

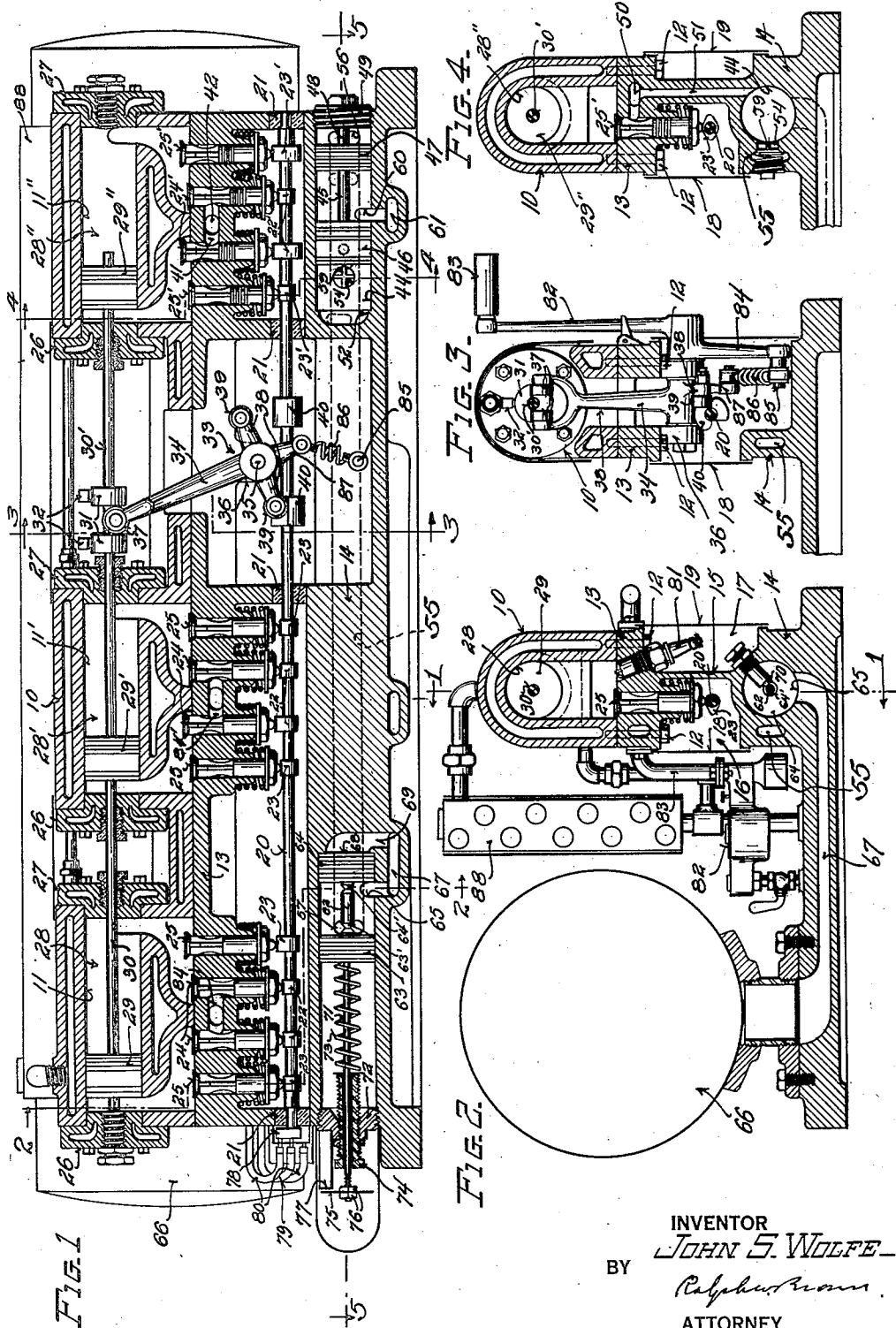
Dec. 8, 1931.

J. S. WOLFE

1,835,834

MOTOR COMPRESSOR UNIT

Filed Sept. 19, 1929 2 Sheets-Sheet 1



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Dec. 8, 1931.

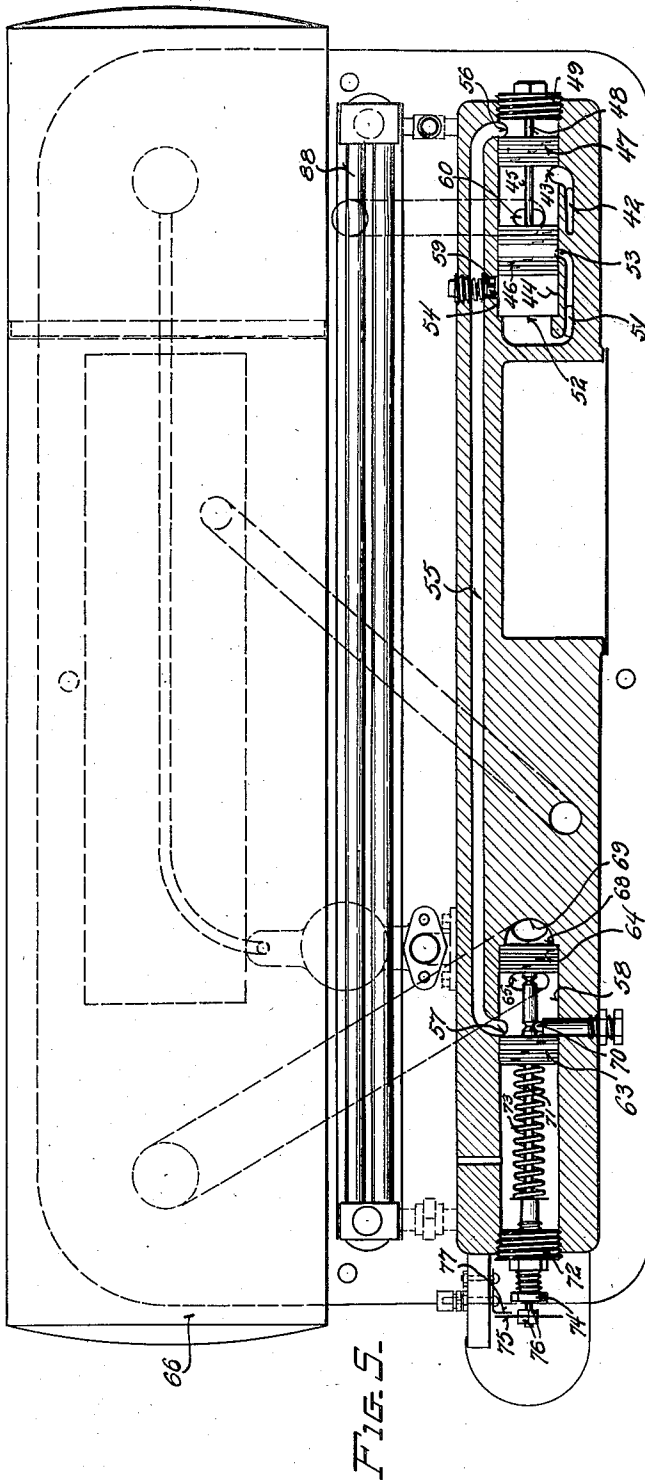
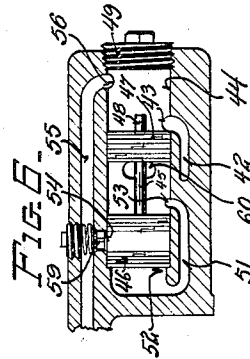
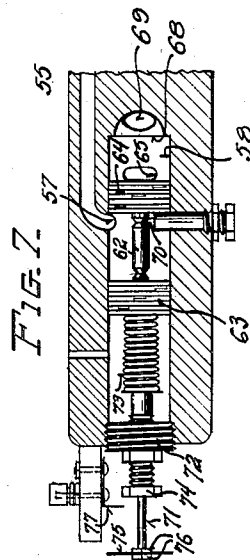
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2 Sheets-Sheet 2



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MOTOR COMPRESSOR UNIT

Application filed September 19, 1929. Serial No. 393,781.

This invention relates to motor-pump units.

One object of the invention is the provision of a motor-pump unit of simple design so as to materially reduce the cost of production and assembly to a fraction of the cost of producing motor-pump units of present day form.

This I accomplish by employing as a power source an internal combustion engine comprising a plurality of double acting cylinders having their pistons directly connected together and in direct connection with the piston of a pump cylinder. By the use of an arrangement of this type it is possible to obtain excellent results and at the same time eliminate the necessity of the crank shaft and fly wheel heretofore required.

A further object resides in the design and arrangement of parts which combine and coact in a manner to provide an improved motor-pump unit of compact form and one which is normally under its own control during the course of operation.

Another object is the provision in a motor-pump unit of means for rendering the motor active or inactive in accordance with predetermined pressures within the reservoir fed thereby.

Other objects and advantages will appear from the following description of an illustrative embodiment of the present invention.

In the drawings:

Figure 1 is a vertical longitudinal section through the motor-compressor taken on the line 1—1 of Fig. 2.

Fig. 2 is a vertical sectional view on the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary vertical sectional view on the line 3—3 of Fig. 1.

Fig. 4 is a fragmentary vertical sectional view on the line 4—4 of Fig. 1.

Fig. 5 is a horizontal sectional view taken on the line 5—5 of Fig. 1.

Fig. 6 is a longitudinal sectional view taken through the compressor cylinder control valve showing the valve plunger in its other characteristic operating position.

Fig. 7 is a longitudinal sectional view taken through the reservoir control valve show-

ing the valve plunger in its other characteristic operating position.

The motor pump unit shown in the accompanying drawings is in the form of a motor-compressor unit which will be described for the purpose of explanation. It is understood, however, that the device may readily be transformed into a motor pump unit for delivering non-compressible fluid as well as air. This unit comprises a cylinder block 10 provided with three longitudinally spaced aligned bores 11, 11', and 11'' of equal length. The cylinder block 10 is secured by appropriate anchoring means such as cap screws 12 to a flange 13 formed integral with a base casting 14 and spaced therefrom by a vertical longitudinally extending web 15. The web 15 divides the space between the base casting 14 and the horizontal flange 13 into two longitudinally extended recesses 16 and 17. Plates 18 and 19 which are removably secured to the base 14 form closures for the recesses 16 and 17 respectively.

A cam shaft 20 which is positioned longitudinally of the machine passes through the recess 15. This cam shaft is journaled in suitable bearings 21 positioned in the base casting 14. A plurality of sets of cams 22 and 23 are fixedly mounted on the cam shaft 20 and serve as operating means for spring urged intake and exhaust valves 24 and 25 respectively of the motor cylinders. These valves are mounted in the usual manner within the horizontally extended flange 13 of the base 14.

End caps 26 and 27 applied to the ends of the spaced aligned bores 11, 11' and 11'' in the cylinder block 10 serve to close the several bores to form cylinders 28, 28' and 28'' respectively. Cylinders 28, and 28' form the motor cylinders, while the cylinder 28'' is the compressor cylinder. Pistons 29, 29' and 29'' are positioned within the cylinders 28, 28' and 28''. Pistons 29 and 29' are connected by a piston rod 30 which passes through suitable packing glands in the adjacent end caps of cylinders 28 and 28'. Pistons 29' and 29'' are connected by a piston rod 30' which passes through suitable packing glands in the adjacent ends caps of cylinders 28' and 28''. The compressor cylinder 28'' is provided with a valve plunger 31 which is secured to the base 14 by a pin 32. The valve plunger 31 is provided with a valve seat 33 which is formed in the base 14. The valve plunger 31 is provided with a valve seat 33 which is formed in the base 14. The valve plunger 31 is provided with a valve seat 33 which is formed in the base 14.

ders 28' and 28''. The piston rods 30 and 30' are preferably removably secured to the pistons 29, 29' and 29'' for the purpose of facilitating assembly.

A pair of collars 31 are adjustably secured in spaced relation on the piston rod 30' by means of set screws 32. These collars reciprocate between the cylinders 28' and 28'' and serve as actuating means for a tumbler mechanism 33. The tumbler mechanism comprises a lever 34 rockably mounted on a shaft 35 which is journaled in suitable lugs 36 formed integral with the horizontal flange 13. The upper extremity of the lever 34 is bifurcated to span the piston rod 30' and a roller 37 is rotatably mounted on each extremity of the bifurcated portion of the lever 34. These rollers 37 lie adjacent the sides of the piston rod 30' and in the path of travel of the collars 31 in such position that as the collars reciprocate with the rod 30' the lever arm 34 is oscillated on the shaft 35. A pair of laterally extended arms 38 formed as an integral part of the lever 34 carry roller elements 39 which coast with lugs 40 on the cam shaft 20 to impart intermittent rotary motions of 90 degrees to the cam shaft. This intermittent rotary motion of the cam shaft effects the timed opening and closing of the several intake and exhaust valves 24 and 25 respectively through the action of the sets of cams 22 and 23.

The compressor cylinder 28'' is provided with a pair of intake and exhaust valves 24' and 25' respectively in communication with each end of the cylinder. These valves are identical with the valves 24 and 25 of the motor and are actuated by cams 22' and 23' which are similar to the cams 22 and 23 except for the fact that the cams 22' and 23' are each provided with a pair of lobes placed diametrically in place of a single lobe. The intake valves 24' of the compressor cylinder are connected by a passage 41 which communicates with a passage 42 which terminates in a port 43 in the wall of a bore 44 in the base 14. The bore 44 houses a valve plunger 45 which is provided with a pair of spaced heads 46 and 47'. The head 47' is provided with a tail rod 48 which serves to limit the extent of movement of the valve plunger in one direction. A screw threaded plug 49 serves as a closure for the bore 44. A passage 50 which connects the exhaust valves 25' is in open communication with a passage 51 which extends downwardly and terminates in a pair of ports 52 and 53 which pierce the end and wall respectively of the bore 44. A port 54 in the wall of the bore 44 communicates with a longitudinal passage 55 which terminates at one end in a port 56 in the bore 44 and at its other end in a port 57 in a bore 58 which forms a second valve to be hereinafter described. The port 54 is normally closed by a spring urged check valve 59. A port 60 in

the bore 44 lies between the heads 46 and 47 of the valve plunger and is in constant communication with atmospheric pressure through a passage 61 in the base.

With the valve plunger 45 in the position shown in Figs. 1 and 5, the intake valves 24' in the compressor cylinder 28'' are in open communication with atmospheric pressure by virtue of the fact that the spaced heads 46 and 47 bridge the ports 43 and 60 in the bore 44 and thus permit free admission of air from the passage 61 to the passages 42 and 41 to supply the cylinder 28'' with air to be compressed. The exhaust valves 25' are in communication with one end of the bore 44 through the port 52 and the passages 50 and 51. The port 52 communicates through the bore 44 with the port 54 which is provided with a check valve 59 which permits the air to leave the bore and enter the passage 55 but precludes the reentrance of air into the bore 44 through the port 54. One end of the passage 55 is directed to the outer end of the bore 44 and enters through the port 56 for a purpose to hereinafter appear. When the valve plunger is in the position shown in Fig. 6 it will be noted that the spaced heads 46 and 47 bridge the ports 53 and 60 in the bore 44. By bridging these ports the exhaust valves are placed in communication with atmospheric pressure by affording free passage of air from the passage 61 to the passage 50 through the passage 51. It will also be noted that the port 56 adjacent the end of bore 44 is now in communication with the passage 42 through the port 43. This port 42 as previously described is open to the intake valves 24' of the compressor cylinder through the passage 41. Thus it will readily be understood that by movement of the plunger in the bore 44 it is possible to establish a connection directing atmospheric pressure to either the intake valves 24' or the exhaust valves 25'.

The bore 58 in the base 14 houses a valve plunger 62 which is provided with a pair of spaced heads 63 and 64. The port 57 in the bore 58 lies intermediate the heads 63 and 64. A port 65 adjacent the head 64 communicates with a reservoir 66 through a passage 67. A port 68 in the inner end of the bore 58 is in open communication with the reservoir 66 through a passage 69 which joins the passage 67.

With the valve plunger 62 in the position shown in Figs. 1 and 5 direct communication is established between the reservoir 66 and the passage 55 by reason of the fact that the ports 57 and 65 are bridged by the spaced heads 63 and 64. With the valve plunger 62 in the position shown in Figure 7 it will be noted that the head 64 lies between the ports 57 and 65 thus blocking communication therebetween. By blocking communication between the ports 57 and 65 it will be appar-

ent that the reservoir 66 has been isolated from the remainder of the system.

The valve plunger 62 is provided with grooves 63' and 64' which lie adjacent the spaced heads 63 and 64 respectively. These grooves serve to receive a spring urged detent 70 which normally holds the plunger 62 in either of its two positions. The head 63 is provided with a tail rod 71 which passes through an end cap 72 which serves as a closure for the bore 58. One end of a coil spring 73 which surrounds the rod 71 abuts the outer face of the head 63. The other extremity of the spring 73 is in abutting relation with the inner extremity of an adjustable plug 74. By adjustment of the screw threaded plug 74 it is possible to vary the compression of the spring 73 to thus regulate the pressure exerted by it upon the valve plunger 62. A disk 75 properly insulated from the rod 71 is secured to the end thereof by a pair of nuts 76. This disk normally is in contact with a finger 77 to complete the electrical circuit constituting the ignition system of the motor. However when the plunger 62 is urged to the left in the base 58 the disk will be urged away from the finger to break the electrical contact and stop the motor.

A distributor of a well known type having an arm 78 is fixedly mounted on one end of the cam shaft 20. The arm 78 carries the usual contact point which intermittently establishes electrical connection between a lead-in wire 79 and each of the wires 80 which are severally connected to spark plugs 81 (only one of which is shown) in each end of the cylinders 28 and 28'.

A brief description of the entire machine will now be given. It will be noted that the motor comprises a pair of double acting cylinders 28 and 28' positioned in tandem relation and operating on a four stroke cycle. By virtue of this arrangement the pistons of the two cylinders produce a power stroke in both directions of reciprocation. Fuel from a carburetor 82 is delivered through a manifold pipe 83 into intake ports 84 and 84' of cylinders 28 and 28' respectively. These ports 84 and 84' are in open communication with the two intake valves 24 in each of the cylinders. The exhaust valves 25 of each of the cylinders 28 and 28' are connected by passages 85 and 85' respectively. These passages are directly connected to an exhaust manifold (not shown).

With the parts in the position shown in Fig. 1 let us assume that the fuel charge which has previously been compressed within the left end of cylinder 28 has just been ignited. As this occurs the explosion drives the piston 29 to the right. An exhaust stroke is effected in the right end of this cylinder to discharge the burned gases of the previous stroke through the exhaust valve 25 which

is in raised position. The piston 29' will also be driven to the right by virtue of its direct connection to the piston 29 through the connecting rod 30. As the piston 29' moves to the right the left end of the cylinder is on its intake stroke and will draw its fuel charge through the intake valve 24 which is in raised position. On this stroke of the piston 29' the fuel which was drawn into the right end of the cylinder 28' on the previous stroke will be compressed due to the fact that both the intake and exhaust valves 24 and 25 in this end of the cylinder are closed. As the pistons 29 and 29' are moving to the right the collars 31 are forcing the lever 34 of the tumbler mechanism to the right and at the end of this stroke the roller 39 will engage the right hand lug 40 to impart a rotation of 90° to the cam shaft. As this occurs the electrical circuit for the spark plug in the right end of the cylinder 29' will be completed by contact made by the arm 78 with the lead wire 80 which is directed to this particular plug. In this manner the charge of fuel compressed in the right end of cylinder 29' on the preceding stroke will explode and drive the piston 29' to the left. The fuel charge within the left end of the cylinder 28' will be compressed, as the piston 29' moves to the left in cylinder 28' on this stroke. As the piston 29 is driven to the left in the cylinder 28 a fuel charge will be drawn into the right end of the cylinder through the intake valve 24 which will be open. The exhaust valve 25 in the left end of the cylinder 28 will also be open at this time to permit the piston 29 to force the burned gas out of the exhaust valve on its travel to the left. At the left extremity of the stroke of the tumbler mechanism 33 will again function in a manner similar to that previously described to again rotate the cam shaft 20 to reposition the several valves preparatory to the next stroke. At the instant that the piston has reached the end of its leftward travel the fuel which was compressed on the preceding stroke in the left end of cylinder 28' will be ignited to force the piston 29' to the right on a driving stroke. On this stroke the gases in the right hand end of the cylinder 28' will be forced out through the open exhaust valve 25. As the piston 29 is being forced to the right on this stroke the fuel charge admitted in the right end of cylinder 28 on the preceding stroke will be compressed as both intake and exhaust valves are closed. The intake valve 24 in the left end of the cylinder 28 is open and hence as the piston 29 moves to the right a fuel charge will be drawn into this end of cylinder 28. At the end of the present stroke the tumbler mechanism will again be actuated to position the valves and the fuel compressed within the right hand end of cylinder 28 will simultaneously ignite to start the piston 29 on a driving stroke to

the left. This stroke will compress the charge of fuel in the left end of the cylinder by virtue of the fact that both of the valves are closed. As the piston 29' is forced to the left in cylinder 28' the exhaust gases will be forced out through the open exhaust valve 25 in the left end of the cylinder. Simultaneously a fuel charge will be drawn into the right end of the cylinder 28' through the open intake valve 24. With the completion of this stroke the engine has been driven through a complete cycle and with the turning of the cam shaft at the end of the stroke the engine parts will have returned to the position shown in Fig. 1.

As the motor is reciprocating in the manner previously described the piston 29'' is constantly reciprocating in the compressor cylinder 28''. On the first stroke of the engine described in the preceding paragraph the piston 29'' is driven to the right and the air previously admitted to this end of the cylinder is forced out through the open exhaust valve 25' in the right end of the cylinder and thence through the passages 50 and 51 and delivered to the left end of the bore 44 through the port 52. The action of the air on the head 46 will force the valve plunger to the right until the port 54 has been uncovered at which time the air pressure will unseat the valve 59 and pass freely into the passage 55. From this passage it will be delivered to a second valve bore 58 through the port 57. With the valve plunger 62 in the position shown in Fig. 1 the port 57 is in communication with the port 65 to permit the air to enter the reservoir 66 by way of the passage 67. Upon the next succeeding stroke of the motor the compressor piston 29'' is driven to the left and the air which was drawn into this cylinder through the intake valve 24' will be discharged through the exhaust valve 25 and travel the same course to the reservoir 66. It will be noted at this time that the intake valves 24' are in constant communication with atmospheric pressure when the valve plunger 45 is in the position shown in Fig. 1. This communication is established by the fact that the spaced heads 46 and 47 bridge the ports 43 and 60 which are the respective ends of passages 42 and 60. The passage 42 is open to the intake valves 24' through the passage 41 while the passage 60 is open at its outer end to atmospheric pressure.

The compressor piston will continue to deliver air to the reservoir 66 in a manner just described until such time as the pressure in the reservoir is built up to the point where the pressure exerted upon the outer face of the head 64 through the passage 68 from the reservoir will be sufficient to overcome the combined resistance of the spring 73 which is holding the plunger 62 in the right hand position and the resistance of the spring

urged detent 70 which is engaged in the groove 64'. When the reservoir pressure is sufficient to overcome the resistance the valve will be forced into its left hand position as shown in Fig. 7 of the drawings. With the valve plunger 62 in this position the reservoir will be completely isolated from the remainder of the system and the motor will cease to function by reason of the fact that the ignition circuit has been broken due to the movement of the disk 75 away from the contact finger 77.

The motor will remain idle until such time as the air supply in the reservoir has been depleted to such an extent that the pressure is insufficient to retain the valve plunger 62 against the spring 73 at which time the plunger will be forced back to its original position in the bore 58 to reestablish communication between the reservoir and the balance of the system. The reservoir pressure will then be directed through the passage 55 to the bore 44 through the port 56. The pressure in this end of the bore 44 will act upon the head 47 to force the plunger 45 to the left in the bore 44 as shown in Figure 6. With the valve plunger 45 in the left hand position it will be noted that the passage 55 will be in open communication with the passage 42 through the port 43. In this manner the reservoir pressure will pass up to the intake valves 24' (one of which is always open) in the compressor cylinder 28'' to force the piston 29'' to the right or left as the case may be to restart the pistons 29 and 29' in the motor cylinders 28 and 28'. As the piston 29'' reaches the end of its stroke the tumbler mechanism is actuated and the piston will start on a stroke again under the action of the air pressure in the reservoir. The exhaust valves 25' in the compressor cylinder are in communication with atmospheric pressure by reason of the fact that the manifold passage 50 and the passage 51 are connected to the base 44 through the passage 53 which is greatly reduced in size to form in effect a bleed. With the valve plunger 45 in the position shown in Figure 6, the air from the cylinder 28'' will pass through the valves 25' and be directed through the bleed passage 53 into the bore 44 from which it enters the passage 61 which is exposed at its outer end to atmospheric pressure.

The fact that the valve plunger 62 has been returned to its normal operating position and reestablished the ignition circuit before the air from the reservoir has been directed to the piston 29'' to restart its movement is significant by reason of the fact that the piston 29'' may be driven from the air reservoir 66 through several strokes if necessary until the motor will again start to function under its own power. Upon the restarting of the motor the pressure directed

from the end of the compressor cylinder through one of the valves 25' will be built up to such an extent that the bleed passage 53. will be unable to accommodate the volume of air at the high pressure. The pressure so developed will again be directed into the end of the bore 44 through the port 52 to force the plunger 45 to the right and reestablish the normal operating condition in the system.

For the purpose of the initial starting of the motor a crank arm 82 is rockably mounted on the shaft 35. The upper extremity of the arm is provided with a suitable handle 83. A depending lever 84 formed integral with the arm 82 carries a horizontally extended pin 85. A coil spring 86 is anchored at one end to the pin 85 while its other extremity is anchored to an arm 87 formed integral with the lever 34. By rocking the crank arm 82 the spring 86 will exert a pull upon the arm 87 of the lever 34. This pull will be transmitted through the lever 34 to the rollers 37 which bear against the spaced collars 31 and thereby move the piston rod 30' to impart motion to the several pistons. In this manner the crank arm may be oscillated until such time as sufficient compression is built up in the cylinders 28 and 28' to permit the gases to be ignited when a spark jumps across the points of a plug.

The restarting mechanism just described also functions to prevent stalling of the motor due to failure in the ignition circuit or otherwise. In this connection it will be noted that during normal operations, that is while the reservoir is being filled, the valve plunger including heads 46 and 47 remains in the position shown in Figures 1 and 5. Should the motor fail to continue functioning, however, the pressure in the left hand of the bore 44 will immediately fall off thereby permitting the plunger of this valve to shift into position of Fig. 6 under the reservoir pressure existing in the right hand of the bore. As previously explained this movement of the valve connects the intake valves 24' to the reservoir pressure and the exhaust valves 25' to atmosphere so that the compressor then functions as a motor to cause the motor to complete its stroke.

The several cylinders are water jacketed and a radiator 88 which is connected in any usual manner to the cylinder block serves to keep the temperature of the engine down to a point to insure efficient operation.

While the invention has been described in considerable detail in the foregoing specification it is understood that various changes may be made in its embodiment without departing from or sacrificing any of the advantages as hereinabove claimed.

I claim:—

1. In a motor pump unit the combination of an internal combustion engine having a

plurality of cylinders, a piston reciprocating in each cylinder, a reciprocating driving connection between said pistons, intake and exhaust valves for said cylinders, means controlled by the reciprocation of said pistons for controlling said valves to effect a power stroke in each direction of reciprocation, a pump having a reciprocating piston, and a reciprocating driving connection between said engine pistons and said pump piston.

2. In a motor pump unit the combination of an internal combustion engine having a reciprocating double acting piston, a pump having a reciprocating piston, reciprocating driving means between said engine piston and said pump piston, a reservoir fed by said pump, and means responsive to the pressure in said reservoir for automatically stopping said internal combustion engine and consequently said pump.

3. In a motor pump unit the combination of an internal combustion engine having a reciprocating double acting piston, a pump having a reciprocating piston, a reciprocating driving connection between said engine piston and said pump piston, a reservoir fed by said pump, and means responsive to pressures in said reservoir for automatically starting and stopping said engine.

4. In a motor-compressor unit the combination of an internal combustion engine having a reciprocating double acting piston, a compressor having a reciprocating double acting piston, reciprocating driving means between said engine piston and said compressor piston, a reservoir, a communicating passage between said compressor and said reservoir, pressure operated valve mechanism in said passage, said valve mechanism being operable to direct air from said compressor to said reservoir, a second pressure operated valve mechanism in said passage, said second valve mechanism being operable to cut off communication between said compressor and reservoir and to effect a stopping of said motor when the pressure in said reservoir has reached a predetermined limit.

5. In a motor-compressor unit the combination of an internal combustion engine having a plurality of cylinders, a piston reciprocable in each cylinder, a reciprocating driving connection between said pistons, intake and exhaust valves in said cylinders, a compressor cylinder having a reciprocating piston therein, a reciprocating driving connection between said engine pistons and said compressor piston, intake and exhaust valves in said compressor cylinder, a cam shaft for operating said engine and compressor valves, and rockable means driven from said reciprocating driving connection between pistons for effecting an intermittent rotary motion to said cam shaft to effect the timed opening and closing of said intake and exhaust valves.

6. In a motor-compressor unit the combi-

- nation of an internal combustion engine having a plurality of cylinders, a piston reciprocable in each cylinder, a reciprocating driving connection between said pistons, intake and exhaust valves in said cylinders, a compressor cylinder having a reciprocating piston therein, a reciprocating driving connection between said engine pistons and said compressor piston, intake and exhaust valves in said compressor cylinder, a cam shaft for operating said engine and compressor valves, and rockable means driven from said reciprocating driving connection between pistons for effecting an intermittent rotary motion to said cam shaft to effect the timed opening and closing of said intake and exhaust valves, a reservoir, a communicating passage between said compressor and said reservoir, pressure operated valve mechanism in said passage, said valve mechanism being operable to direct air from said compressor to said reservoir, a second pressure operated valve mechanism in said passage, said second valve mechanism being operable to cut off communication between said compressor and reservoir and to effect a stopping of said motor when the pressure in said reservoir has reached a predetermined limit.
7. In a motor-compressor unit the combination of an internal combustion engine having a reciprocating double acting piston, a compressor having a reciprocating piston, a reciprocating driving connection between said engine piston and said compressor piston, a reservoir fed by said compressor, valve means between said compressor and reservoir for effecting communication between said compressor and reservoir and responsive to a predetermined pressure in said reservoir for cutting off communication between said compressor and reservoir, and means responsive to pressures in said reservoir for automatically starting and stopping said engine.
8. In a motor-pump unit the combination of an internal combustion engine having a reciprocating double acting piston, a pump having a reciprocating double acting piston, reciprocating driving means between said engine piston and said pump piston, a reservoir, a communicating passage between said pump and said reservoir, pressure operated reversing valve mechanism in said passage, said valve mechanism being operable to direct fluid from said pump to said reservoir, said valve mechanism also being operable to direct fluid from said reservoir to said pump for the purpose of restarting said motor.
9. In a motor pump unit the combination of an internal combustion engine having a reciprocating double acting piston, a pump having a reciprocating piston, a reciprocating driving connection between said engine piston and said pump piston, a reservoir fed by said pump, and a reversing valve
- between said pump and reservoir operable to direct fluid from said pump to said reservoir and from said reservoir to said pump for the purpose of restarting the motor after it has been stopped.
- In witness whereof, I hereunto subscribe my name this 12 day of August, 1929.
- JOHN S. WOLFE.