C. V. FITE.

STARTING APPARATUS FOR AUTOMOBILE OR OTHER ENGINES.

APPLICATION FILED MAY 11, 1917.

1,280,005.

Patented Sept. 24, 1918.

4 SHEETS—SHEET 1.

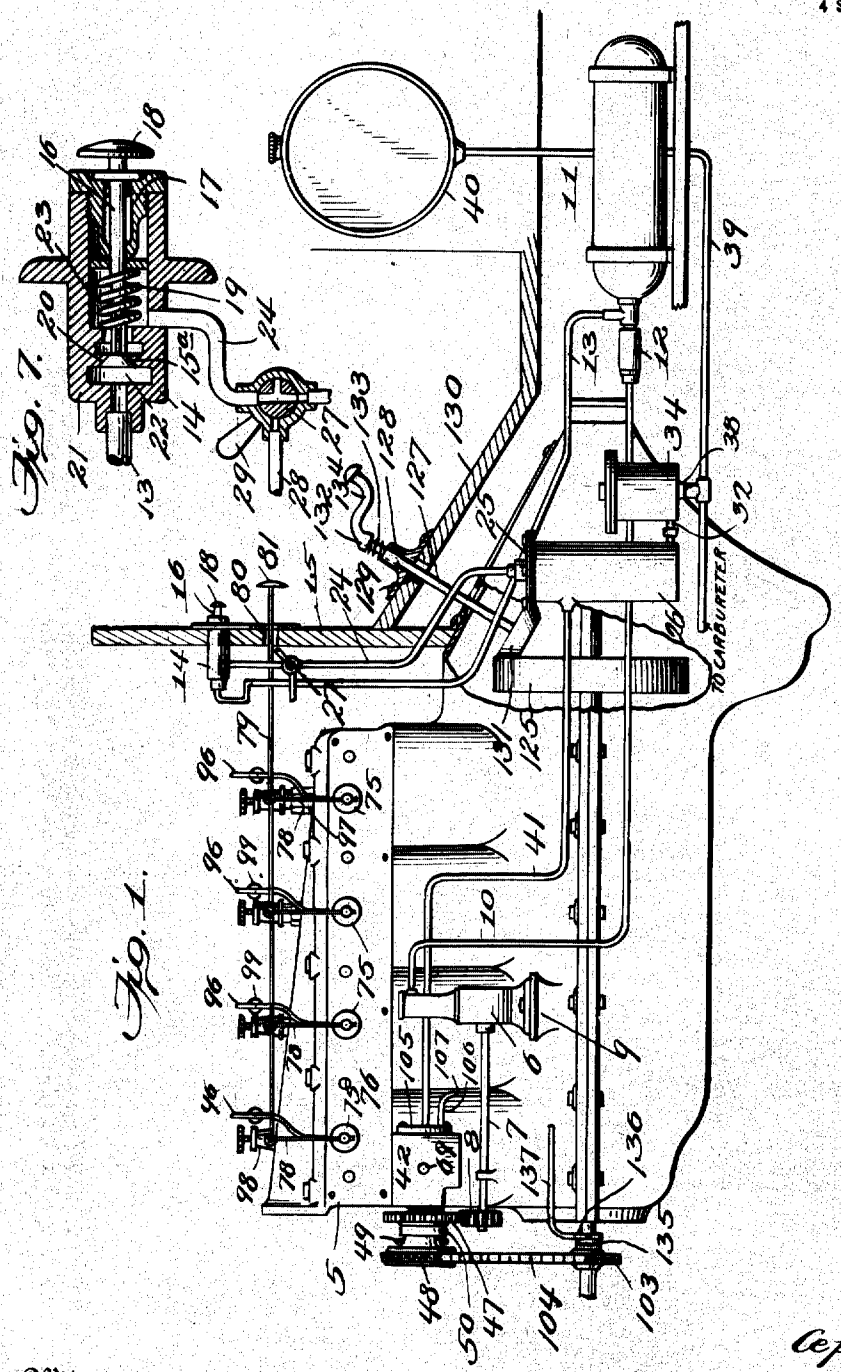


Fig. 1.

Witness
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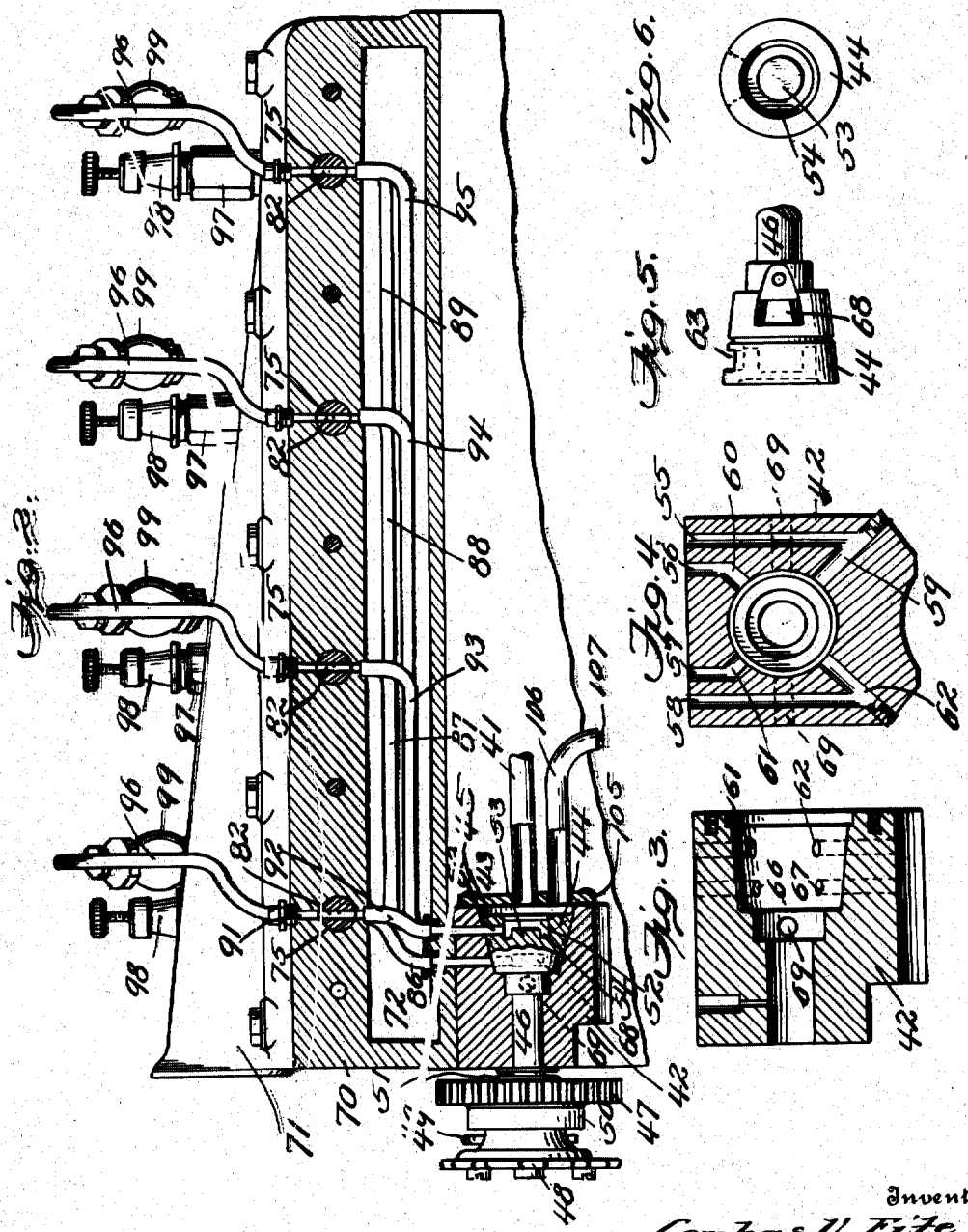


Fig. 2.

Fig. 6.

Fig. 5.

Fig. 4.

Fig. 3.

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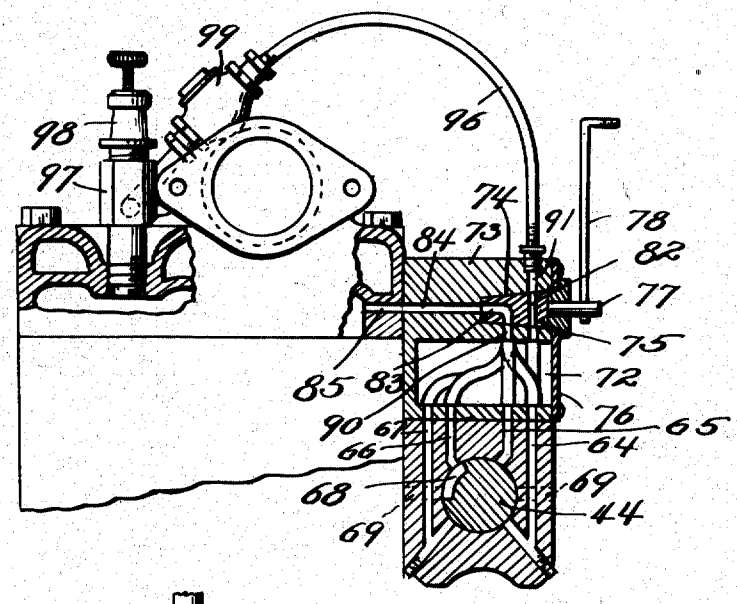
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4 SHEETS—SHEET 3.

Fig. 8.



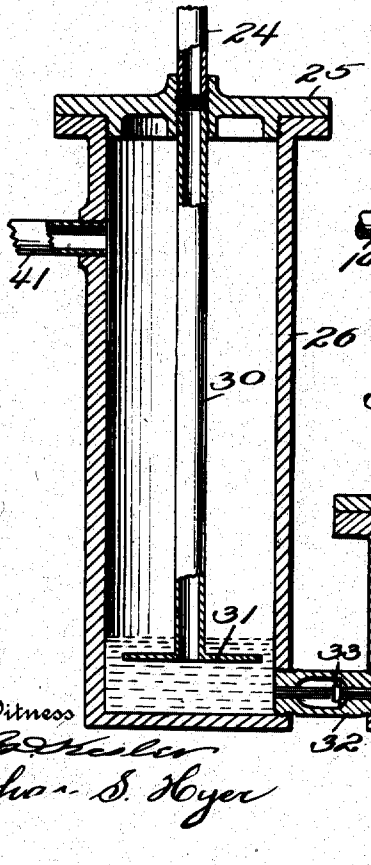


Fig. 10.

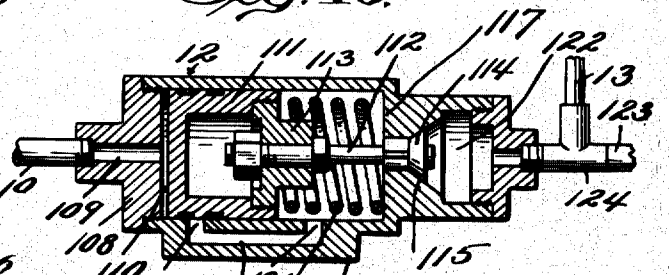


Fig. 9.

119

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4 SHEETS—SHEET 4.

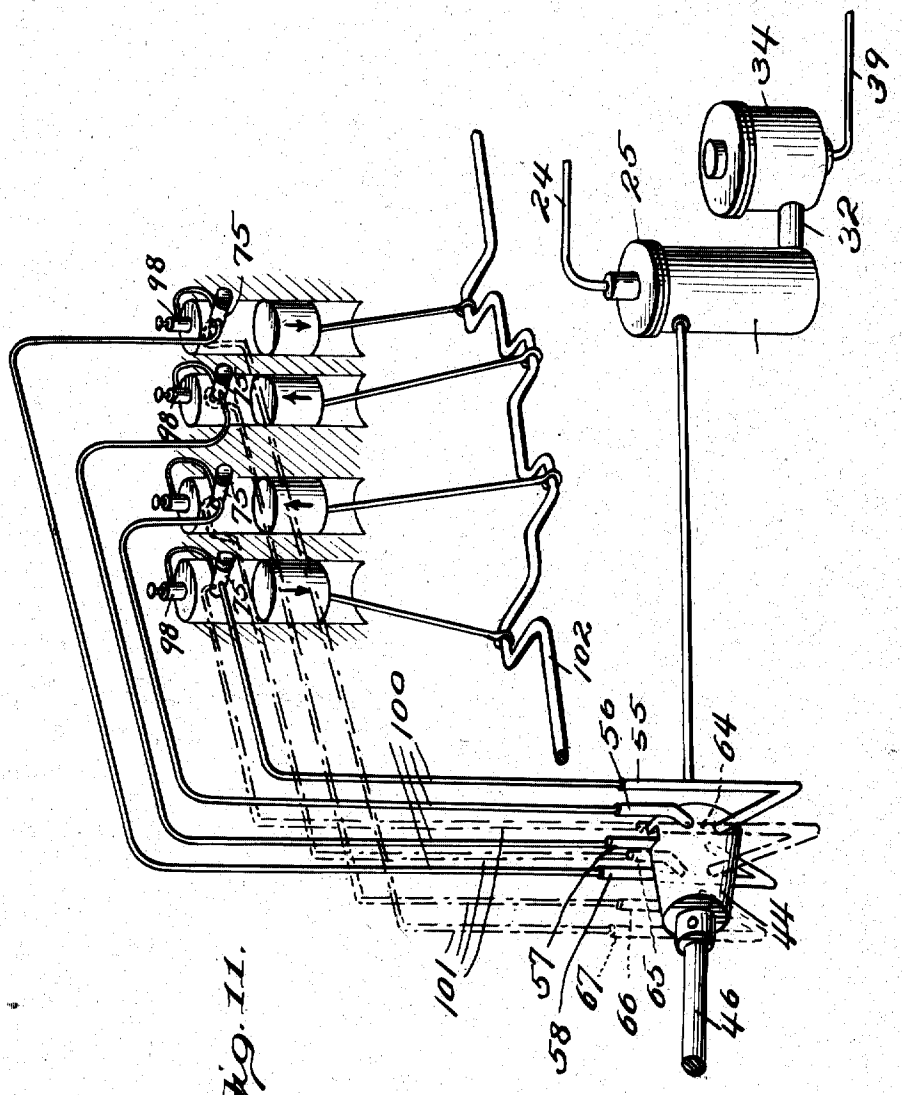


Fig. 11.

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UNITED STATES PATENT OFFICE.

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STARTING APPARATUS FOR AUTOMOBILE OR OTHER ENGINES.

1,280,005. Specification of Letters Patent. Patented Sept. 24, 1918.

Application filed May 11, 1917. Serial No. 167,981.

To all whom it may concern:

Be it known that I, CEPHAS V. FITE, a citizen of the United States, residing at Charlotte, in the county of Mecklenburg and State of North Carolina, have invented new and useful Improvements in Starting Apparatus for Automobile or other Engines, of which the following is a specification.

This invention relates to starting apparatus for internal combustion engines and particularly automobile engines or motors of that type characterized by means for delivering air under pressure carrying therewith a vaporized hydrocarbon to the working cylinders of the engine. The improved apparatus has been designed more particularly for the multiple cylinders of the engine or motor of the Ford automobile, and air under pressure carrying a hydrocarbon vapor is regularly fed in timed relation or sequence to the several cylinders against the pistons of the latter to start the pistons in operation and at the same time actuate the air pressure mechanism so as to always maintain an ample supply of air under pressure in stored condition for immediate use in starting the pistons when the engine or motor is so cold that it will not become operative by reason of the failure of the carbureter to act and supply the cylinders and pistons with the motive agent or hydrocarbon mixture in the usual manner. The improved starting apparatus is in the nature of an attachment which may be readily applied to the type of automobile motor engine specified, but is not limited to this particular application as it may be used in connection with the motors or engines of other commercially known automobiles. It will therefore be understood that the main object of the invention is to provide readily operative means for starting a cold automobile engine or motor and maintaining the operation of the latter until it becomes sufficiently heated to cause the usual carbureter to act and feed the explosive mixture in proper proportion to the several cylinders and pistons when the starting apparatus will be cut out or operatively disconnected with relation to the cylinders and pistons of the motor. A further object of the invention is to provide a starting mechanism of this class having improved means for effecting the several operations necessary to the regular and positive feed of air under pressure carrying a hydrocarbon vapor to the several cylinders and pistons of an automobile or multiple-cylinder engine or motor and to effect a regular compression and storage of the air within a reservoir and to control the said apparatus from the interior of the automobile by readily accessible actuating devices. A further object of the invention is to provide a novel form of valve for controlling the supply of the air under pressure carrying or impregnated with a hydrocarbon vapor in sequence to the cylinders and pistons of a multiple-cylinder engine or motor and by the same valve to relieve the successive cylinders of any compressed air that may remain therein to avoid interference with the proper starting operation of the pistons within the cylinders prior to the time that the cylinders and pistons are supplied with an explosive mixture from the regular or usual form of carbureter, the said valve being automatic in its operation and preferably operated from the crank shaft of the engine or motor.

With these and other objects and advantages in view, as will appear from the subjoined description, the invention consists in the preferred construction and arrangement of the several parts which will be more fully hereinafter described and claimed.

In the drawings:

Figure 1 is a side elevation of a multiple-cylinder engine or motor showing the improved starting attachment applied thereto and also illustrating the dash and foot-board of an automobile in section to demonstrate the application of parts of the improved apparatus thereto.

Fig. 2 is a longitudinal vertical section through the upper portion of the improved starting apparatus or attachment and showing the upper part of the multiple-cylinder engine or motor and the feed and outlet pipe connections between the automatically operated controlling valve and the cylinder.

Fig. 3 is a longitudinal vertical section through the automatic controlling valve taken in a plane at an angle to that shown by Fig. 2.

Fig. 4 is a transverse vertical section through the automatic controlling valve and casing thereof.

Figs. 5 and 6 are detail views in side and end elevation of the automatic controlling valve removed from its casing.

Fig. 7 is a longitudinal vertical section of the manually operated valve for setting up communication between the compressed air reservoir and the hydrocarbon vaporizing means.

Fig. 8 is a transverse vertical section through the automatic controlling valve and pipe connection box and showing the upper portion of one cylinder partially broken away and in section to illustrate the pipe connection for the supply of the air under pressure carrying the hydrocarbon vapor to the cylinder and an outlet duct or passage for relieving the cylinder of compressed air together with a valve means for setting up communication between the automatic controlling valve and the pipe connections.

Fig. 9 is a transverse vertical section taken through the means for charging or impregnating the air under pressure with the hydrocarbon vapor or hydrocarbon and the float means for maintaining the hydrocarbon at a proper level in the said charging means.

Fig. 10 is a longitudinal vertical section of the check valve introduced between the air compressor or pump and the storage reservoir or tank.

Fig. 11 is a sectional perspective diagrammatic view showing the supply pipe connections to the several cylinders and pistons from the controlling valve and the outlet connections for the compressed air from the several cylinders in relative association with the said valve and also illustrating the connection between the means for charging or impregnating the air under pressure with hydrocarbon or hydrocarbon vapor.

The numeral 5 designates a multiple-cylinder engine or motor of that type ordinarily used in the Ford automobile, but as hereinbefore specified this multiple-cylinder motor or engine may be of that class or particular form used in other automobiles as the motive means. The improved starting apparatus is in the form of an attachment and applied to one side of the multiple-cylinder engine or motor and comprises an air compressor or pump 6 having a shaft 7 of the compressing roller thereof projected forwardly and provided with a pinion 8 on its front end slightly in advance of the front terminal of the multiple-cylinder motor. The air compressor or pump 6 is mounted upon a suitable support 9 and will be of any preferred type of devices of this class. Connected to the top of the compressor or pump 6 is a compressed air conveying pipe 10 which runs rearwardly to and connects with a tank or reservoir 11, a check valve 12 being interposed between the pipe 10 and the said tank or reservoir 11. Between the check valve 12 and the tank or reservoir 11 a compressed air feed pipe 13 is connected and is also attached to the rear end of a manually operated communication establishing valve 14 held by the dashboard 15 of the automobile within easy reaching distance of the driver or operator of the machine. The communication establishing valve 14 comprises a valve 15^a held on the rear end of a stem 16 movable in suitable bearings in the valve casing and projecting outwardly through a gland or stuffing box 17 and provided with a button or head 18 on its rear end, a spring 19 engaging the said stem and operating to normally seat the valve 15^a or close the same against a valve seat 20, the casing 21 of this valve having a small chamber 22 formed therein adjacent to the valve seat 20 into which the valve 15^a may move and open the seat or establish communication between the pipe 13 and the interior of the casing 21 where a chamber or passage 23 is provided with which a pipe connection 24 has communication and extends downwardly to the top 25 of a charging means or cylinder 26. The pipe 24 has a two-way valve 27 interposed therein and provided with an outlet or vent 28, this valve being operable through the medium of a handle 29 connected to the stem thereof, and by this means the charging tank 26 may be relieved of surplus air under pressure that may remain therein when the valve 15^a is permitted to close after the improved starting apparatus has served its purpose and the multiple-cylinder engine or motor becomes active by the ordinary means or is sufficiently heated to set up a practical operation of the carbureter relatively thereto. As long as the valve 15^a is held open by pressure of the stem 16 the compressed air will be supplied to the charging tank or cylinder 26, and under such conditions the valve 27 will be adjusted to set up communication between the top 25 of the charging tank or cylinder 26 and the valve 14, escape or ventage of the air under pressure through the vent pipe 28 then being prevented. Connected to the top 25 of the charging tank or cylinder 26 is a tubular stem 30 which projects downwardly into the interior of the said charging tank or cylinder to a point near the bottom of the latter and is provided with a terminal disk or spreader 31. Close to the bottom of the tank or cylinder 26 a pipe 32 is attached and provided with a suitable check valve 33 therein, the pipe 32 also being attached to the bottom of a float chamber 34 having therein a float 35 with a stem 36 provided with a lower valve 37 movable in a connecting nipple 38 connected to the gasolene feed

pipe 39 which runs to the usual carbureter from the hydrocarbon or gasolene reservoir 40 situated as usual in automobiles and under the seat of the Ford type of machine, as clearly shown by Fig. 1. It will be understood that the float chamber with its float regulates the inflow of the hydrocarbon or gasolene into the bottom of the charging tank or cylinder 26 and maintains a constant level of the hydrocarbon or gasolene in the said charging tank. The tubular stem 30 extends downwardly far enough into the interior of the said charging tank or cylinder 26 to locate the disk or spreader 31 below the level of the hydrocarbon or gasolene therein, and by this means the air under pressure passing downwardly through the tubular stem 30 is caused to circulate through the body of gasolene in the charging tank or cylinder below the upper level of the gasolene and then passes upwardly into the said charging tank or cylinder above the gasolene level and passes out through a pipe 41 to the rear of the casing 42 of an automatically operating supply controlling valve 43 having therein a rotating valve 44 disposed in a chamber 45 bored or otherwise formed in the casing and of a particular construction which will be presently explained. The valve 44 has a forwardly projecting stem 46 which continues beyond the front end of the casing 42 a suitable distance and has thereon a spur gear 47 which meshes with the pinion 8 on the shaft or stem 7 of the air compressor or pump 6. On the projecting valve stem 46 a sprocket wheel 48 is also secured by means of a pin 49 and may be removed as desired; and between this sprocket wheel and the spur gear 47 is a space member 50, and between the opposite side of the spur gear 47 and the front end of the casing 42 a spring 51 surrounds the said projected stem 46 and serves to hold the valve 44 firmly to its seat. The valve 44 is of frusto-conical form and is illustrated diagrammatically in Fig. 11, the casing 42 being removed to show the pipe connections and passages in full and dotted lines and by continuing single lines in full and dotted form relatively to the several cylinders and pistons of the engine or motor. The valve casing 42 is in the form of a block of suitable material which is bored out to form the valve chamber 45 and to permit the stem 46 to project therethrough as explained. This block of material forming the casing 42 is also bored at different angles and at various points to provide the passages or ports to set up communication between the pipe 41 by way of the valve 44 and the casing or block 42 with the several cylinders and pistons of the engine, as will be presently explained. The valve 44 has the rear enlarged extremity thereof chambered, as at 52, and into the chamber thus formed a boss 53 centrally projects, thereby forming an annular groove 54 opening into the chamber and providing for a registration with the ports of the valve which open into the chamber adjacent to the said groove. The chamber 52 of the valve opens into the valve chamber 45 of the casing or block 42, and by this means the air under pressure carrying the hydrocarbon vapor is unobstructedly permitted to enter the chamber 52 and groove 54 of the valve. The casing or block 42 is formed with vertical bores or ports 55, 56, 57 and 58 diagrammatically represented in Fig. 11 in the form of pipes, the bores 55, 56, 57 and 58 respectively intersecting angular bores or ports 59, 60, 61 and 62, the bores 59 and 62 being continued diagonally through the valve chamber 45 and plugged at their opposite lower ends for convenience in construction, and at regular intervals the chamber 52 and groove 54 are caused to communicate with the angular bores or ports 59, 60, 61 and 62 through the medium of a single port 63 formed in the valve 44.

The casing or block 42 in rear of the ports, bores or passages, 55, 56, 57, 58, 59, 60, 61 and 62 is formed with other similarly positioned ports or passages as indicated by dotted lines in Figs. 3 and 11 and indicated by reference characters 64, 65, 66 and 67 which continue through the top of the casing or block 42 and also open at their inner ends into the valve chamber 45 for sequential registration with an exhaust passage 68 having outlet ports 69 opening through the opposite sides of the casing or block 42. The casing or block 42 is suitably secured on the side of the upper portion or head of the engine or motor, that shown in the drawings being of the standard type ordinarily employed as a part of Ford automobile engines or motors. Above the casing or block 42 is an elongated box 70 bolted to the cylinder head 71 and occupying a position relatively to the latter as clearly shown by Figs. 2 and 8, this box having a lower elongated chamber 72 and an upper solid body or head 73 formed with a plurality of tapered valve seats or chamber 74 to receive rotatable plug valves 75. Over the box 70 and closing the chamber 72 and also holding the plug valves 75 in opposite position within the body or head 73 is a removable plate 76 which may be detached at any time found necessary to repair or otherwise manipulate the parts carried by or passing through the said box. Each of the plug valves 75 has a stem 77 extending outwardly through the plate 76 and provided with an operating rod 78, all of the operating rods 78 of the several stems 77 and valves 75 standing in the same position and connected to a slide rod 79 extending rearwardly through an opening 80 in the dash

15 and provided with a rear head 81 on its rear end and whereby all of the valves 75 may be uniformly and simultaneously operated to turn the same. Each valve 75 has a port 82 extending therethrough at a point near the outer end thereof and constituting a feed passage through the valve, and in the rear of each valve is an angular exhaust port 83 opening through the center of the rear end of the valve and angularly out through the side of the same, as clearly shown by Fig. 8. The rear straight portion of each port 83 continually registers with a bore or port 84 extending transversely through the body or head 73, said port 83 being continued by a port 85 bored through the side of each cylinder head and opening into the top of the cylinder for the purpose of exhausting compressed air or relieving each cylinder of compression resistance therein prior to the admission of the starting fluid or air under pressure bearing hydrocarbon vapor into each cylinder. The plug valves 75 will all be first simultaneously operated to set up communication through them with the ports or passages 64, 65, 66 and 67 of the casing or block 42 by means of pipes 86, 87, 88 and 89 between the said ports 64, 65, 66 and 67 and ports 90 vertically formed in the lower portion of the body or head 73 and with which the angular portions of the ports 83 of the valve 75 are adapted to have registration. As hereinbefore indicated, the ports or passages 64, 65, 66 and 67 are adapted to register at intervals with the passage 68 in the rear portion of the valve 44, and the latter passage in turn registers with the outlet port 69 to regularly and sequentially exhaust or relieve the cylinders of compressed air or stored compression therein. The supply ports 82 of the plug valves 75 are brought into registration with all of a series of feed ports or passages 91 extending upwardly through the top portion of the body or head 73 simultaneously with the registration of the exhaust ports 83 with the ports 84 and 85. The ports 91 are connected by pipes 92, 93, 94 and 95 with the ports or passages 55, 56, 57 and 58 of the casing or block 42. The upper terminals of the ports 91 are connected by suitably curved or other pipes 96 with chambered plug sleeves 97 in which are fitted the sparking plugs 98 in the top of the respective cylinders, each connection between the ports 91 and the cylinders being the same and each pipe having a check-valve 99 interposed therein between the body or head 73 and the plug sleeve 97. The plug sleeve opens into the top of its cylinder close to the inner active extremity of the sparking plug 98 so as to insure an explosion and combustion of the preliminary charge supplied to each cylinder. It will be understood that the check-valves 99 in the several connecting supply pipes 96 are to prevent the charges of the air under pressure bearing hydrocarbon vapor from being forced backwardly into said connecting supply pipes 96 by compression and explosion effect. It will also be understood that the plug valves may be simultaneously operated to cut off communication between the ports or passages 82 and the ports 91, and also to cut off communication between the ports 83 and the ports 90 by a proper movement of the slide rod 79, and this position of the plug valves will be provided after the engine has started to work normally or has become sufficiently heated to receive regular charges of the motive medium by way of the ordinary carbureter. The connecting pipes for supplying the several cylinders with the preliminary starting charges are indicated by full lines 100 in Fig. 11 and the exhaust pipe connections 86 are indicated by dotted lines 101 in the same figure of the drawing, said full and dotted lines being respectively shown as extending from the supply and exhaust ports formed in the casing or block 42, the latter being omitted in Fig. 11 to more clearly show the positions of the respective ports.

The crank shaft 102 of the engine or motor is projected, as usual, in advance of the motor casing, and thereon is keyed a sprocket wheel 103 in vertical alinement with the sprocket wheel 48 on the projected valve stem 46, the latter serving as a shaft means for rotating the valve 44 in proper timed relation. Trained over the sprocket wheels 48 and 103 is a silent chain belt 104, and by this means the projected stem 46 and valve 44 are regularly rotated in consonance with the actuation of the crank shaft 102, and in the operation of the starting apparatus the valve 44 automatically distributes and regularly times the supply of the preliminary charging motive agent under pressure to the cylinders in sequence in accordance with the well understood cylinder and piston operation, and said valve likewise simultaneously at timed intervals exhausts the cylinders of any compressed air or relieves them of resisting compression so that the preliminary charges of motive agent may readily operate as a starting medium with the least possible resistance. From the valve stem 46, through the medium of the spur gear 47, the pinion 8 is actuated, and the shaft or stem 7 of the rotor of the air compressor or pump 6 is also regularly set in motion to compress the air and force the compressed air through the pipe 10 into the tank or reservoir 11, the latter remaining charged at all times and ready for instant use and will be provided with a suitable safety valve so that after a maximum pressure is reached therein an automatic relief may ensue. The sprocket wheel 48 and

the spur gear 47 may be readily removed from the projected valve stem 46, and over the rear end of the casing or block 42 a plate 105 is removably secured, and by detaching the said plate the valve 44 and its stem 46 may be readily withdrawn for the purpose of cleaning or repairing the same, it being understood that the pipe 41 will be first detached or uncoupled from the plate 105. Connected to the plate 105 and opening into the chamber 45 is a drain and cleaning pipe 106 which is normally provided with a removable plug 107. By means of this pipe 106 the valve chamber 45 and the valve 44 may be flushed with any suitable material, such as gasolene, or cleaned by any other means, and any residuum therein that is desired to be drained off may be readily liberated by removing the plug 107.

The check-valve 12 is shown in detail by Fig. 10 and the pipe 10 communicates with the forward head 108, the latter having a port 109 centrally formed therein and opening into the interior chamber 110 of the valve. In this chamber a plunger or reciprocating valve 111 is mounted and has a valve stem 112 connected to an inner head 113 thereof and to a valve 114 coöperating with a valve seat 115 formed in the opposite end of the casing 116. Between the plunger 111 and the rear end wall 117 of the chamber 110 a spring 118 is mounted and bears at opposite extremities on the plunger and said wall to normally force the plunger forwardly and seat the valve 114. Communicating with the chamber 110 is a lateral passage 119 having two ports 120 and 121 to set up communication between the front and rear portions of the said chamber when the plunger 111 is forced rearwardly against the resistance of the spring 118 by the compressed air brought to bear on the forward end of the plunger from the pipe 10, the plunger first receding or moving rearwardly until the port 120 is uncovered and remaining in this position under the pressure of the air and at the same time permitting the air to pass through the passage 119 by way of the port 121 in rear of the plunger 111 into the rear portion of the chamber 110. The rearward movement of the plunger 111 unseats the valve 114 and the compressed air passing into the chamber 110 in rear of the plunger 111 passes the open valve 114 and enters a rear chamber 122 and, through the medium of a pipe 123, thence enters the tank or reservoir 11 where it is stored. The pipe 13 is connected to the pipe 123 by a T-coupling 124. It will be seen that it will be impossible for the stored air under pressure in the tank or reservoir 11 to pass forwardly through the check-valve 12 in view of the fact that the valve 114 would immediately close should any air pressure be brought to bear upon the rear side thereof, and, moreover, when the pressure on the forward extremity of the plunger 111 is less than the force of the spring 118 exerted on said plunger, the latter will move forwardly and close the valve and air under pressure may by this means be retained without liability of leakage in the tank or reservoir 11.

Means are provided to move the engine off "dead center" when the engine has stopped in such position and it is desired to operate the starting device. In the present instance this is shown as comprising a shaft 127 having a support or bearing 128 on the foot-board 130 and extending through an opening 129 in the foot-board and through an opening in the casing of the fly-wheel of the engine, a bevel wheel at the lower end of said shaft to engage the face of the fly-wheel 125 adjacent the periphery of the latter, and a suitable operating device, such as a crank handle 134, at the upper end of said shaft. The shaft 127 is slidable lengthwise in the bearing or support 128 and a spring 133 mounted on said shaft between the bearing or support 128 and a collar 132 on the shaft tends to move the shaft upwardly and thus normally holds the bevel wheel 131 out of engagement with the fly wheel. In operating this mechanism, the shaft is pressed downwardly so as to cause the bevel wheel 131 to engage with the fly-wheel, and the said shaft is then turned sufficiently to throw the crank shaft 102 off dead center and thereby facilitate the starting of the engine or motor, as will be readily understood. As soon as the shaft 102 is turned over sufficiently, the shaft 127 is relieved of downward pressure, the spring 133 moves it upwardly, and the bevel wheel 131 is thus automatically disengaged from the fly-wheel.

From the foregoing explanation the operation of the several parts will be readily understood and the advantage of the improved mechanism is that it may be readily applied to standardized makes of engines or motors used in automobiles or for other purposes without materially modifying the general structure and organization of said engines and motors. It will be seen that the only changes necessary in the present illustration of the invention as applied to what is known as a Ford type of motor is the boring of the ports 85 through the cylinder head, and the provision of the plug sleeves 97, together with such bearings and bracket supports as may be readily secured to the one side of the engine or motor without interfering with the general organization of the parts of the engine or motor. Another advantage of the improved apparatus is that the apparatus is always ready for instant operation, as a charge of air under compression will be car-

ried at all times in the tank or reservoir 11, and by operating the starting valve 14 communication between the air under compression from the tank or reservoir 11 and the charging tank or cylinder 26 may be quickly set up and the automatic controlling valve 44 supplied with a charge and, in turn, control the supply to the several cylinders in sequence after the latter have been relieved of stored pressure or air under compression. After the starting apparatus has been run a sufficient length of time to heat up the engine or motor, the starting valve 14 will be released and the flow of compressed air charged with hydrocarbon vapor will cease relatively to the valve 44, and the engine or motor may then continue to operate normally without interference by the improved apparatus. The improved starting apparatus may continue to run or operate with the engine or motor, but if desired the sprocket wheel 103, as shown by Fig. 1, may have a clutch member 135 and said sprocket wheel mounted to run loose on the crank shaft 102, the latter shaft having a shiftable clutch member 136 thereon to engage the clutch member 135. The clutch member 136 may be operated by a rod or lever 137 extending rearwardly and adapted to be reached by the operator within the body of the automobile or any other device with which the improved starting apparatus may be used. Through the medium of the clutch mechanism and rod 137 the starting mechanism may be disengaged from the shaft 102 and remain idle during the normal operation of the motor or engine.

The improved starting apparatus is adapted for use with any type of internal combustion engine having any number of cylinders and is not limited to its use with an automobile motor or engine, but is equally well serviceable in connection with the motor of an aeroplane, boat, tractor, truck or stationary engine of the internal combustion type. Moreover, in its use in connection with an automobile engine or motor the starting apparatus is not limited to any particular make of automobile as hereinbefore noted, and the improved attachments may also be applied in connection with internal combustion engines of any power. Instead of connecting the apparatus through the medium of the sprocket wheel 103 and the remaining mechanism directly associated with the latter in relation to the crank shaft, said mechanism may be used with the usual form of cam shaft, and while the apparatus is particularly advantageous in starting a motor or engine which is cold it may be used in like manner for starting a warm engine as the temperature of the motor or engine has no effect on the improved apparatus. It is also proposed to use gasolene or other hydrocarbon or a substitute from a tank that may be practically conveyed by the improved starting apparatus to the cylinder or cylinders of the motor or engine and capable of being exploded by a spark. It will be noted that the improved starting apparatus involves a two-way pipe system to charge the cylinder or cylinders and to relieve the latter of compression resistance, and also that there is a pipe to and from each cylinder; or in other words each cylinder is independent as to its supply conduit and relief conduit.

What is claimed as new is:

1. The combination with a multiple-cylinder internal combustion engine, of means for starting the same comprising a source of fuel under pressure, a rotary valve mechanism for successively charging the said cylinders and connected to the said fuel source, said valve mechanism also operating to relieve the cylinders of compression resistance prior to the admission thereto of the fuel under pressure, and manually controlled valve mechanism interposed between the rotary valve mechanism and the cylinders and comprising a rotary valve for each cylinder having distinct passages therethrough with individual pipe connections to different parts of each cylinder for respectively regulating the admission of the fuel under pressure to each cylinder and the relief of the said cylinder of pressure resistance.

2. The combination with a multiple-cylinder internal combustion engine, of means for starting the same comprising a source of fuel under pressure, rotary valve mechanism automatically operating to successively charge the cylinders and connected to said fuel source, means between the said rotary valve mechanism and cylinders and connected to the latter for controlling communication between the valve mechanism and cylinders, manually controlled valve mechanism interposed between each cylinder and the rotary valve and having distinct passages therethrough connected to different portions of each cylinder and the rotary valve, and a manually operative starting valve mechanism for releasing the fuel relatively to the said rotary valve mechanism.

3. The combination with a multiple-cylinder internal combustion engine, of means for starting the same comprising an air compressing pump and a storage tank connected thereto, a fuel supply source connected to the storage tank to provide fuel charging means in conjunction with the air under pressure, means for controlling the use of air under compression alone or fuel alone, rotary valve mechanism automatically operating to successively charge the cylinders and connected to the said fuel source and cylinders, and manually controlled mechanism interposed between each cylinder and the rotary valve and having distinct pas-

sages therethrough connected to different portions of each cylinder and rotary valve.

4. The combination with a multiple-cylinder internal combustion engine, of means for starting the same comprising an air compressor and storage tank connected thereto, hydrocarbon charging means for the air under pressure from the tank, an automatically operating rotary valve mechanism connected to the cylinders and the hydrocarbon charging means and operative to successively charge the cylinders and relieve the same of compression resistance prior to the admission of the fuel to the cylinders, manually controlled valve mechanism interposed between each cylinder and the rotary valve and having distinct passages therethrough connected to different portions of each cylinder and the rotary valve, and a manually operative starting valve mechanism for releasing the fuel relatively to said rotary valve mechanism.

5. The combination with a multiple-cylinder internal combustion engine, of starting means therefor comprising a source of fuel under pressure, a rotary valve mechanism connected to the cylinders and the source of fuel, and a valve interposed between each cylinder and the rotary valve mechanism and having distinct passages therethrough to connect with different portions of the cylinder, all of the cylinder valves being simultaneously operative to open up the cylinders to relieve them of compression resistance or to permit charges of the fuel to be successively applied thereto.

6. The combination with a multiple-cylinder internal combustion engine, of means for starting the same comprising a source of fuel under pressure, a rotary valve connected to said source of fuel and operated from the crank shaft of the engine, said rotary valve also being connected to the cylinders, a valve between the rotary valve and each of the cylinders and having distinct passages therethrough connected to different portions of each cylinder for setting up communication between different parts of the rotary valve and each cylinder, and a manually operative starting valve mechanism for releasing the fuel relatively to the said rotary valve mechanism.

7. The combination with a multiple-cylinder internal combustion engine of a rotary valve mechanism for successively charging the cylinders, means for starting the engine comprising a source of air under pressure, a charging tank connected to said valve, a valve mechanism having independent connections respectively attached to the source of air under pressure and to the top portion of the charging tank, and a valve interposed between the said valve mechanism and the top of the charging tank to cut off the charging tank and source of air under pressure from the rotary valve mechanism independent of the condition of the said latter mechanism.

8. The combination with a multiple-cylinder internal combustion engine, of means for starting the same comprising a source of air under pressure, a fuel charging tank, valve means connected to the said source of air under pressure and charging tank, a rotary valve mechanism for successively charging said cylinders and connected to the charging tank, said rotary valve mechanism also operating to relieve the cylinder of compression resistance prior to the admission thereto of the fuel under pressure, and manually controlled valve mechanism interposed between the rotary valve mechanism and the cylinders and comprising a rotary valve for each cylinder having distinct passages therethrough with individual pipe connections to different parts of each cylinder for respectively regulating the admission of the fuel under pressure to each cylinder and the relief of said cylinder of pressure resistance.

9. The combination with a multiple-cylinder internal combustion engine, of rotary valve mechanism for successively charging the cylinders, means for starting the engine comprising air compression and storage means, hydrocarbon charging means and said rotary valve connected to the air storage means, starting valve mechanism for setting up communication between the storage means and the hydrocarbon charging means, and valve mechanism interposed between and connected to the hydrocarbon charging means and the cylinders and consisting of a valve for each cylinder having distinct passages therethrough for connection to different parts of the respective cylinder and to different parts of the rotary valve, all of these cylinder valves being manually operative to control communication between the rotary valve and the cylinders.

10. The combination with a multiple-cylinder internal combustion engine, of means for starting the same comprising an air compressor and storage tank connected thereto, a check valve interposed between the storage tank and compressor, hydrocarbon charging means having a tubular stem extending downwardly thereinto and provided with a horizontal spreader at the lower end thereof below the level of the hydrocarbon, a manually operative starting valve mechanism connected to the storage tank in rear of the check valve and also to the upper end of the tubular stem of the hydrocarbon charging means, an automatically operating rotary valve connected to the hydrocarbon charging means and to the several cylinders, a single pipe constituting the connection between the hydrocarbon charging means and said valve, and manually operative valves individually mounted for service relatively

to each cylinder and connected to the rotary valve, each manually operated valve having distinct passages therethrough connected to different portions of each cylinder and the rotary valve, the manually operative valves being simultaneously actuated to control communication between said rotary valve and the cylinders.

11. The combination with a multiple-cylinder internal combustion engine, of means for starting the same comprising a source of fuel under pressure, a rotary valve connected to the source of fuel and the cylinders and automatically operating to control communication between the source of fuel and the cylinders, and a rotary valve between each cylinder and the said automatically operating rotary valve and having distinct passages therethrough connected to different parts of each cylinder and the automatically operating rotary valve, the rotary valves of the cylinders being connected for simultaneous operation and manual control to regulate the communication of the automatically operating rotary valve with the cylinders and the supply of charges of fuel to the latter.

12. The combination with a multiple-cylinder internal combustion engine, of means for starting the same comprising a source of fuel under pressure, automatically operating rotary valve means connected to the source of fuel and having two sets of ports and connecting pipes and conduit means between the same and each cylinder for respectively relieving the cylinders of compression resistance and supplying the cylinders with charges of fuel in succession, and a valve for each cylinder having distinct passages therethrough connected to different parts of each cylinder and located in the connecting means and conduits leading to the cylinders from the said ports of the rotary valve to control communication between the latter ports and valve and the cylinders.

13. The combination with a multiple-cylinder internal combustion engine, of means for starting the same comprising a rotary valve mechanism common to all and having connections to different portions of the cylinders, an individual rotary valve for each cylinder interposed in the connections and all simultaneously manually operative to open and close communication relatively to the cylinders, the individual valve for each cylinder having distinct passages therethrough with individual pipe connections to different parts of each cylinder and rotary valve, a source of fuel supply under pressure connected to said rotary valve mechanism, and manually operative means for establishing communication between the source of fuel supply and said rotary valve mechanism.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

CEPHAS V. FITE.

Witnesses:
G. M. HUBBARD,
H. L. TAYLOR.