J. V. RICE, Jr.

STARTING AND REVERSING MECHANISM FOR GAS ENGINES.

APPLICATION FILED OCT. 28, 1909.

967,559. Patented Aug. 16, 1910.

4 SHEETS—SHEET 1.

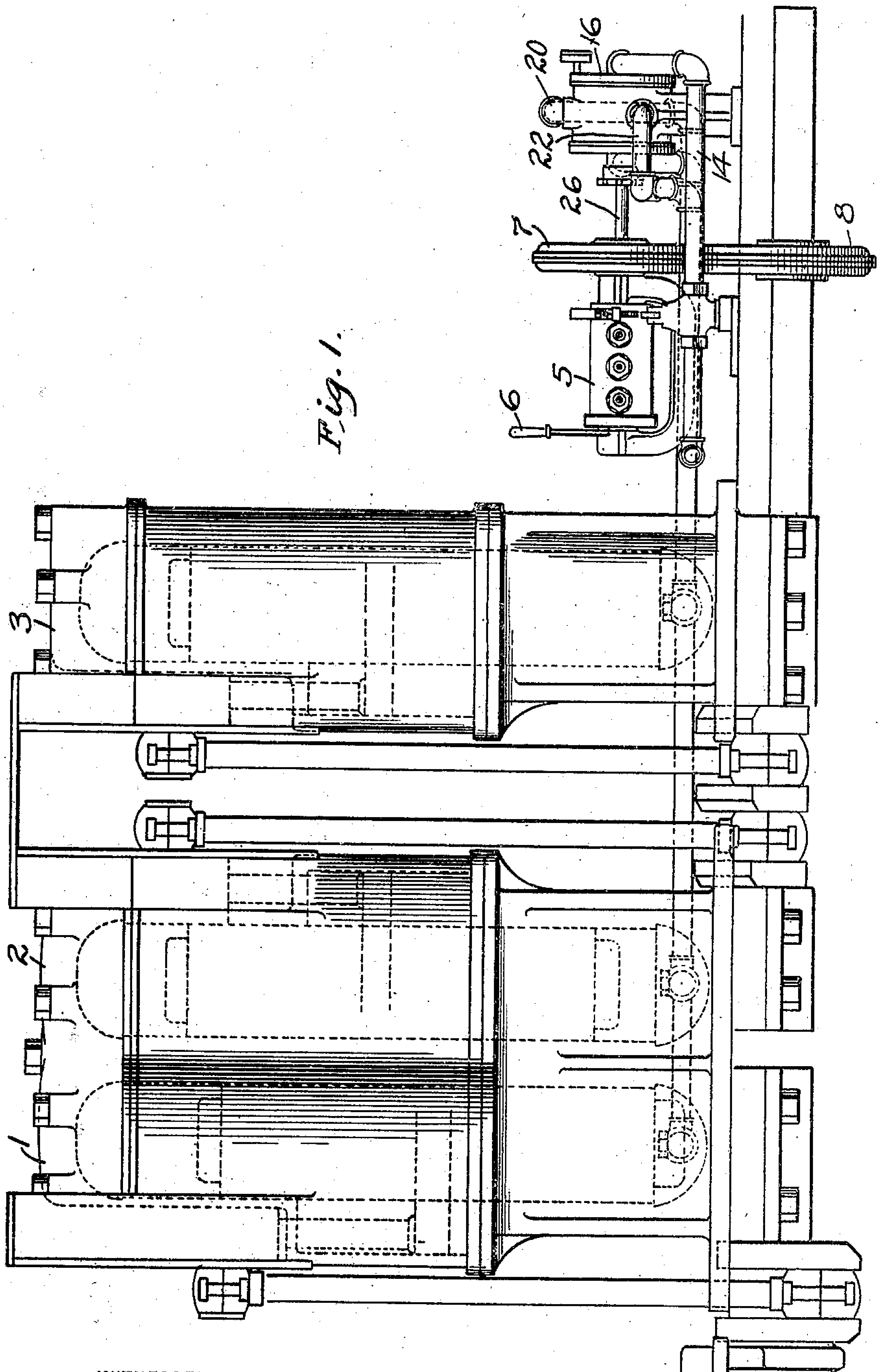

Fig. 1.

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4 SHEETS—SHEET 2.

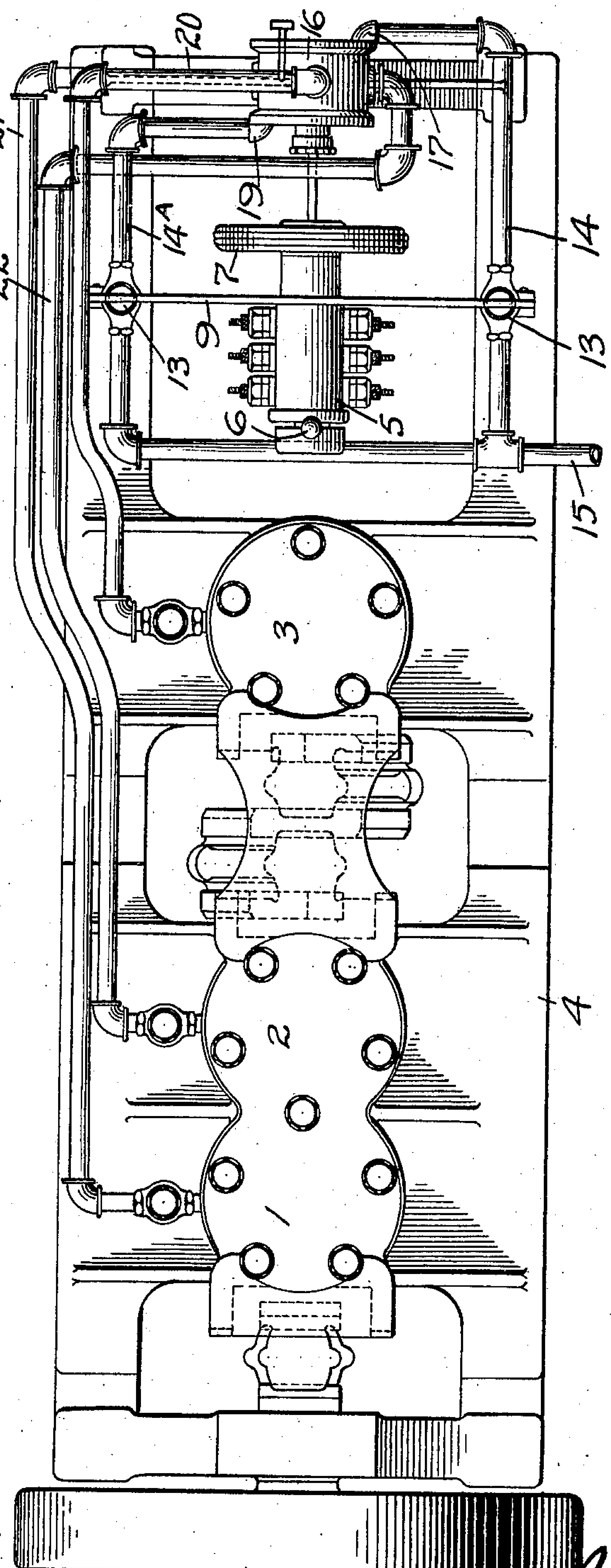

Fig. 2.

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4 SHEETS—SHEET 3.

Fig. 4.

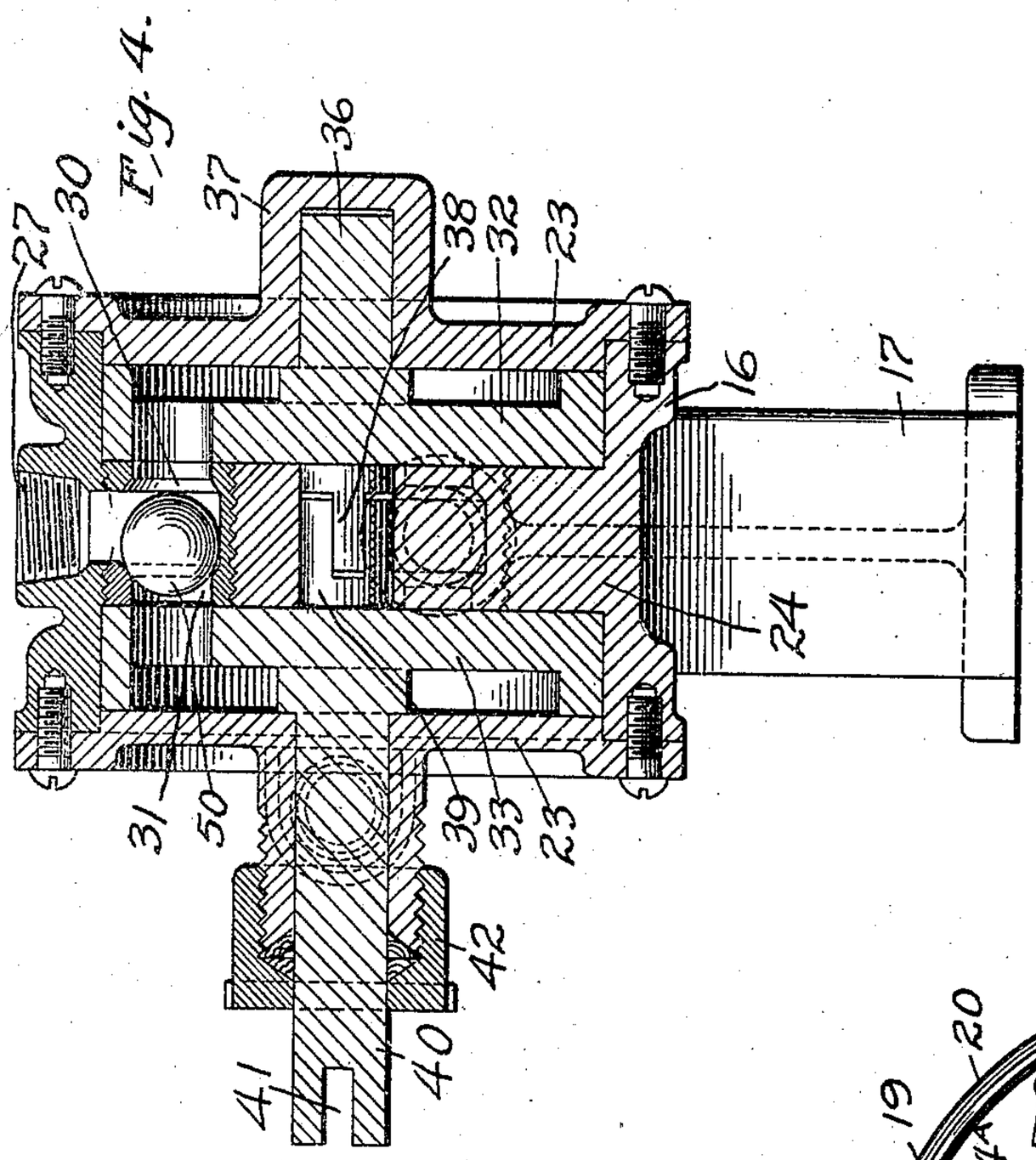


Fig. 5.

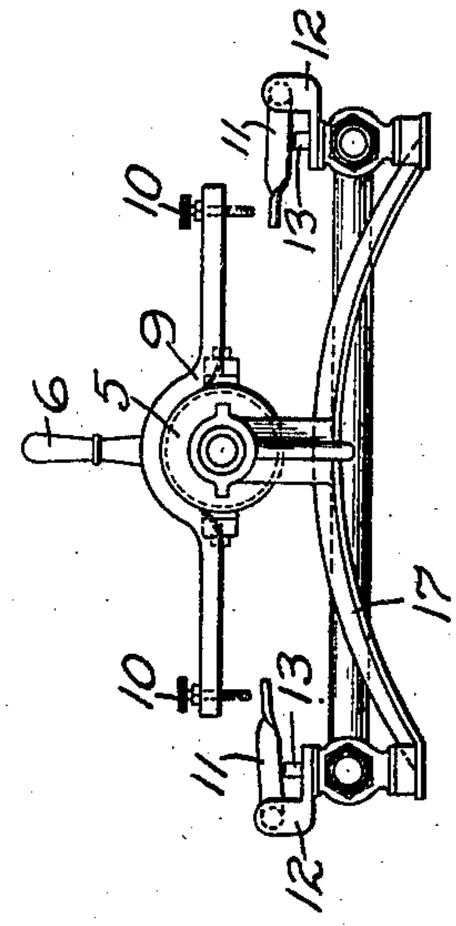
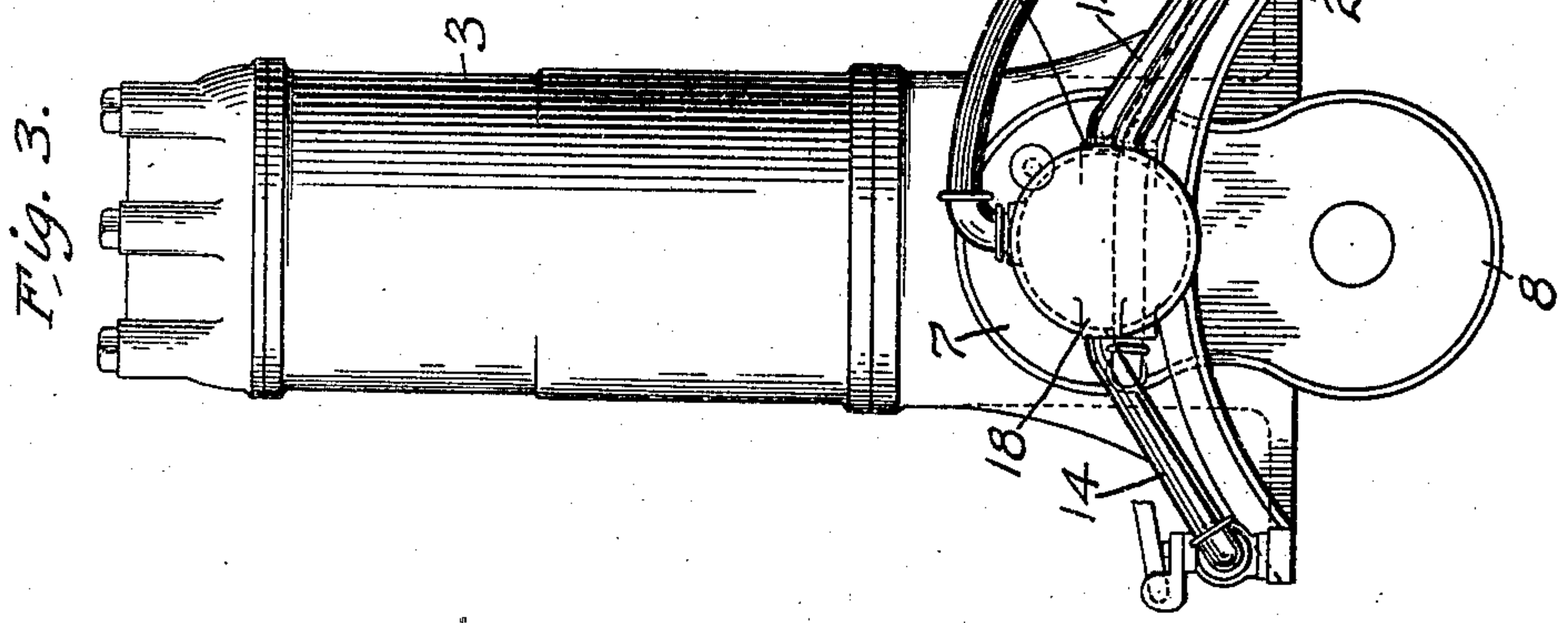


Fig. 3.



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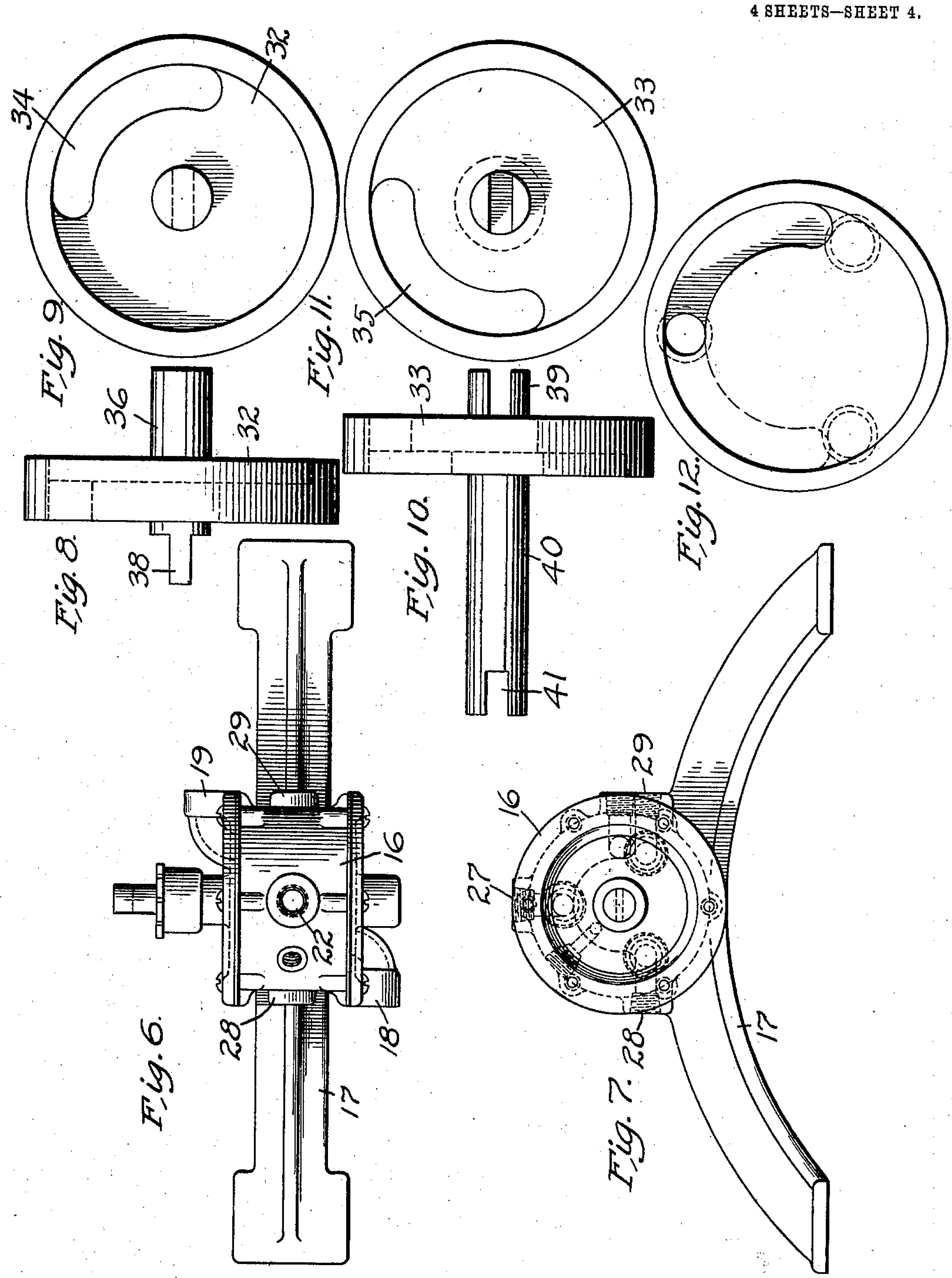

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STARTING AND REVERSING MECHANISM FOR GAS-ENGINES.

967,559. Specification of Letters Patent. Patented Aug. 16, 1910.

Application filed October 28, 1909. Serial No. 525,217.

To all whom it may concern:

Be it known that I, JOHN V. RICE, Jr., a citizen of the United States of America, residing at Bordentown, in the county of Burlington and State of New Jersey, have invented certain new and useful Improvements in Starting and Reversing Mechanism for Gas-Engines, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to mechanism for starting and also for reversing gasolene or other explosive engines of whatever type, and relates more particularly to the means for employing compressed air, which is introduced into the engine cylinder and caused to coöperate with the piston and other moving parts, and thus actuate the engine in the proper way.

The object is to provide a simple, efficient, reliable and economical starting and reversing mechanism, and one which will not be likely to get out of order.

In common with many other gas engines an air pump and an air storage reservoir are employed in order to store up the necessary energy to be used in starting and reversing the mechanism.

The invention, therefore, may be said briefly to consist essentially in the construction, arrangement and combination of parts, and in numerous details and peculiarities thereof, substantially as will be hereinafter described and claimed.

In the accompanying drawing illustrating my invention, Figure 1 is a side elevation of my improved gas engine and the mechanism for starting and reversing it. Fig. 2 is a top plan view of the same. Fig. 3 is a right hand end elevation with certain parts removed. Fig. 4 is an enlarged sectional detail of the air-distributer casing and its interior valve mechanism for handling the air and subdividing it for diffusion to the different cylinders where required. Fig. 5 is an enlarged detail elevation of the timing lever and an arrangement of valves actuated thereby for controlling the passage of air from the reservoir to the valve mechanism. Fig. 6 is a top plan view on an enlarged scale of the air distributing casing. Fig. 7 is a side elevation of the same. Fig. 8 is an edge elevational view of one of the slotted valve disks or plates and its shaft. Fig. 9 is a side view of the same. Fig. 10 is an edge elevational view of the other or companion valve disk or plate. Fig. 11 is a side view of the same. Fig. 12 is a side view of the two plates or valves showing how the curved slots therein overlap each other.

Similar characters of reference designate corresponding parts throughout all the different figures of the drawings.

In Figs. 1 and 2, I have illustrated a specimen or example of gas or explosive engine for explanatory purposes merely, in order to show how my improved starting and operating mechanism, which utilizes compressed air, can be successfully and operatively applied for practical use. I have no thought, therefore, of being confined to the special engine mechanism herein offered, but reserve the liberty of varying such mechanism in so far as it may be desired, for it will be discovered that my starting and reversing appliances are equally applicable to a great number of different forms of engine. In the illustrated type, however, the engine consists of three cylinders 1, 2 and 3 suitably carried by a main framework 4. This engine is shown, described and claimed in my Letters Patent for improvements in internal combustion engines, No. 937,862, dated October 26, 1909, to which reference is here made for a further explanation of its operation.

5 designates a timer which is ordinarily employed in connection with the sparking mechanism of gas engines. Mounted alongside of this timer is the timing lever 6. The shaft 26 of the timer is parallel to and vertically above the crank shaft of the engine and is gear driven at the same speed as the crank shaft. It is unnecessary to describe these parts in detail further than to say that the gears just referred to are contained in casing 7 and 8 shown in edge view in Fig. 1 and in side view in Fig. 3. The timer and timing lever are preferably arranged as shown at that end of the engine opposite the clutch end. The timing lever 6, moreover, is shown in Fig. 1 and in Fig. 5, where its relation to the timer 5 is indicated, and it is seen that this handle serves to oscillate the horizontal arm 9, whose middle curved part is supported on the timer 5, and the ends of which arm 9 carry adjustable contact screws 10 which are adapted to move the pivoted

levers 11 by striking against the free ends of said levers as seen in Fig. 5. Levers 11 are pivoted to the brackets 12 on the main frame and lie directly over the vertical valve stems 13 belonging to valves in the air pipes 14 and 14ª. Accordingly the movement of the timing lever 6 in one direction or the other will vibrate the arm 9 and cause one or the other of the contact screws 10 to strike one or the other of the levers 11, and thus open either the valve in the pipe 14 or that in the pipe 14ª, and allow the passage of air through one or the other of these pipes.

The supply of air to the distributer from the reservoir is controlled by the two valves just mentioned, which are located in the branch pipes 14 and 14ª, said valves being preferably directly opposite the timing mechanism just referred to. When the timing lever 6 is rocked, one end of the horizontal arm 9 is, of course, elevated and the other depressed. The depressed end, by coming into contact with the upwardly projecting stem attached to the valve, presses said stem downwardly and opens the valve. It will be seen, therefore, that when the timer is rocked as far as it will go in one direction, the arm on that side will depress the corresponding valve pin, open the valve and admit air under pressure to the go-ahead or the go-astern side of the air distributer, as the case may be; while the throwing of the timing lever in the opposite direction will have the effect of opening the other valve and admitting air to the opposite side of the distributing mechanism. These valves are automatically closed by springs, so that the air is shut off as soon as the pressure of the timing arm is removed from the upwardly projecting valve stem. It is, of course, to be understood that the timer, the air distributer and the admission valves are so arranged with relation to each other that when the timer is rocked to give a retarded spark, say, for starting forward, the valve admitting air to the go-ahead side of the air distributing mechanism is caused to open and the engine is started. Since the air is admitted only to the lower ends of the cylinders, the upper ends are lifted to pick up the load. As soon as the pistons are regularly working, the timer may be rocked so as to advance the spark slightly, this being the usual procedure when the engine gets under way, and this permits the air valve to close, whereupon the lower ends of the cylinders take up their share of the work.

The air reservoir is not shown in the drawings as it is a common feature and it is unnecessary to illustrate it. Air is led from said reservoir by the pipe 15, which divides when it reaches the engine into the aforesaid pipes 14 and 14ª, and these branches run along opposite sides of the timer at equal distances from it and approach and enter the air distributing mechanism. The casing of the latter is designated 16. It is shown in the enlarged detail view of Fig. 4, and is also represented clearly and accurately in Figs. 6 and 7. This casing is supported on some suitable part of the framework, as, for instance, the rigid arch 17. One of the air supply pipes, as 14, enters the front side, or the right-hand side, of the casing 16 of the air distributer as it is shown in Figs. 2 and 3, being coupled thereto at the inlet opening 18, (see Fig. 6,) whereby a supply of air is had for moving the engine forward, while the other air supply pipe 14ª on the other side of the engine enters the casing 16 of the air distributer on the rear side, or left-hand side, thereof, that is to say, the side nearest the cylinders of the engine as the same is portrayed in Figs. 2 and 3, a coupling being effected at the inlet 19, (see Fig. 6,) and through this pipe and inlet air is delivered for the purpose of starting the engine in the reverse direction, that is to say, for reversing the engine.

From three equidistant points around the circumference of the casing 16 of the air distributer pipes are led off to the different cylinders of the engine, there being one pipe running to the lower end of each of said cylinders. These three pipes are designated 20, 21 and 22. The pipe 20 runs to the cylinder 3; the pipe 21 leads to the cylinder 1; the pipe 22 leads to the cylinder 2. Pipe 20 connects with the casing 16 on top thereof at the center; while pipe 21 enters the casing 16 on one side, and pipe 22 on the other side, their points of entry being opposite to each other.

The body of the distributer consists of a casing 16 (see Fig. 6,) with its ends closed by heads 23 secured in place by screws or other means, and its interior divided into two parts by a central wall or web 24 parallel to and equidistant from the heads 23. The compartments thus formed in the casing, between the central web 24 and the heads 23, may be termed the forward and the reverse valve chambers respectively. The central web 24 is of considerable thickness and there are three equidistant ports 27, 28 and 29 in the wall of the cylinder 16, which ports communicate with the pipes 20, 21 and 22 leading to the cylinders 1, 2 and 3, said pipes being screwed radially into the casing 16 at the ports 27, 28 and 29. These ports in turn each open into both of the aforesaid valve chambers through the branch ports 30 and 31. Said branch ports consist each of a hole or opening through the central wall 24 communicating respectively with the ports 27, 28 and 29 opening into the cylinder supply pipes.

Within the chambers or compartments in the distributer casing 16 are two valves 32 and 33, one in each chamber. Said valves

are flat disks carried by a shaft and rotating air-tight within the chambers against opposite faces of the central wall. These valves 32 and 33 are of such diameter that they cover the ports 30 and 31 in the wall. In the valve 32 is cut a slot 34 on an arc concentric with the circumference of the disk of the valve, having a length of about 120° and registering with the ports 30 in the central wall. In the other valve 33 there is a similar curved slot 35 which likewise registers with the ports 31. Valve 32 is provided with a shaft section 36 which enters a bearing 37 having a closed end and formed in one of the cylinder heads 23. The opposite side of the valve 32 is provided with a flattened part 38 which forms a part of the shafting for the two valves. Said flattened part 38 engages a recessed part 39 on the valve 33. Said valve has on its opposite side a shaft section 40 which passes through a bearing 42 with a stuffing box on one head 23 of the casing 16. The end of the shaft section 40 is grooved or slotted at 41 to enable the end of the shaft 26 of the timing mechanism to be connected thereto. Obviously the central wall 24 of the cylinder 16 is bored or has an opening through it to accommodate the parts 38 and 39 of the shaft. By this arrangement it will be evident that the rotation of the shaft will rotate the two valves 32 and 33. In each port in the central wall, there is a valve consisting of a ball 50 which is preferably a round steel ball having such a function that when it is pressed toward one of the branch ports 30 or 31, as the case may be, it will close it, leaving the other branch port open, and thus giving free passage from one valve chamber to one cylinder supply pipe. The port in one valve has a slight lead on the forward side, and the port in the other valve has a lead on the reverse side. Thus it will be noticed that the construction of the air distributer is analogous in some respects to that of a spark distributer in that it has two rotating valves corresponding with the ignition distributer, and ports corresponding with the electrical contact points. As the valve rotates the openings therein register successively therewith and permit air to pass through the ports opening to the pipes leading to the different cylinders.

The valves 32 and 33 rotate at the same rate as the crank shaft, and the operation may be said to be substantially as follows. Suppose it is desired to start the engine ahead and the lever is manipulated to open the forward motion valve. The result of opening this will be to admit air to the valve chamber on the forward motion side. Since there are three cylinders in the engine, 1, 2, and 3, each capable of imparting an impulse to the crank shaft for nearly half a revolution, it is clear that the impulses will overlap somewhat and that there will always be one piston in position to transmit motion to the crank shaft in the proper direction, no matter in what position the engine may stop. There is no possibility of the engine being caught on a dead center, because if one crank is on the center, the one preceding it has still one-sixth of its revolution to pass through, and it will be the one to receive the impulse, the one on the center, however, taking up the work before its predecessor leaves off. The rotating valve on the forward side is set so that the leading end of its slot registers with a port in communication with a cylinder whose piston is just about to commence a forward stroke. As soon as the slot opens, communication is established between the chamber now filled with air under pressure and the port, and the air rushes in and drives the steel ball against the other port or branch opening and prevents blowing through the air, then passes to the cylinder and gives the piston impulse. Air is permitted to pass to this cylinder until the stroke is nearly completed, but before the stroke is finished it will be found that the valve has already opened up the port admitting air to the next cylinder, and so on. When the reverse supply valve is opened the other rotary valve comes into action in exactly the same way, except that the slot in the valve is cut so as to admit air only to those pistons which are in position to give the crank shaft motion in the reverse direction. As there are three explosions during each revolution in the upper ends of the cylinders when the lower ends are under air pressure, it is a very quick and easy matter to start the engine. In actual practice two or three revolutions of the crank shaft are ample when starting cold.

My improved automatic system involves no extra levers for the timer control is carried on the steering wheel of the automobile or motor boat, as the case may be, in the usual way, and the engine is started, regulated and reversed by the simple movements of the ignition control lever. In reversing the engine while in motion by using air, every element of uncertainty in the operation is entirely removed and the operation of reversing is as positive as with a steam engine. Moreover, the cushioning effect of the air greatly reduces the danger of breaking the crank shaft when suddenly reversing at full speed, as in the case of an emergency.

Many changes may be made in the exact construction, combination and arrangement of the various parts without exceeding the scope of the invention, and I therefore reserve the liberty of modifying and changing the parts so far as this may be required in practice.

Having thus described my invention, what

I claim as new and desire to secure by Letters Patent, is:

1. In a starting and reversing device for internal combustion engines, the combination of an air distributer casing, valves therein for controlling the outlet of the air from the casing, and check-valves also in said casing coöperating with the aforesaid valves and so located with respect to them as to allow the air to pass through one valve without entering the other.

2. In a starting and reversing device for internal combustion engines, the combination of a casing, means for supplying air to said casing, a valve mechanism within the casing for controlling the outlet of the air, and a check-valve also in the casing, said check-valve coöperating with the aforesaid valve mechanism and so located with respect to the same as to allow the air to pass through one part of said mechanism without entering the opposite part thereof.

3. In a starting and reversing device for internal combustion engines, the combination of a casing, means for supplying air thereto, valves within the casing for controlling the passage of the air therefrom, and check-valves likewise within the casing and consisting of a free and loosely arranged ball operating in association with the aforesaid controlling valves.

4. In a starting and reversing device for internal combustion engines, an air distributer casing, means for admitting air thereto and withdrawing it therefrom, in combination with valve means in the distributer casing for controlling the outlet of air, and a loose spherical check-valve also in the distributer, coöperating with said valve means and so located with respect thereto as to allow air to pass through a part of the valve means without entering the opposite part thereof.

5. In a starting and reversing device for internal combustion engines, the combination with the cylinder or cylinders, of a casing, means for supplying air thereto, rotary disks within the casing controlling the outlets therefrom, and ball valves likewise within the casing and operating in association with the disks.

6. In a gas engine, a starting and reversing device, comprising the casing, having an air inlet and air outlets, disk valves within the casing having slots, and ball valves operating in connection with said slots and the outlets.

7. In a starting and reversing device for internal combustion engines, the combination with a casing having inlets and outlets for the air, of two chambers therein provided with ports contiguous to the air outlets, slotted valve plates within said chambers, and free spherical valves acting in association with the slotted valves and ports.

8. The combination with a distributer casing from which compressed air is supplied to the cylinders of internal combustion engines, of slotted valve plates, means for separating said valve plates from each other, said means provided with ports, and ball check-valves loosely arranged in connection with said ports.

9. In a starting and reversing device for internal combustion engines, a fluid-pressure distributer comprising essentially a casing, means therein for controlling the outlet of the fluid-pressure, and a loose check-valve in the casing whose position is controlled by the fluid pressure, which check-valve permits pressure to pass through a part of the valve means and find exit from the casing without entering that part of the valve means through which the pressure is not at the time passing.

10. In a starting and reversing device for internal combustion engines, the combination of a cylinder or cylinders, an air distributer having inlets and outlets for the pressure, disk valves therein, a shaft for driving them, ball valves operating in connection with said disk valves, and supply valves operated by connections with the timer for introducing pressure to one side or the other of the distributer.

11. In a starting and reversing device for internal combustion engines, the combination with a distributer casing having inlets and outlets for the air, of two chambers therein, a partition separating the said chambers and provided with ports contiguous to the air outlets, valves within said chambers, and check-valves operating in connection with said ports in the partition.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN V. RICE, Jr.

Witnesses:

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