fig. 20, the exhaust-passage Q remaining closed until the piston reaches the end of its stroke, as shown in Fig. 17.

Although we have described plugs or valves having a continuous rotary motion as a means whereby portions of the liquids contained in the vessels H' H² may be intermittently brought together so as to cause successive explosions, still we do not limit ourselves to this, as it is evident other equivalent means may be employed without departing from the spirit of our invention. For instance, the plugs or valves K' K² K³ K⁴ may be arranged to oscillate, as shown by Figs. 21 to 26, both inclusive, their motion being obtained from a rod, n^7, (which receives vibratory motion from a crank or eccentric or other equivalent means on the crank-shaft of the motor,) through the levers n^4, connected by the link n^6, vertical shaft n^5, and toothed quadrants n^3, gearing into the spur-wheels k^2. In Figs. 21, 22, and 23 the rod n^7 has just completed its backward stroke, and the plugs or valves K' K² have partly discharged their contents, the plugs or valves K³ K⁴ are in communication with the vessels H' H², and the piston D is just commencing its forward stroke, the exhaust-passage Q being closed. In Figs. 24, 25, and 26 the rod n^7 is in its extreme forward position and the plugs or valves have been moved through a half-circle, K' K² being now in communication with the vessels H' H², and K³ K⁴ ready to discharge, the piston D being about to move on its backward stroke. The rod n^7 is made preferably forked, as shown in Fig. 26, so that it can be readily disconnected when the valves are being turned for obtaining the first explosion for starting the motor. The oscillating plugs or valves can be moved up or down for controlling the motor, similarly to the rotating plugs or valves hereinbefore described.

The plugs or valves K' K K³ K⁴, instead of being arranged to rotate or oscillate about their axes for obtaining successive explosions, as above described, may, according to our invention, be moved longitudinally to obtain the same result, such longitudinal motion being increased or diminished either by an attendant or automatically for controlling the motor.

Figs. 27 to 34, both inclusive, illustrate how a double-acting motor having sliding valves

and means for regulating its speed and power may be constructed in accordance with our invention. The plugs or valves K' K² and K³ K⁴ receive alternately an up-and-down motion by means of the eccentric P³ and eccentric-rod P², which latter is jointed to the slotted lever P', fixed to the shaft p^3, to which the forked levers P are also fixed. The plugs or valves are severally provided with a slot or hole, k^7 k^8, (see Figs. 30 to 34,) which, when they are moved downward by the mechanism above described, become severally filled from the vessels H' H² through the passages I' I², and then, on being moved upward, they severally either partly or wholly discharge their contents into the passages I³ I⁴, to meet in the passages O O', there to explode for acting on the piston, as above described. We provide a screwed handle, P⁶, for the rod P², so that its position on the slotted lever P' may be varied by an attendant to increase or diminish the travel of the plugs or valves K' K² K³ K⁴.

Fig. 30 and 31 show in section the plugs or valves at the bottom and top of their stroke, respectively, when the end of the rod P² acts on the lever P' in the position shown in Fig. 28; but if the rod P² be moved higher up the slotted lever P', as shown in Fig. 29, then the plugs or valves will have a longer travel, as shown in Figs. 32 and 33, and more liquid will be discharged from the slots, and the force of the explosion and power of the motor thereby increased. The force of the explosion can be diminished by moving the rod P² to operate nearer to the end of the lever P', and the motor can be stopped by moving the rod to the extreme end of the lever, as the plugs or valves will not then move far enough to discharge any of their contents.

A motor constructed in accordance with our invention may be automatically controlled by means of an ordinary governor acting on the plugs or valves and regulating the quantity of explosive liquid discharged. For instance, in the motor illustrated by Figs. 27 to 34, both inclusive, we provide an ordinary governor, S, which receives rotary motion by means of the bevel-wheels s^4 from the shaft L. We provide a lever, S', which is centered at s' and connected by a link, S², to the rod P². The lever S' is provided with a weight, s^3, to balance the rod P², and it receives motion from the slide s^5, so that when the nominal speed of the motor is exceeded the slide s^5 causes the rod P² to fall, as shown in Fig. 28, and thereby to reduce the speed, or the rod P² will be raised if the nominal speed is not attained.

Figs. 38 and 39 show how a governor may be applied for controlling a motor having rotary or oscillating valves, according to our invention, instead of the screw and hand-wheel hereinbefore described. The levers P, actuating the plugs or valves, are caused to rise or fall by the slide s^5 of the governor S, to which they are connected, thus regulating the amount of liquid discharged and the power of the motor. Between the plugs or valves K' K² K³ K⁴ and the vessels H' H² we sometimes provide stop-cocks T' and T², (see Figs. 35, 36, and 37,) so that the supply from the vessels to the plugs or valves can be shut off, thereby regulating or stopping the motor. We prefer to provide them with levers t' t^2, and to connect the levers together by a rod, t^3, so that they will act together.

In constructing a vertical motor in accordance with our invention, we arrange the plugs or valves to work parallel with the cylinder instead of at right angles thereto, as in the horizontal motors hereinbefore described.

Figs. 40 to 44 illustrate as a type a vertical single-acting motor having sliding valves. The plugs or valves K⁵ K⁶ are connected together by the cross-piece K⁷, (see Fig. 43,) which receives motion from an eccentric or its equivalent on the crank-shaft F, so that they move together. Portions of the contents of the vessels H' H² flow through the passages I' I² (see Fig. 42) into the slots k^7 k^8 when the plugs or valves are at the bottom of their stroke, and when they rise the said contents are discharged through the passages I³ I⁴ into the passage O, there to explode for operating the piston D, as hereinbefore described, for the horizontal motors.

Similar means may be employed for reversing a motor constructed in accordance with our invention as are now used for steam or other motors. For instance, two eccentrics, U U', jointed to a link, U², and provided with a reversing-lever, U³, and connections U⁴, may be used, as illustrated in Figs. 40, 41, and 42. The eccentrics are set on the crank-shaft so that if the link U² be brought over to its extreme position in one direction, as shown in Fig. 40, the eccentric U will operate the plugs or valves K⁵ K⁶ and drive the motor but, if the link U² be reversed, as shown in Fig. 42, the eccentric U', will operate the plugs or valves and drive the motor in the opposite direction.

In constructing a double-acting vertical motor in accordance with our invention, with rotating or oscillating valves, we prefer to use two valves K⁸ K⁹, as shown in Figs. 45 to 48, both inclusive, and to make each of them long enough to serve for causing an explosion at the top and bottom of the cylinder. The plugs or valves K⁸ K⁹ have each two grooves or recesses, k^5 k^6, on opposite sides thereof, so as to cause explosions alternately on the top and bottom of the piston D.

The operations of the plugs or valves K⁸ K⁹, and the means for operating them, are similar to those hereinbefore described for horizontal motors having rotating or oscillating valves K' K² K³ K⁴.

The cylinder and piston, instead of being arranged horizontally or vertically, as above described, may be inclined or arranged to oscillate, without departing from the spirit of our invention, as will be readily understood.

From the foregoing description of our invention applied as stationary motors a prac-

tical man will have no difficulty in constructing a motor for locomotive or marine purpose, in accordance with our invention, or in applying our invention to any of the purposes to which steam-engines or other motors are now used.

In conclusion, we wish it to be understood that we do not limit ourselves to the precise details as herein described and illustrated, as the same may be varied without departing from the nature of our invention.

We do not in this application claim the method hereinbefore described, as it is to be made the subject of a separate application.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In a motor operated by the explosive combination of liquid substances, the combination of a vessel, H′, having an outlet or outlets, I′ I^3, and a vessel, H^2, having an outlet or outlets, I^2 I^4, communicating with each other and with a cylinder containing a piston, as and for the purposes set forth.

2. In a motor, the combination of a cylinder and piston with a pair of plugs or valves, K′ K^2, arranged to continuously rotate or oscillate, so as to intermittently bring together portions of certain liquids from general supplies to cause successive explosions to act upon the said piston, as herein set forth.

3. In a motor, the combination of a cylinder and piston with two pairs of plugs or valves, K′ K^2 and K^3 K^4, arranged to continuously rotate or to oscillate, so as to intermittently bring together portions of certain liquids from general supplies, to cause successive explosions alternately on either side of the said piston, as herein set forth.

4. In a motor, the combination of a cylinder and piston with a pair of plugs or valves, K′ K^2, each having a slot, k^7 k^8, arranged to slide longitudinally, so as to intermittently bring together portions of liquids from general supplies, to cause successive explosions alternately on one side of the said piston, as herein set forth.

5. In a motor, the combination of a cylinder and piston with two pairs of plugs or valves, K′ K^2 and K^3 K^4, each having a slot, k^7 k^8, arranged to slide longitudinally, so as to intermittently bring together portions of liquids from general supplies, to cause successive explosions alternately on either side of the said piston, as herein set forth.

6. In a motor operated by the explosive combination of substances, a pair or pairs of plugs or valves, K′ K^2, having grooves or recesses k^5 k^6, in combination with a lever, P, and a screw and hand-wheel, p', so as to be adjustable longitudinally, to regulate the quantity of the explosive liquid or liquids used in each explosion, as herein set forth.

7. In such a motor, a pair or pairs of plugs or valves, K′ K^2, having grooves or recesses k^5 k^6, in combination with a lever, P, and a governor, S, so as to be automatically adjustable longitudinally, to regulate the quantity of the explosive liquid or liquids used in each explosion, as herein set forth.

8. In such a motor, a pair or pairs of plugs or valves, K′ K^2, having slots k^7 k^8, and receiving vibratory motion by means of levers P and a slotted lever, P′, in combination with a governor, S, so as to automatically obtain an increased or diminished length of travel of the plugs or valves, as and for the purposes specified.

9. In a motor operated by the explosive combination of liquid substances, the combination of a governor with the plugs or valves, so as to automatically regulate the quantities of the explosive substances used in each explosion, as herein set forth.

In testimony whereof we have each signed in the presence of two subscribing witnesses.

GEORGE ASHER.
JOHN BUTTRESS.

Witnesses:
CHARLES BOSWORTH KETLEY,
WILLIAM CHARLES BATTEN.