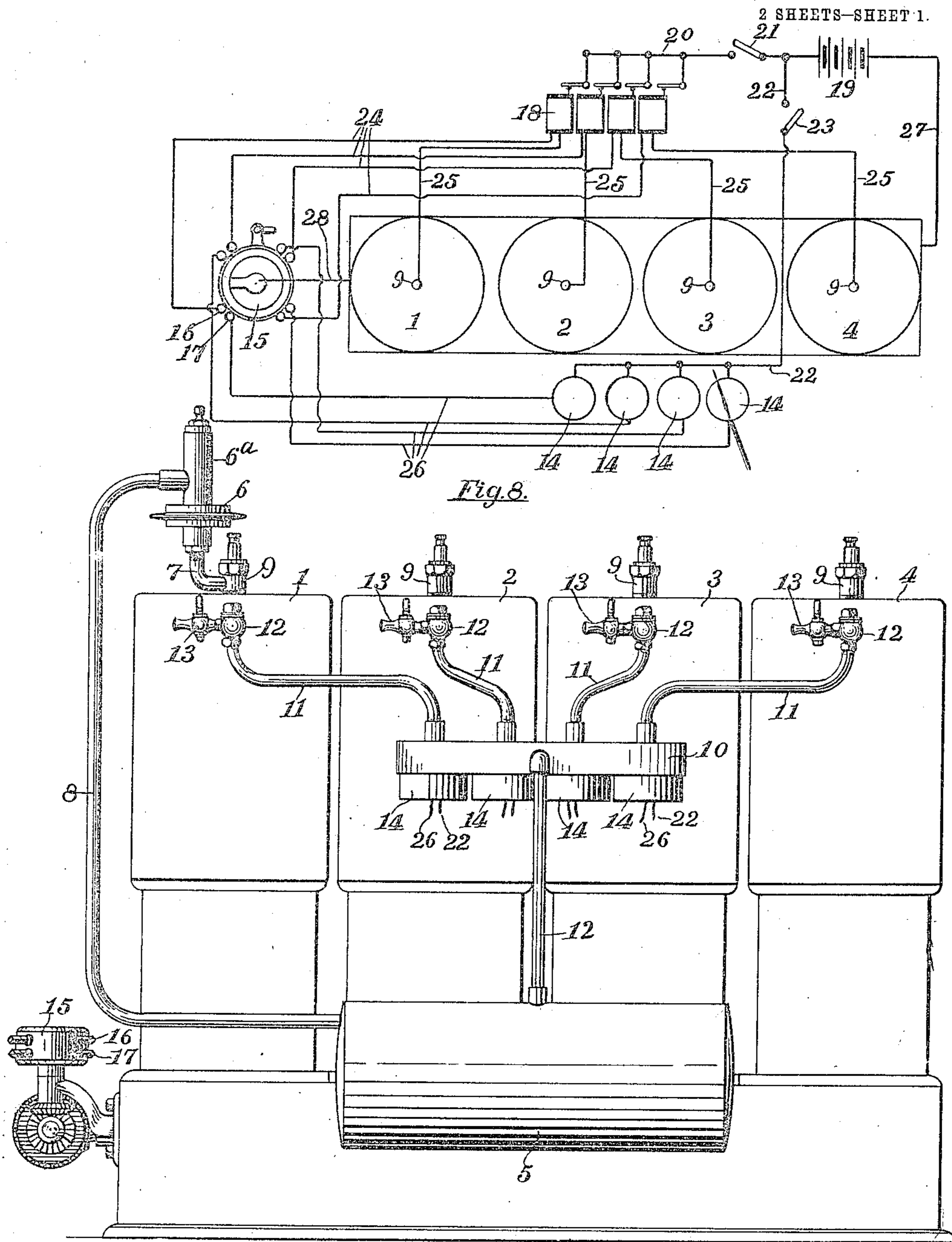


J. W. FITZGERALD.  
 STARTER FOR INTERNAL COMBUSTION ENGINES.  
 APPLICATION FILED JULY 8, 1907.

990,351.

Patented Apr. 25, 1911.

2 SHEETS—SHEET 1.



Witnesses  
 Vernon J. Lilly.  
 Georgiana Chace

Fig. 1.

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 John Watson Fitz Gerald  
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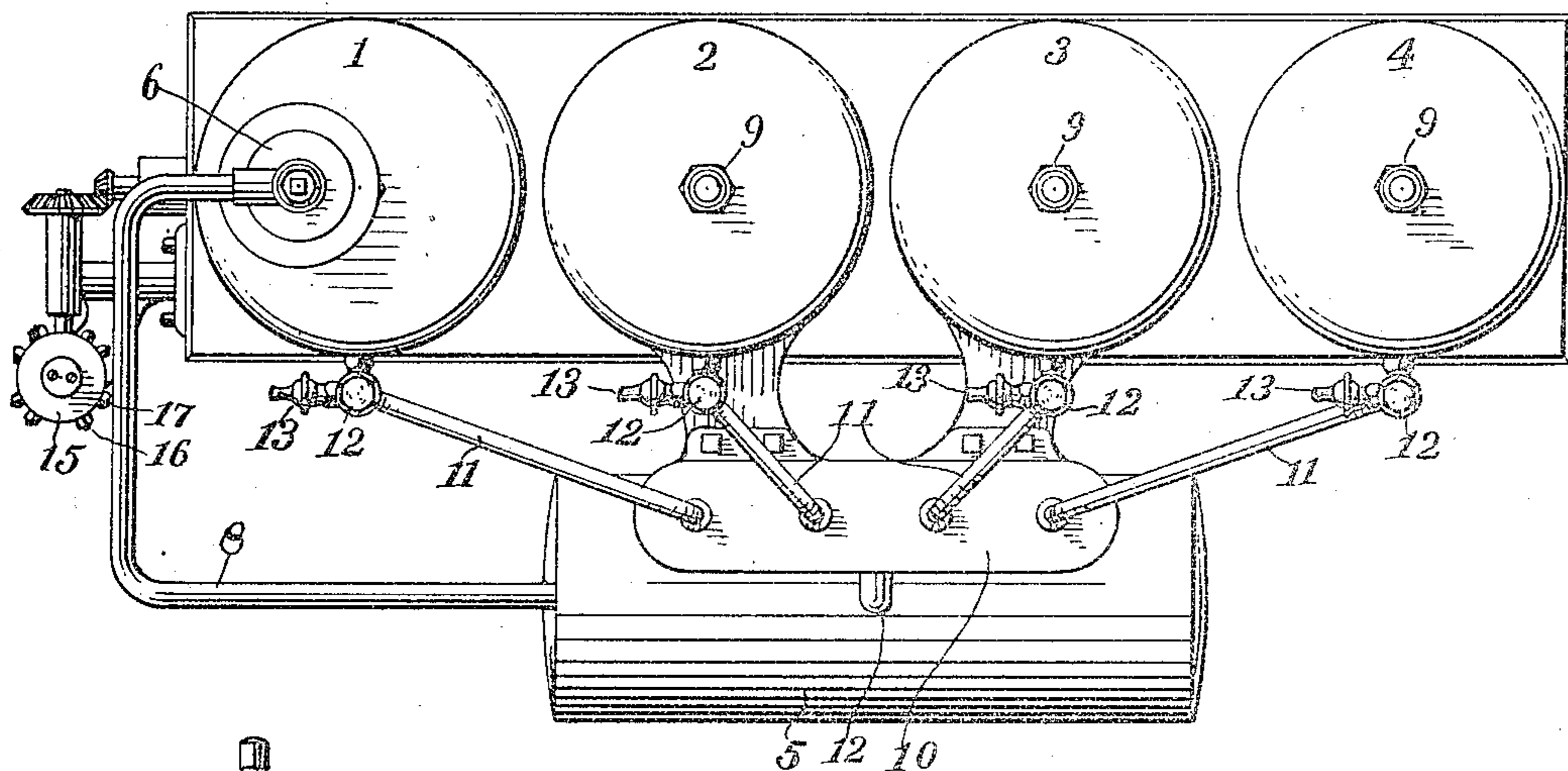


Fig. 2.

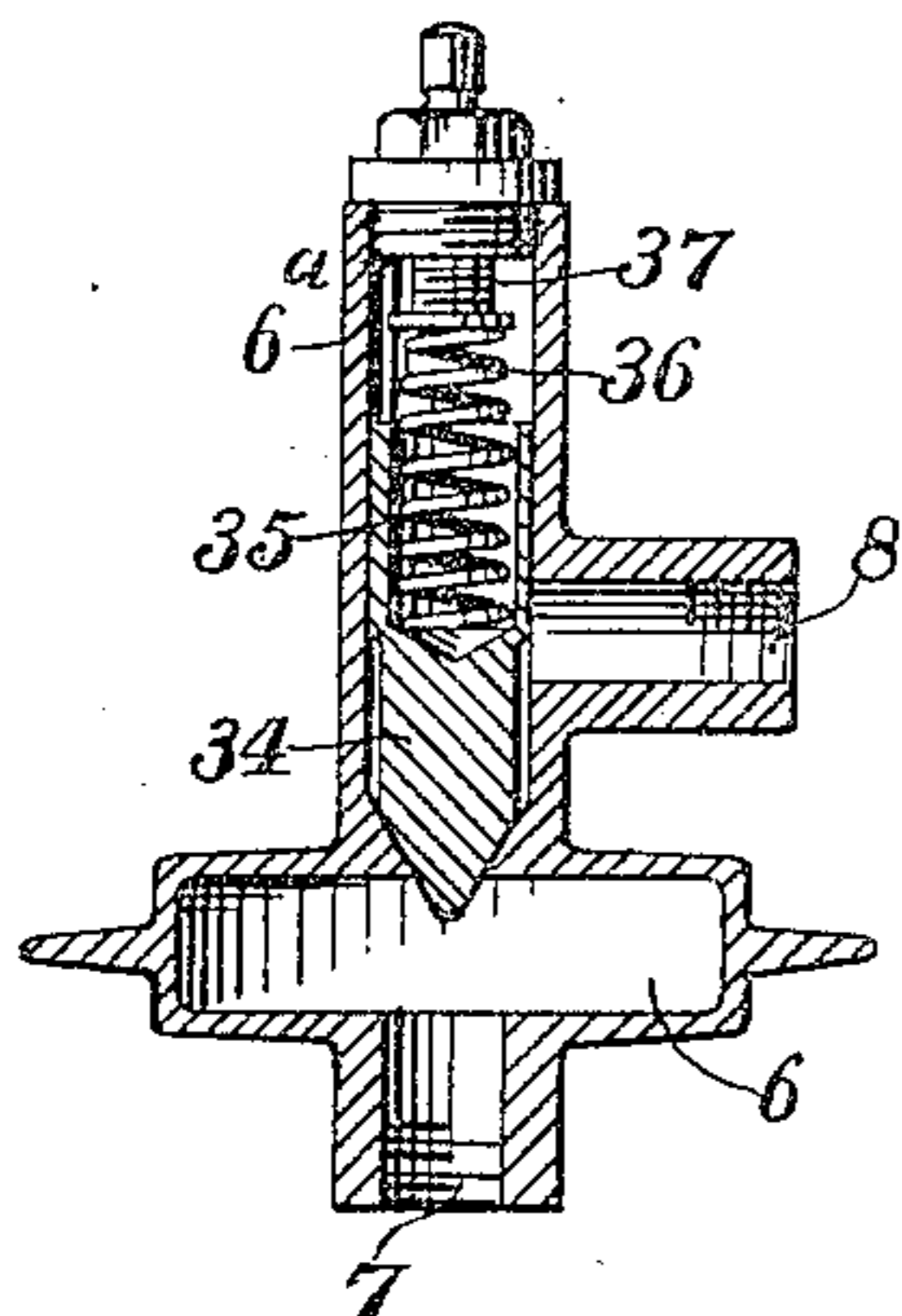


Fig. 3.

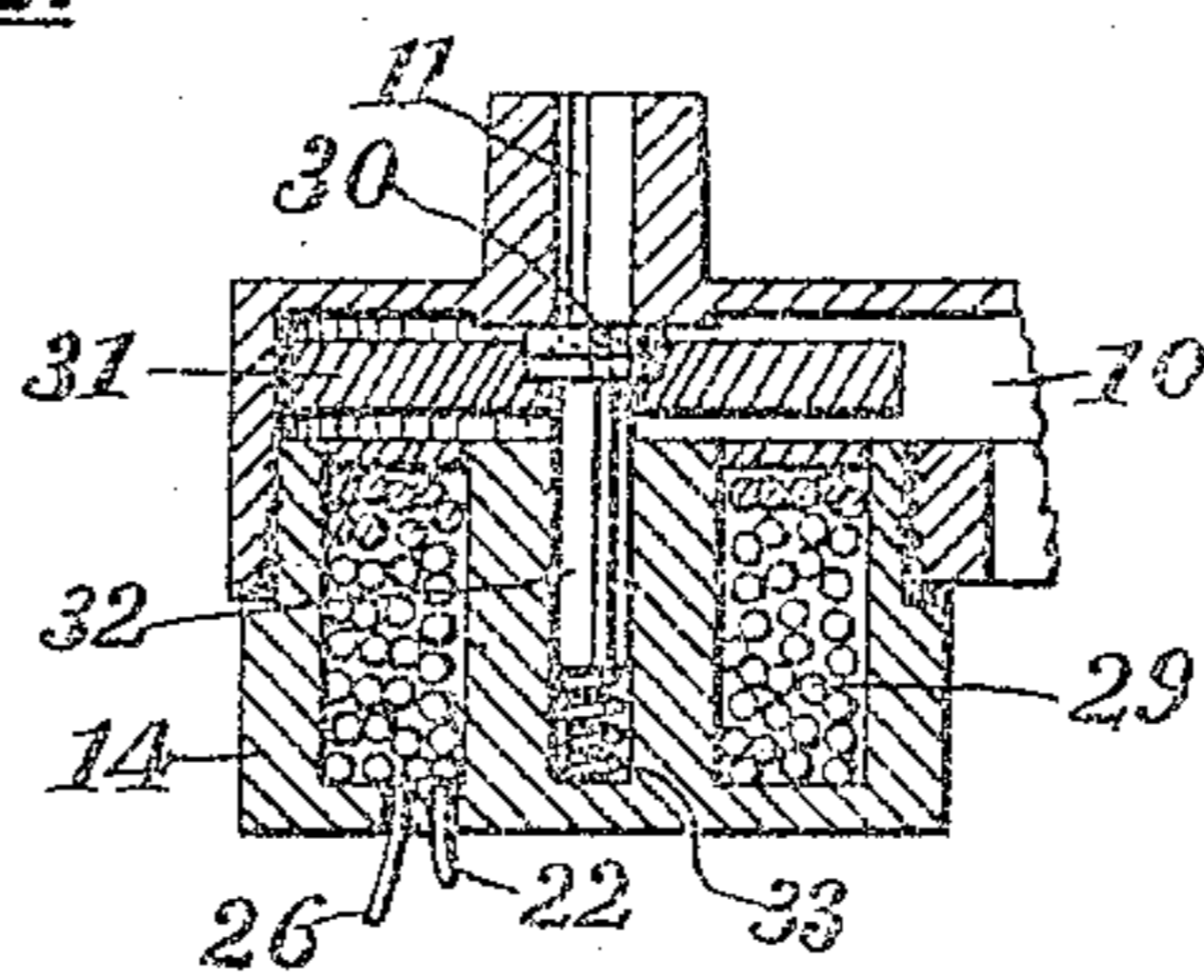


Fig. 4.

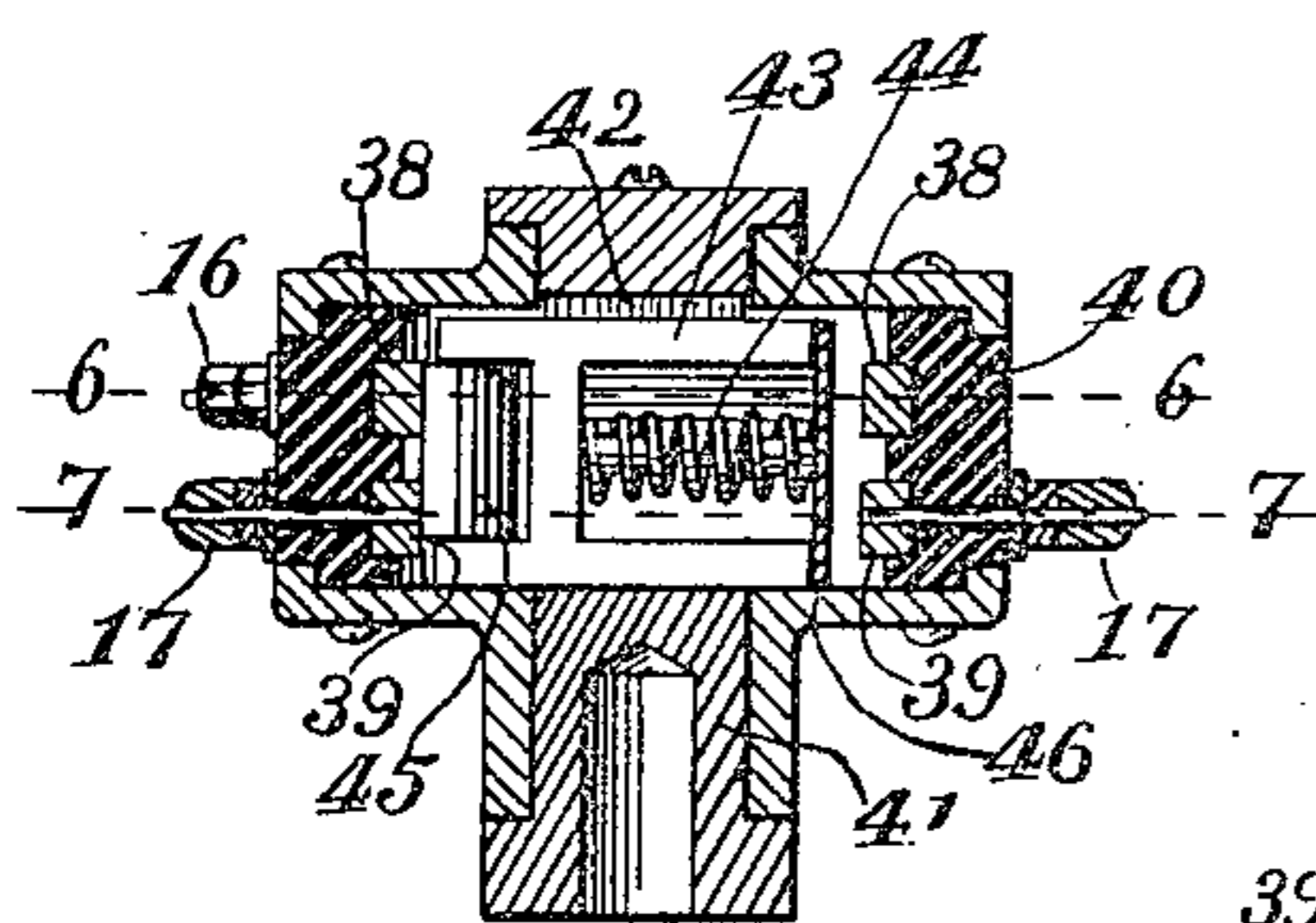


Fig. 5.

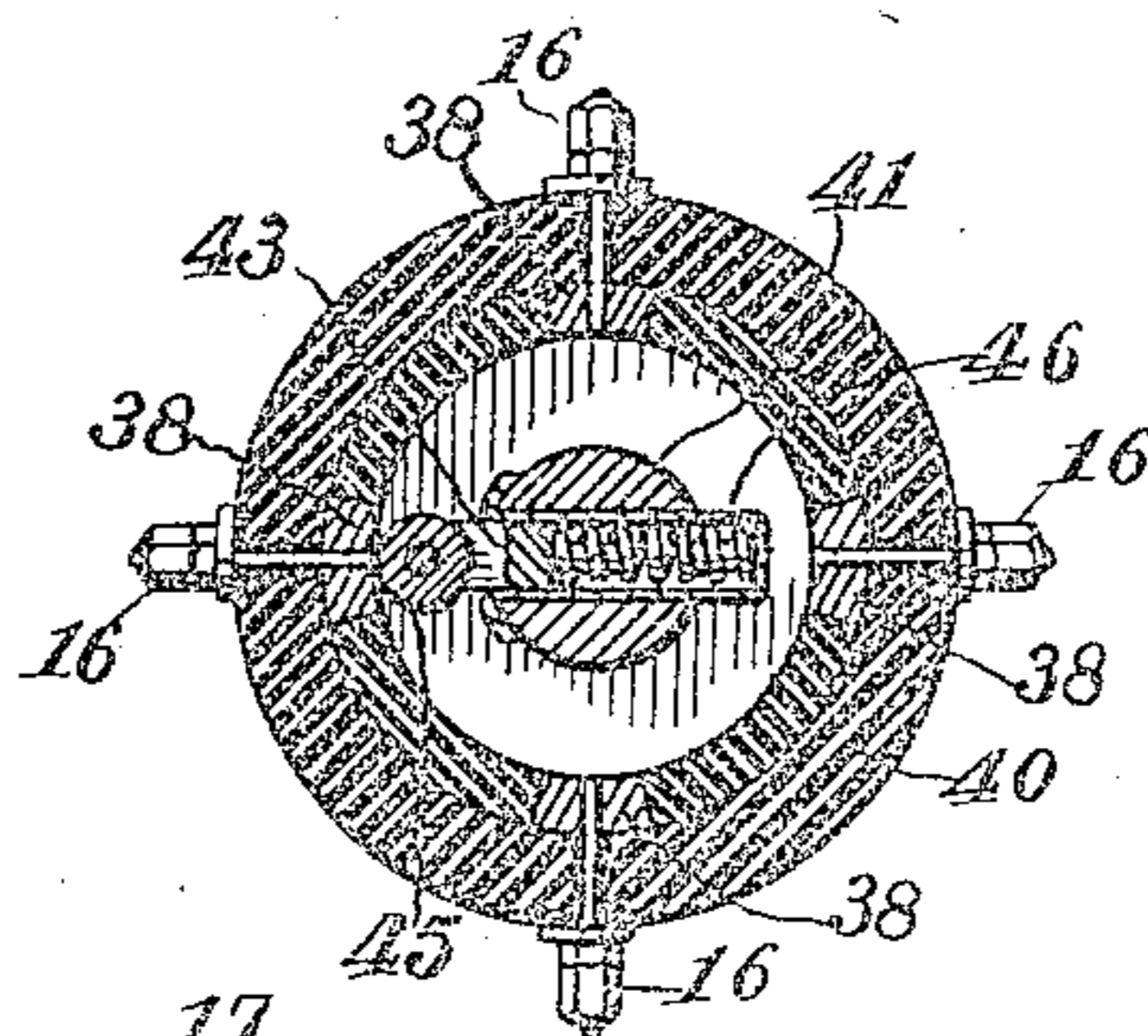


Fig. 6.

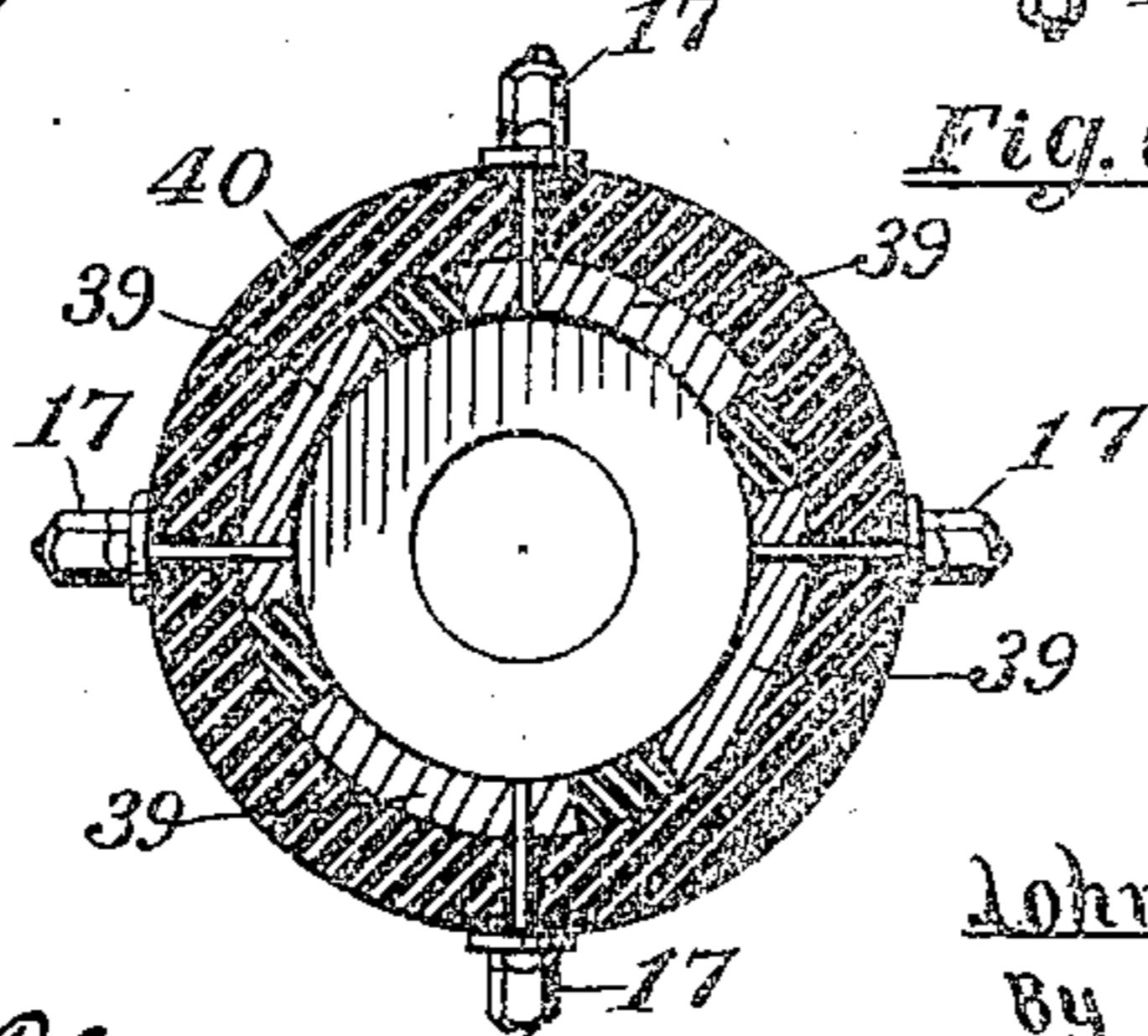


Fig. 7.

Witnesses  
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# UNITED STATES PATENT OFFICE.

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## STARTER FOR INTERNAL-COMBUSTION ENGINES.

990,351.

Specification of Letters Patent.

Patented Apr. 25, 1911.

Application filed July 8, 1907. Serial No. 382,812.

*To all whom it may concern:*

Be it known that I, JOHN WATSON FITZGERALD, a citizen of the United States of America, residing at Grand Rapids, in the  
5 county of Kent and State of Michigan, have invented certain new and useful Improvements in Starters for Internal-Combustion Engines; and I do hereby declare the following to be a full, clear, and exact description  
10 of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in starters for internal combustion engines, and  
15 the object is to provide a device that is substantially automatic in its operation, simple in construction, and reliable in action; and to provide the same with various new and useful features, hereinafter more fully described and particularly pointed out in the  
20 claims.

My device consists essentially of means for admitting a fluid under pressure to the  
25 proper cylinder, and in succession to each cylinder, of an internal combustion engine, said means comprising electrically operated valves, electric ignition circuits and a timer to close said circuits and electric circuits to operate said valves, said circuits also closed  
30 by the timer, and means for manually closing the valve operating circuits during the starting operation and opening the same while the engine is running, and in various features of combination and arrangement, as  
35 will more fully appear by reference to the accompanying drawings, in which:

Figure 1. is an elevation of a device embodying my invention as it appears when applied to a four cylinder internal combustion  
40 engine; Fig. 2. a plan view of the same; Fig. 3. an enlarged detail of the means for charging the reservoir with compressed fluid; Fig. 4. an enlarged detail of one of the valves and its operating magnet; Fig. 5. a detail of the  
45 rotary circuit closer shown in vertical section; Fig. 6. a horizontal section through the same on the line 6—6; Fig. 7. the same on the line 7—7; and Fig. 8. a diagram illustrating the electric circuits of the device, together with the spark circuits of the engine.  
50

1, 2, 3, and 4 represent the respective cylinders of a four cylinder internal combustion engine; 5 represents any convenient reservoir adapted to receive and retain a fluid

under considerable pressure; 6 an auxiliary  
51 combustion chamber for charging said reservoir consisting of a strong metallic chamber of small dimensions compared to the cylinder of the engine and communicating with  
the same through any convenient restricted  
60 passage 7 preferably a pipe having a restricted opening and inserted in the spark plug 9 for convenience in attaching it to engines as now constructed. However, this  
pipe 7 may be otherwise inserted and arranged to communicate with the combustion  
65 chamber of the engine in any convenient way. In the top of this chamber 6 is an opening communicating with an upward extension 6<sup>a</sup> forming a cylindrical valve case, 70  
and closed by a valve 34, the upper portion of which valve fits within this extension and operates as a piston longitudinally movable therein to prevent passage of the hot gases, and to thus protect a spring 36 engaging the  
75 valve 34 to yieldingly seat the same.

37 is a screw engaging the upper end of the spring 36 to adjust the tension of the spring, and extending through a plug which closes the upper end of the extension 6<sup>a</sup>. A  
80 pipe 8 extends from opposite this valve to the reservoir 5, and a pipe 12 extends upward from said reservoir to a chest or chamber 10, from the upper side of which extend  
85 pipes 11 to the respective combustion chambers of the cylinders of the engine, preferably inserted in openings which are usually provided for the pet cocks 13. These pipes are each provided with a check valve 12 to prevent pressure in the combustion chambers  
90 of the cylinders from passing into the pipes 11. In the chest 10 and closing each of the pipes 11 is a valve 30 having a downwardly extended stem 32 supported upon a spring 33 to maintain the valve in closed position. 95  
Surrounding the valve stem is a cylindrical body 14 constituting an electro-magnet, and having an annular chamber in which is located a coil 29 to render the same magnetic, each coil being a part of an electric circuit  
100 hereinafter described. Attached to the valve is a disk armature 31 normally supported at a distance from the magnet 14 and adapted to compress the spring 33 and open the valve when attracted by the magnet. 105

Fig. 8, shows the preferred arrangement of the electric circuits in which are a battery 19, and spark coils 18 connected by con-

ductors 20. Conductors 24 extend from each coil to convey the battery current to the timer 15, which in this instance is shown of double construction, the upper portion being in the spark circuits and having the usual four posts 16 connected to the respective conductors 24 and insulated from each other and provided with short segmental terminals 38, being grounded by a rotative contact mounted on a shaft 41 connected to the engine to rotate synchronously therewith and at one-half the speed of the same (the engine shown being of the four cycle type). The upper part of this timer is thus of the usual construction; the moving contact 45 consisting of a roller is prolonged downward to also operate as a circuit closer to engage the lower series of terminals and carried in a yoke 43 extending transversely through the rotative shaft 41 and held in contact with the various terminals by a spring 44 engaging the yoke at one end and a casing 46 embracing the yoke, at the other end. The upper terminals 38 are made of the usual length to limit the duration of the spark and the lower series of terminals 39 are made longer, whereby the valves are held open a considerable length of time or nearly the entire stroke of the piston, and these lower terminals are connected in circuits with the respective coils by means of the post 17 and the conductors 26, the other ends of the coils being connected by conductors 22 to the battery circuit. The rotating closer of the timer 15 is grounded to the engine by a conductor 28 and the engine grounded to the battery 19 by a conductor 27, both in the usual way. Switches 21 and 23 are placed in the circuits 20 and 22, whereby either circuit may be cut out at pleasure.

The operation of my device is as follows: The engine may first be started by a manually operated crank as usual, or initial fluid pressure may be pumped up in the reservoir by any convenient means, such as a power operated or manually operated air pump, when the engine may be started by means of this fluid pressure by merely closing the switch 23. The elongated contacts 39 will usually close the proper circuit by engagement of the roller 45. If, however, this is not the case, a slight shifting of the timer by the usual adjusting means will close a circuit, and this circuit will necessarily be the one belonging to whatever cylinder, the piston in which is making the working or explosion stroke. The fluid pressure thus admitted to a cylinder will start the engine and timer, whereby the next closure of a circuit by the timer will be that of the cylinder next in order to make a working stroke, and so on continuously until the normal operation of the engine is established, when the compressed charges in the cylinders will overcome the pressure of the fluid from the

reservoir 5 and stop the flow therefrom. It is then only necessary to open the switch 23 and stop the action of the valves. As soon as the normal process of the engine begins, a portion of the compressed charge of the cylinder 1 will be forced through the restricted passage 7 into the chamber 6 and when the charge is fired in the cylinder, fire will also pass into said chamber and explode the contents thereof and raise the pressure therein. The restricted passage 7 will not permit the gases to escape from the chamber 6 and the pressure to fall as rapidly as in the combustion chamber of the cylinder, but the valve 34 will be raised and the gases will escape into the pipe 8 and thence to the reservoir 5. As the pressure in the reservoir increases this back pressure on the valve together with the spring 36 will eventually hold the valve 34 closed and the charge fired in the chamber 6 will then all escape through the restricted passage 7 into the cylinder. The pressure in the reservoir 5 is thus automatically limited to a maximum depending upon the adjustment of the spring 36. The higher the tension of the spring, the lower will be the maximum pressure reached in the reservoir. When the engine is stopped this reservoir will thus be automatically charged, and remain with its contents under pressure, ready for starting the engine again at any time, which is automatically accomplished by merely closing the switch 23 when the described operation of starting will be automatically repeated.

Obviously a separate rotary circuit closer for the valves may be used, or the primary circuits of the usual timer can be shunted through the coils of the valve operating magnets, but I prefer a circuit closer that will hold the valves open longer than would the usual spark timer. So also any other circuit closer adapted to close the proper circuits would be available for my purpose. Many other modifications may be adopted without departing from the essence of my invention.

What I claim is.

1. An explosive engine starting device comprising an auxiliary pressure chamber, a magnetically controlled valve in said chamber for each individual cylinder for controlling the admission of pressure thereto, and a timing device operated by the engine for controlling the action of said magnetic means to allow the proper valve to raise and admit the pressure to the proper cylinder to start the engine, said timer being also arranged to control the ignition in the engine cylinders.

2. In combination with an internal combustion engine having an electric ignition system controlled by a timer, electrically operated starting valves for the engine, means for supplying fluid under pressure

through said valves to the engine, electric circuits for operating the valves also controlled by the timer, and means for manually opening the valve circuits while the engine is running and closing the same while the engine is starting.

3. In combination with an internal combustion engine having a plurality of cylinders and an electric timer, means for supplying fluid under pressure to the respective cylinders of the engine, electrically operated valves to admit said fluid to said cylinders, electric circuits to operate said valves, said circuits being also closed by the timer, and a manually operated switch for simultaneously closing said valve circuits while starting the engine and opening the same while running the engine.

4. In combination with an internal combustion engine having a plurality of cylinders, electric igniting circuits and a timer to successively close said circuits, means for supplying fluid under pressure to the respective cylinders of the engine, electrically operated valves to admit said fluid to said cylinders, shunt circuits from the igniting circuits to operate said valves, said shunt circuits also being closed by the timer, and a switch adapted to simultaneously close the shunt circuits when starting the engine and to open the same while the engine is running.

5. In combination with an internal combustion engine having an electric igniting device comprising a primary circuit and manually adjustable timer, means for supplying fluid under pressure to the respective cylinders of the engine, valves to control said fluid, electro-magnets to open said valves, a shunt circuit from the primary circuit of the ignition device to energize the

magnets, an auxiliary series of terminals in the timer, and connected through the magnet coils to the shunt circuit.

6. In combination with an internal combustion engine having a plurality of cylinders, an electric ignition device comprising a primary circuit and a timer having a terminal for each cylinder; a rotating circuit closer adapted to successively engage said terminals and rotated by the engine, a second series of terminals in said timer and also engaged by said circuit closer, means for supplying fluid under pressure to each cylinder of the engine, valves to control said fluid, electro-magnets to open the valves, electric circuits to the magnets, and connected to the second series of terminals in the timer.

7. In combination with an internal combustion engine having a plurality of cylinders, means for supplying a fluid under pressure to the several cylinders of the engine, valves to control the flow of fluid to the respective cylinders, electric circuits to operate the respective valves, an electric ignition device having ignition circuits and comprising a timer having a series of short terminals in the ignition circuits, and a series of longer terminals in the valve operating circuits, and a rotary circuit closer adapted to simultaneously close one ignition circuit and one valve circuit related to the same cylinder of the engine, said closer being connected to the engine and operated thereby.

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

JOHN WATSON FITZGERALD.

Witnesses:

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LUTHER V. MOULTON.