Nov. 18, 1924. 1,516,006

C. H. FOX

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Fig. 1.

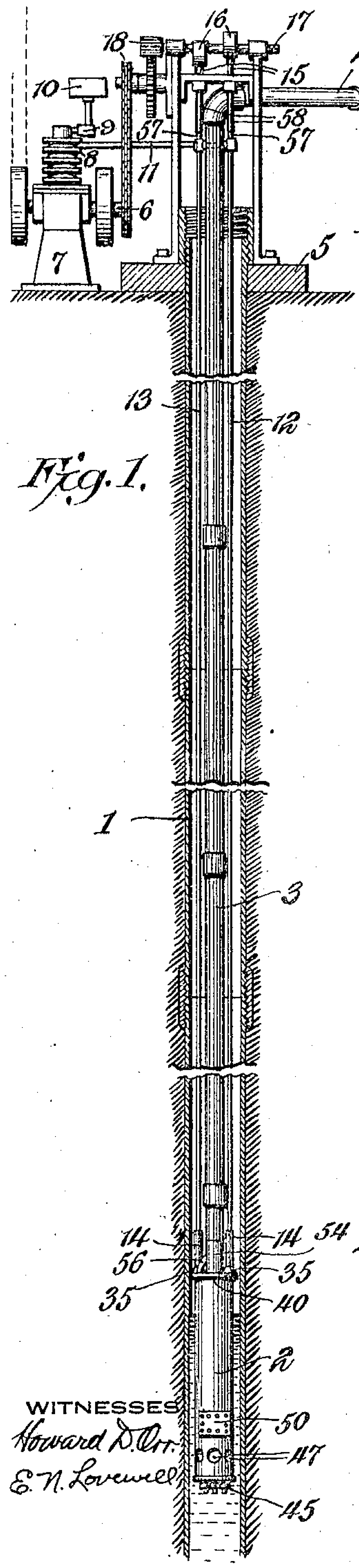


Fig. 9.

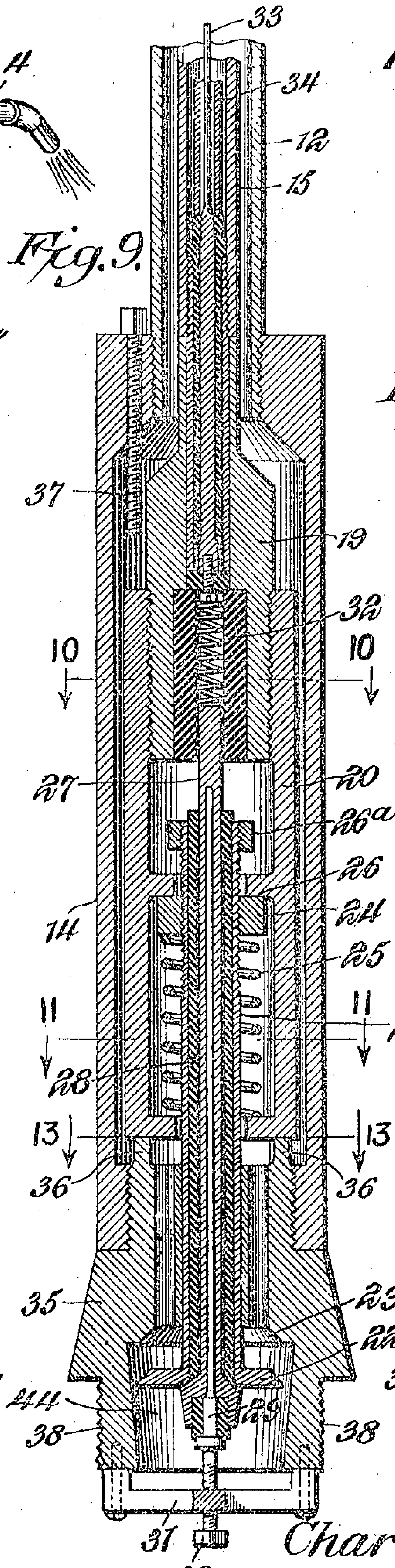


Fig. 10.

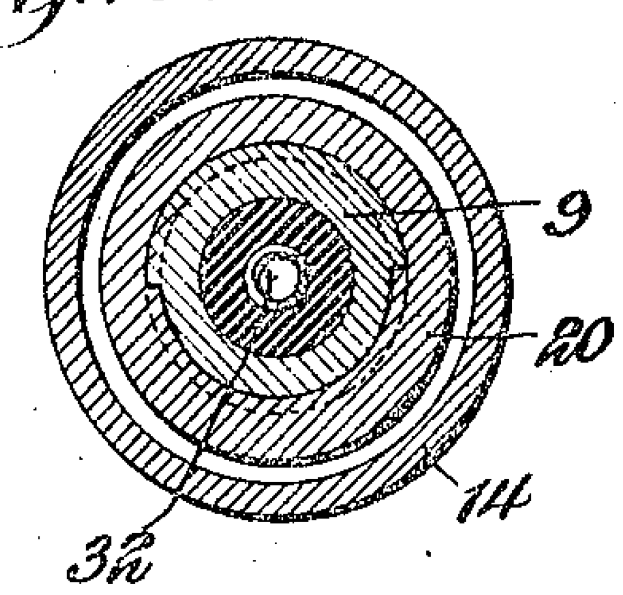


Fig. 11.

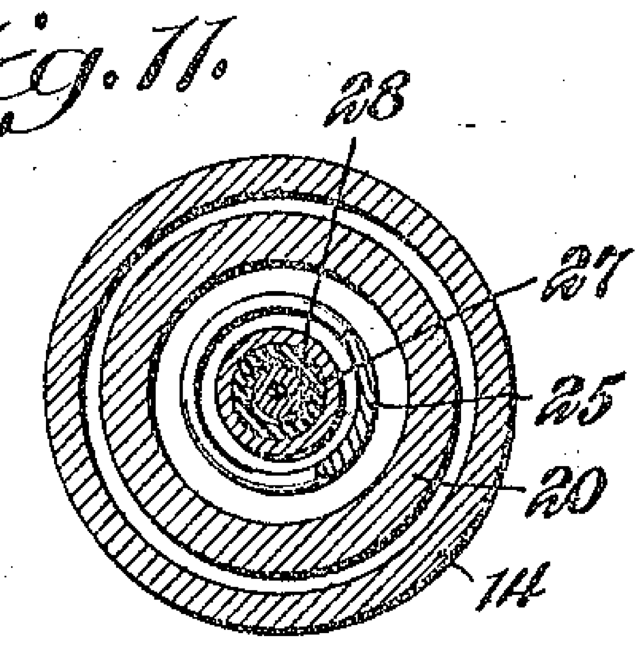


Fig. 12.

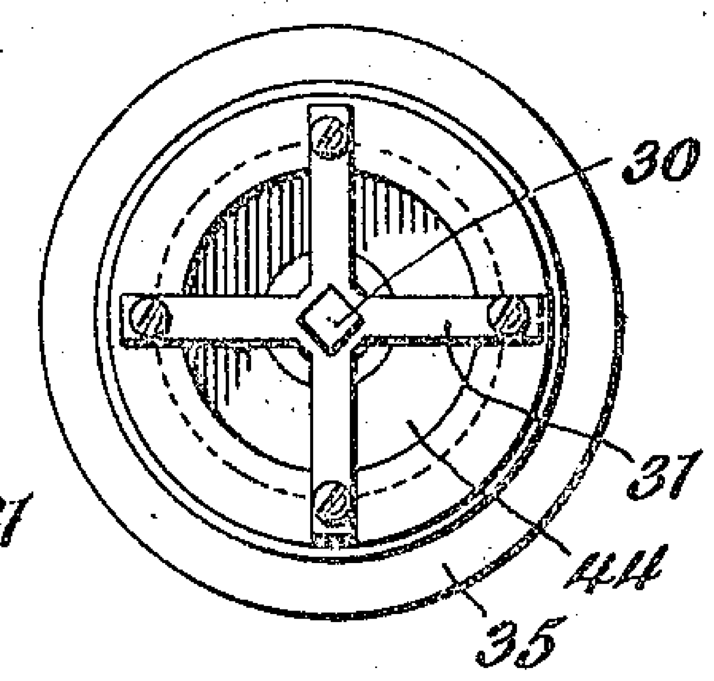
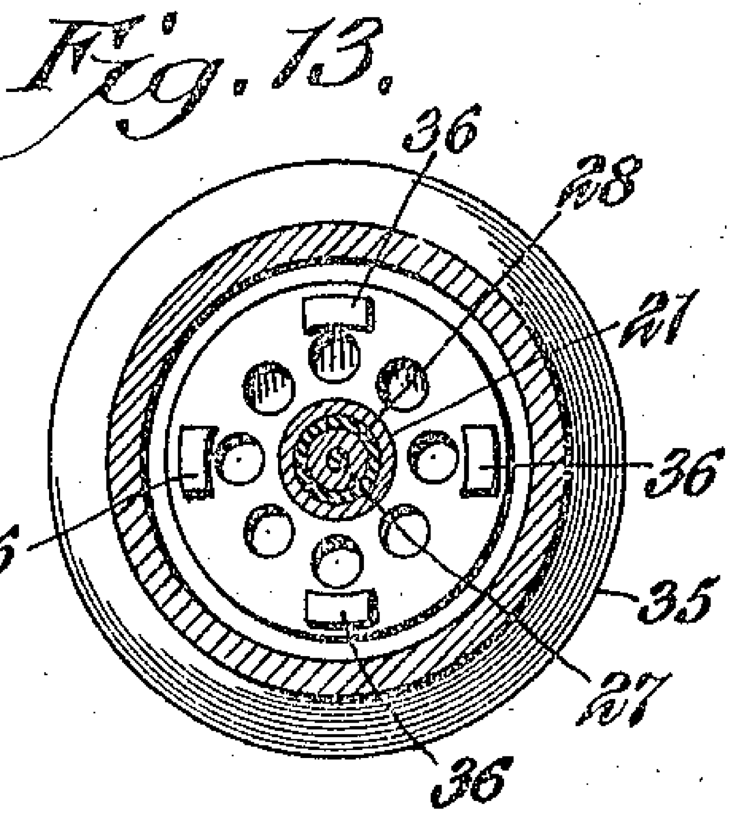


Fig. 13.



WITNESSES
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Fig. 2.

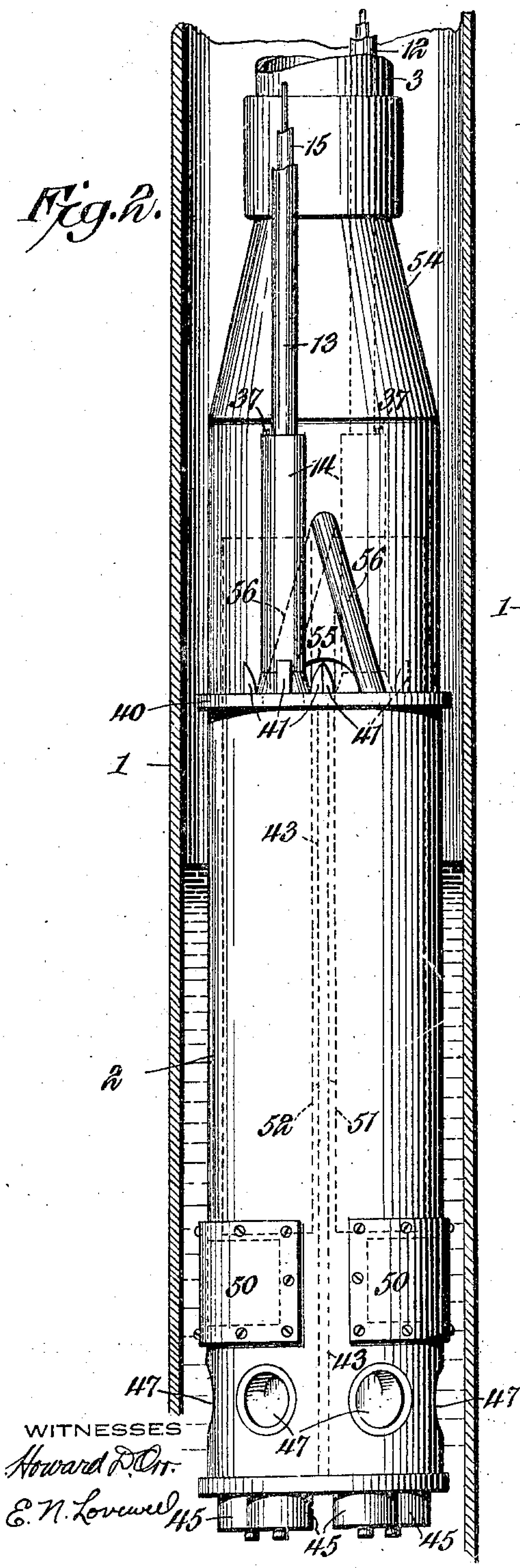

Fig. 3.

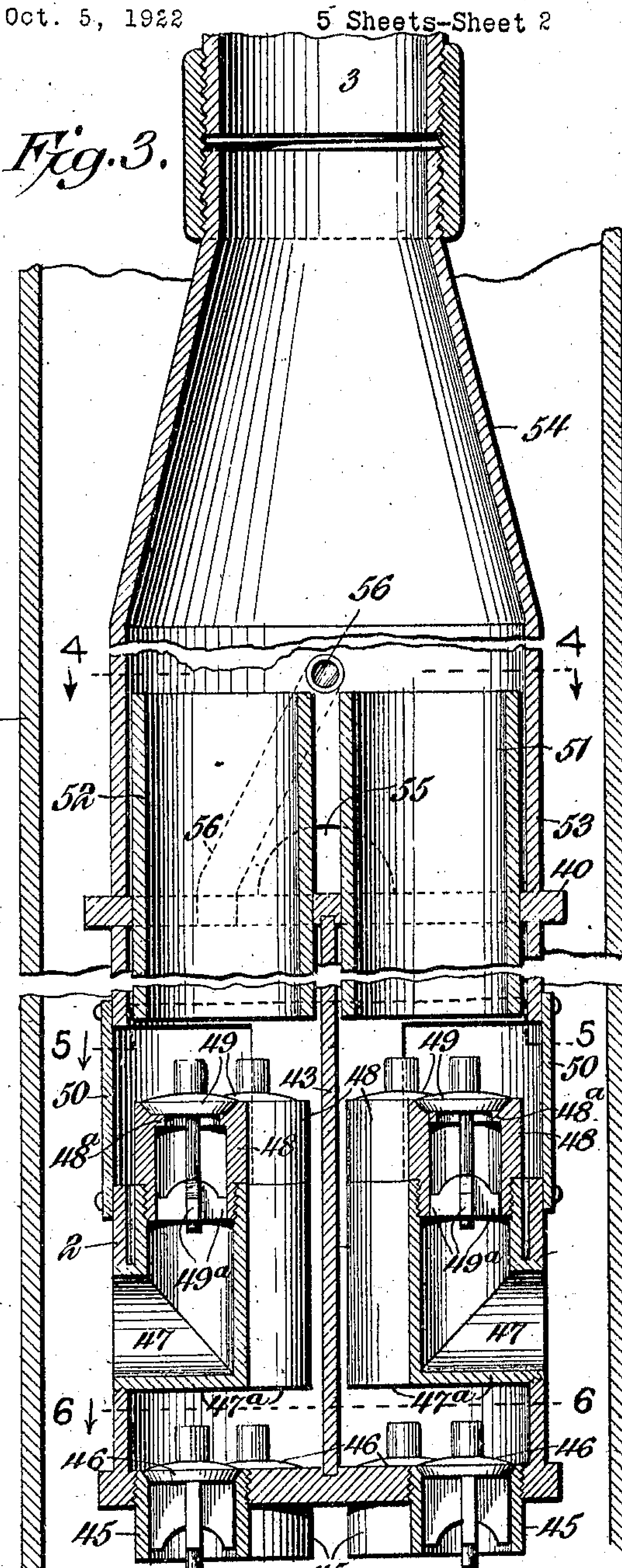

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Fig. 4.

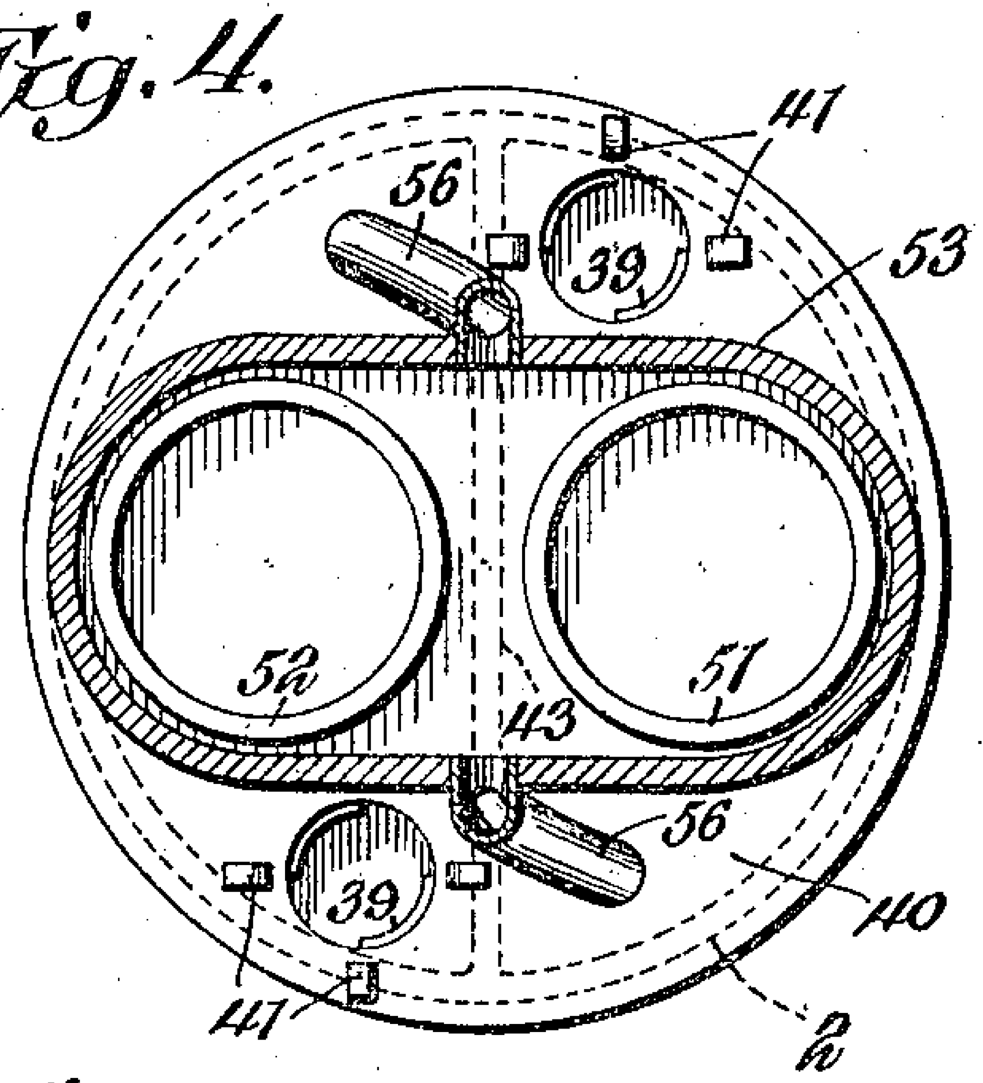


Fig. 5.

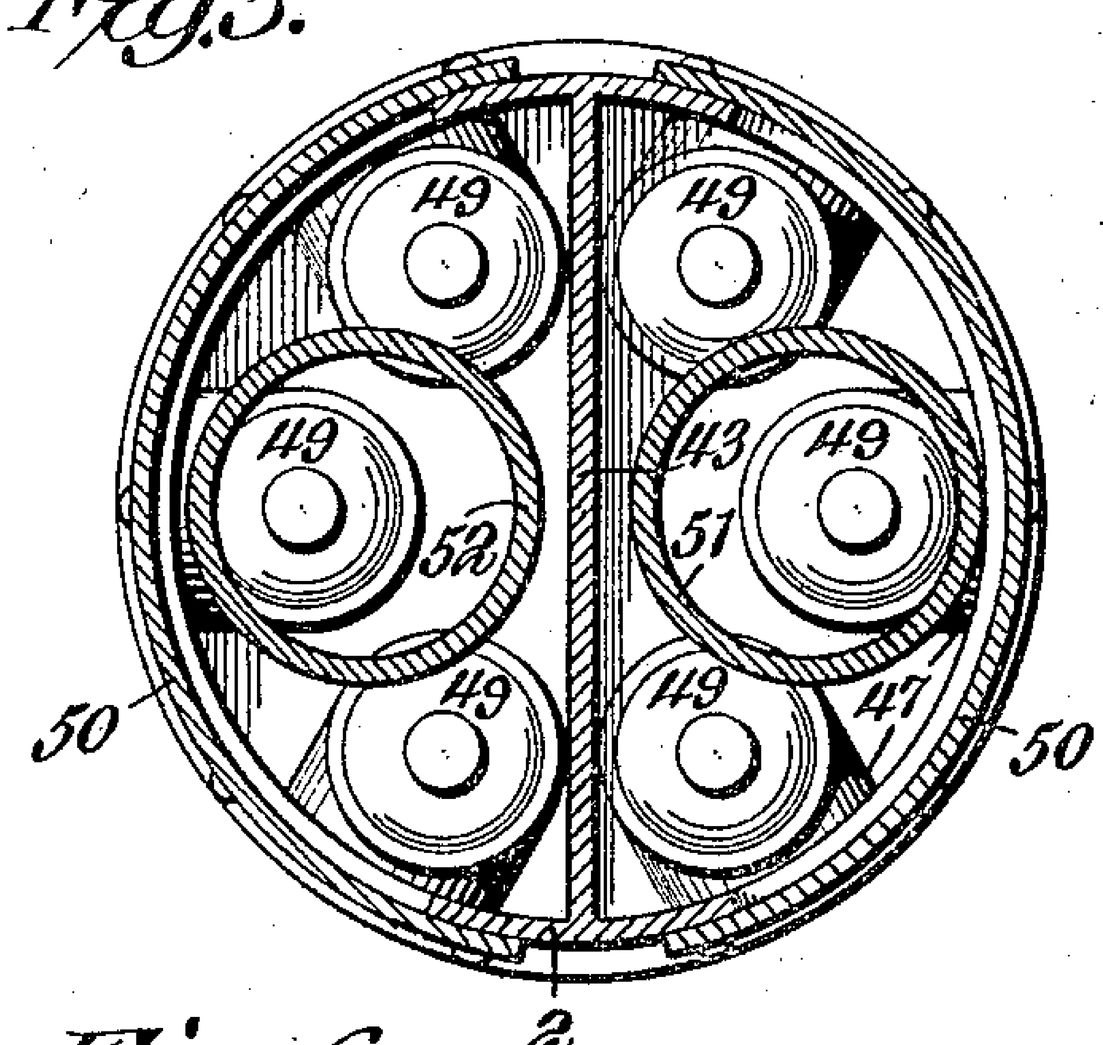


Fig. 6.

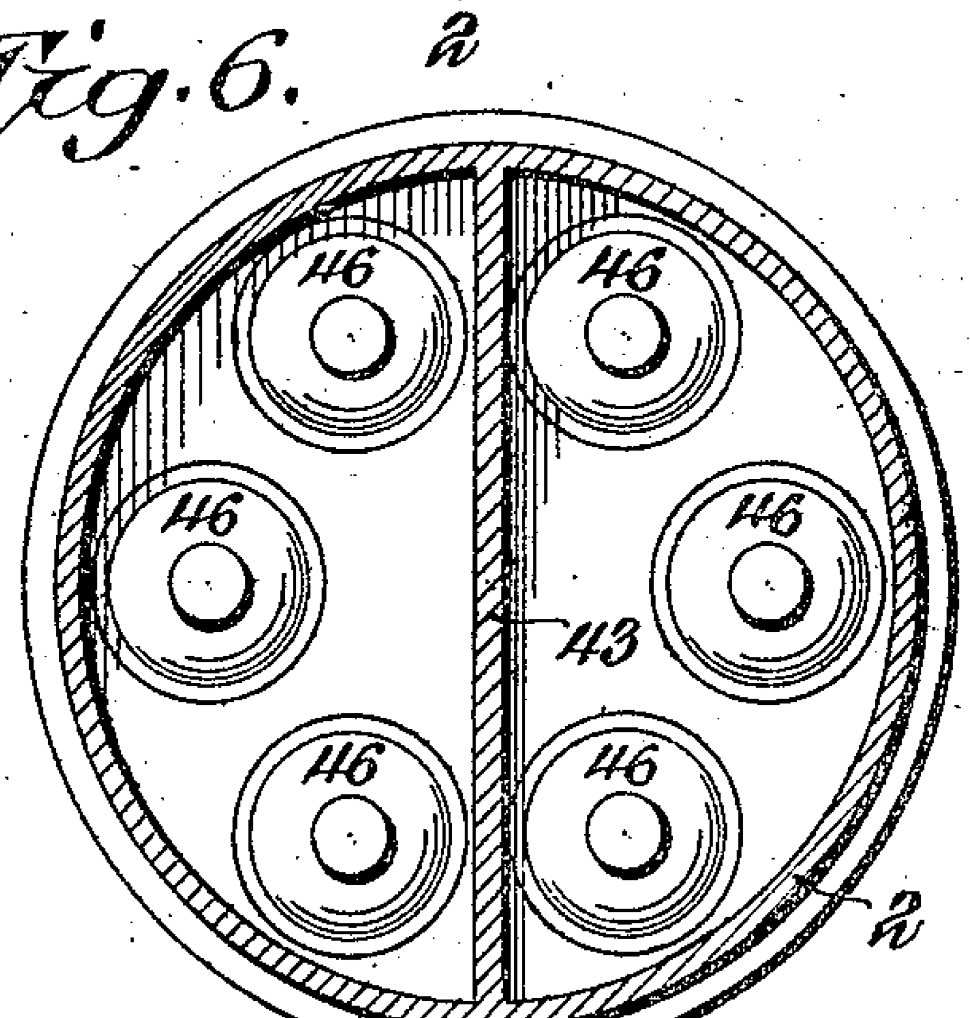


Fig. 7.

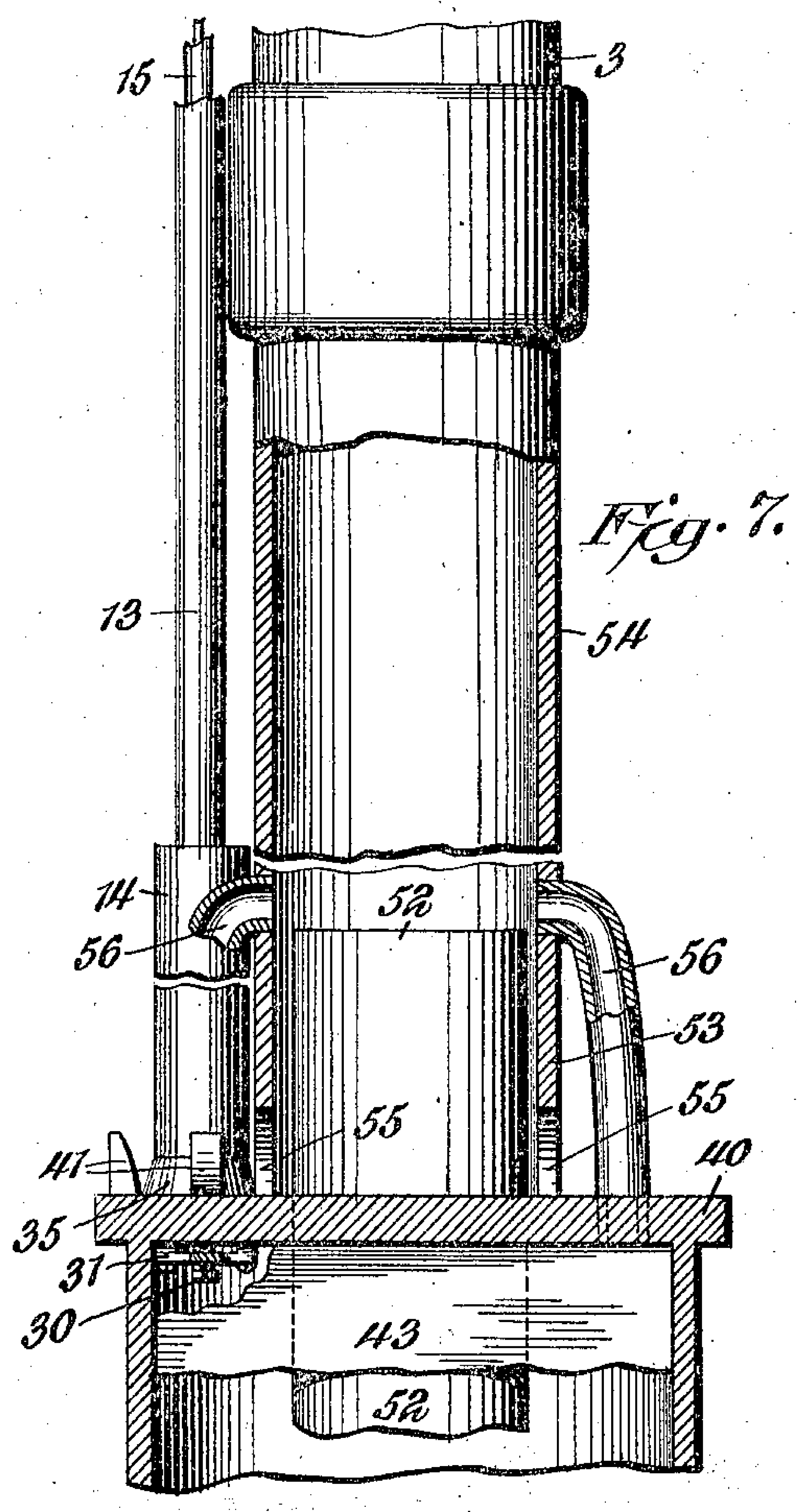
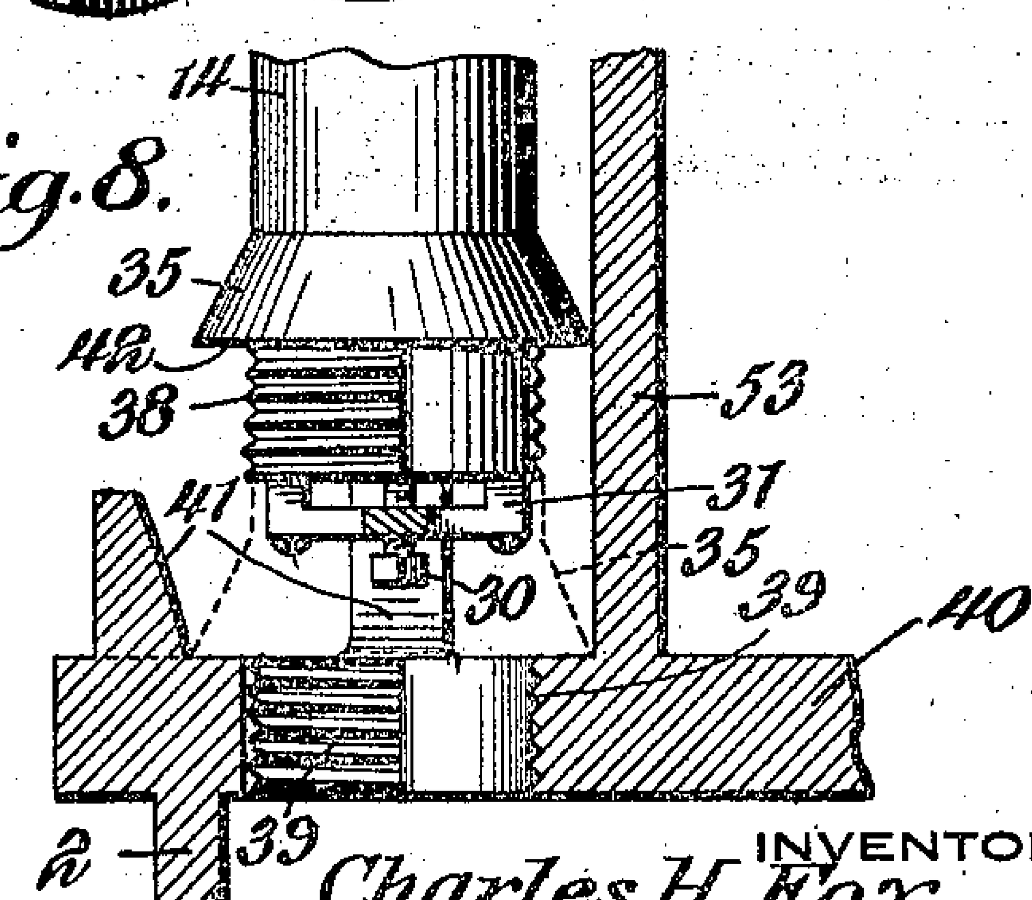


Fig. 8.



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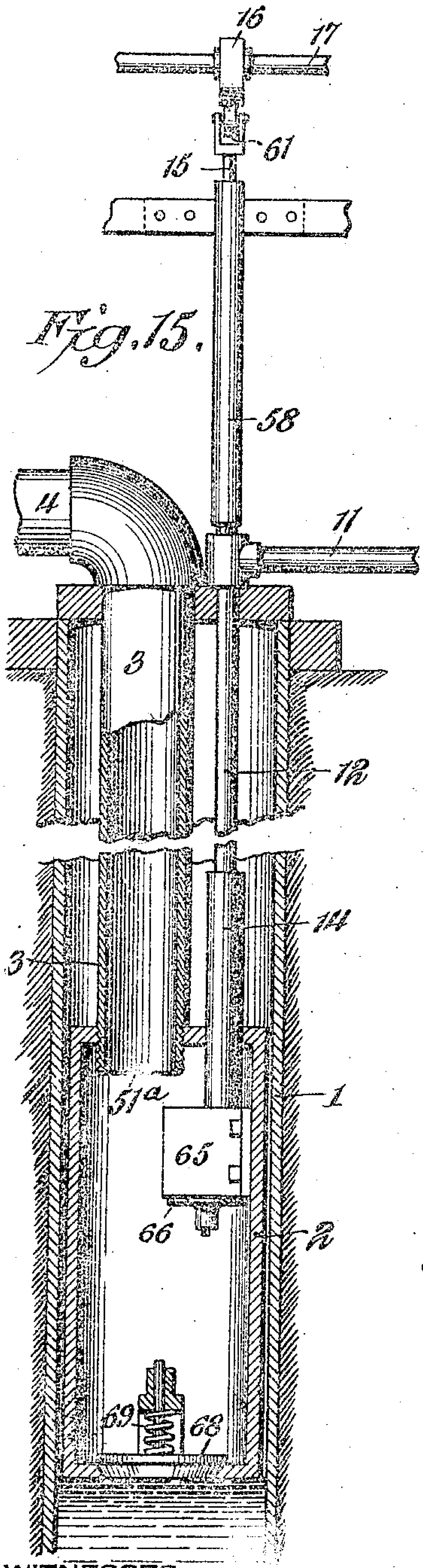

Fig. 15.

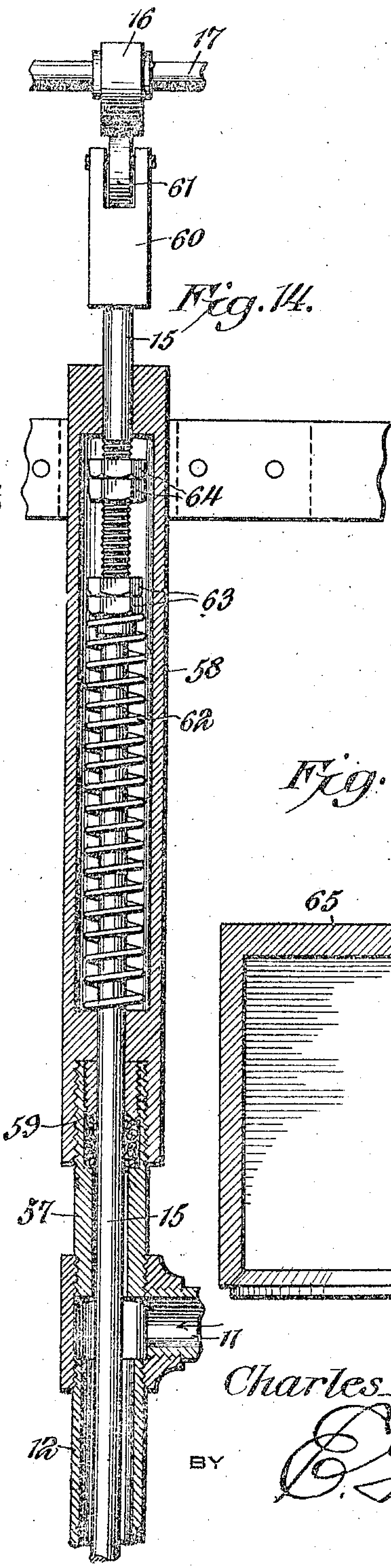

Fig. 14.

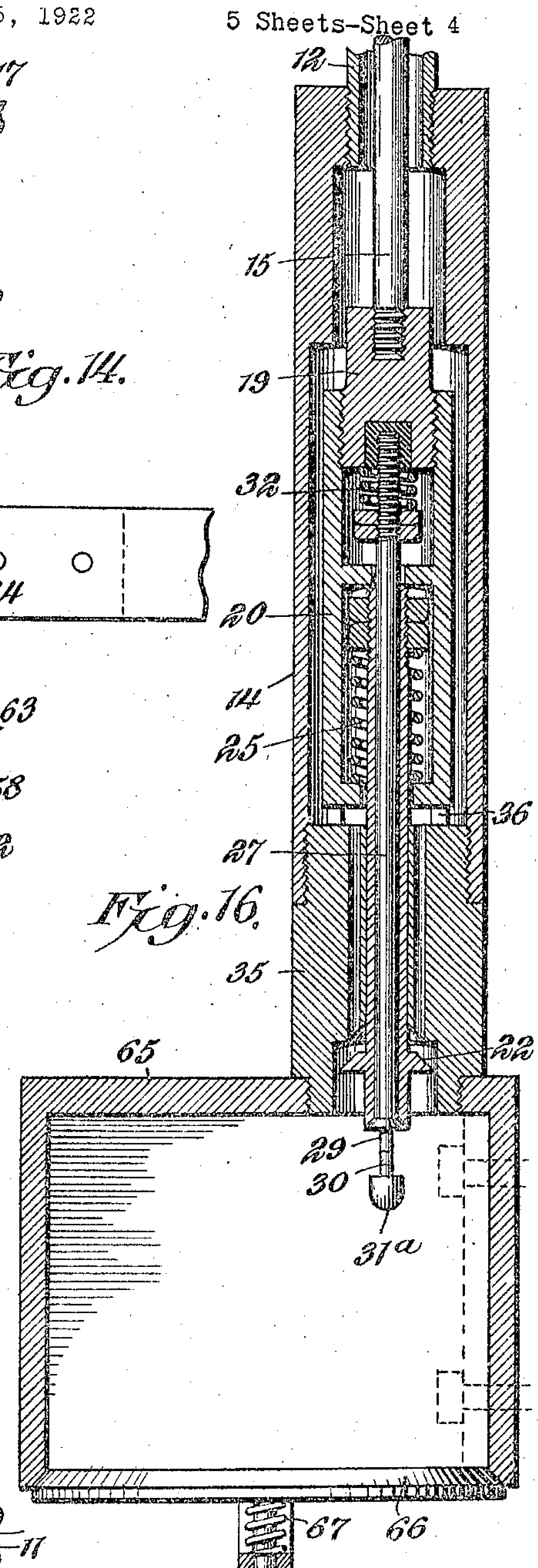

Fig. 16.

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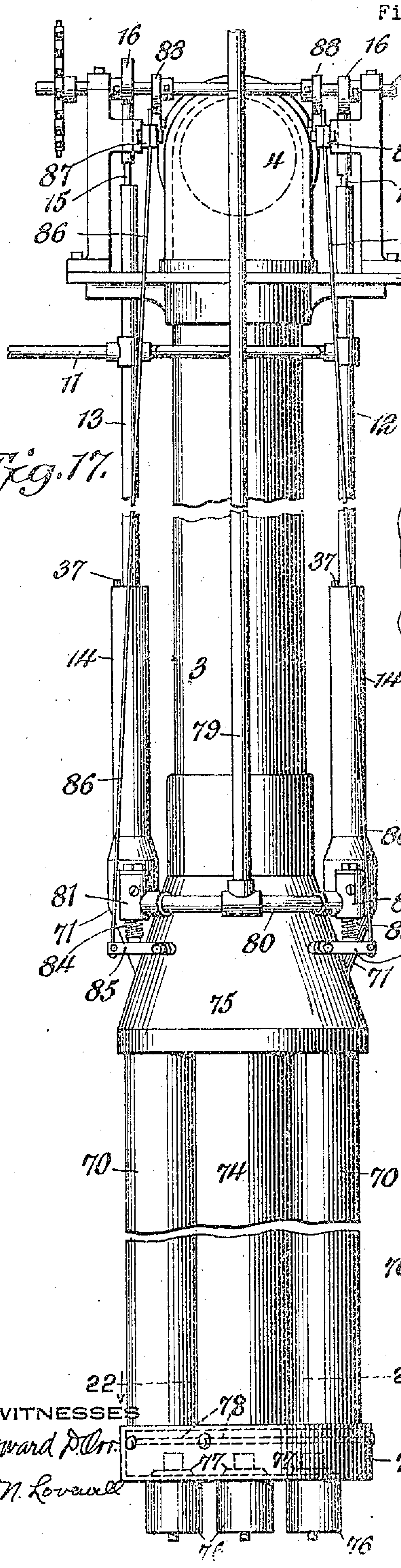

Fig. 17.

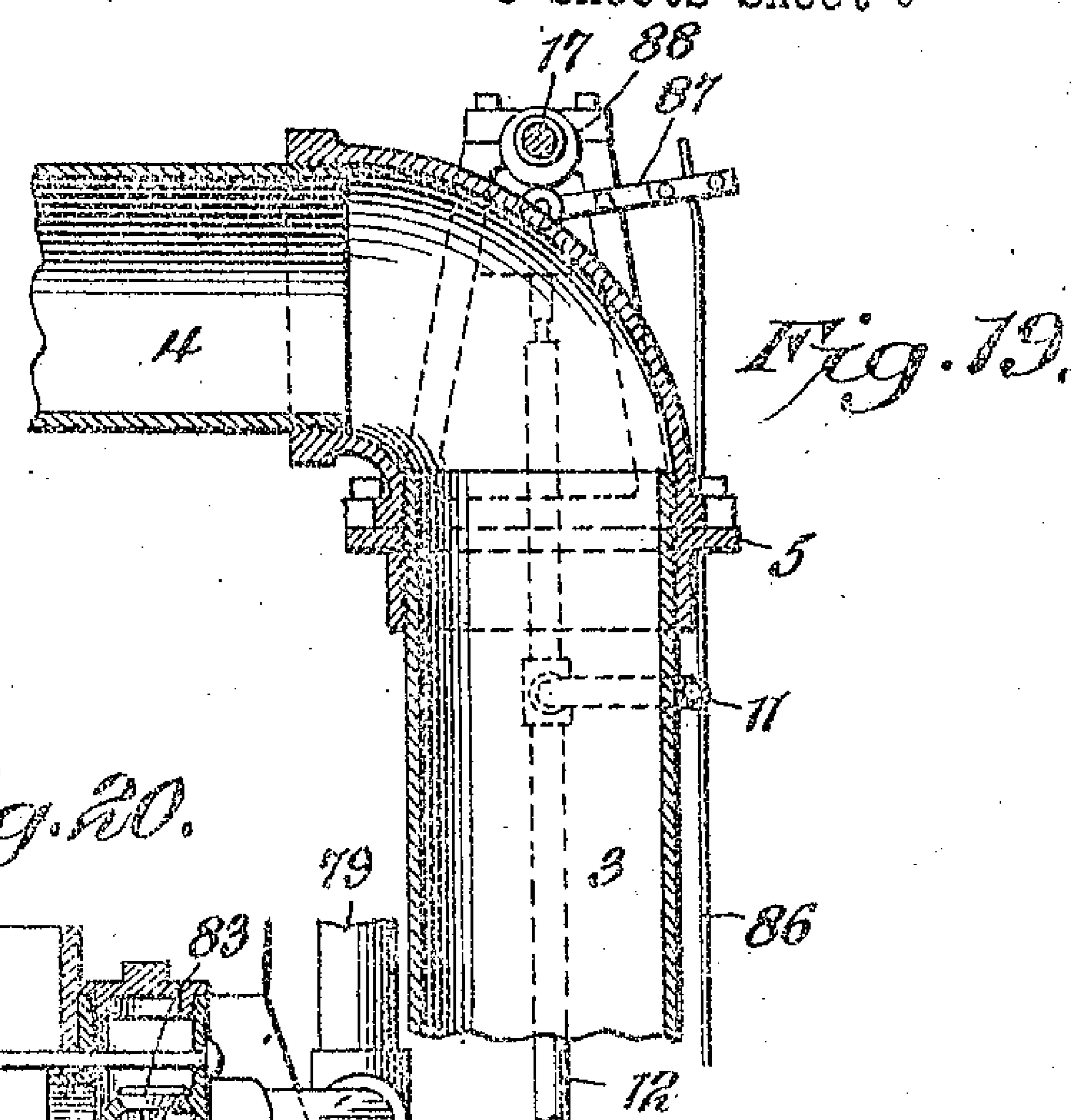

Fig. 19.

Fig. 18.

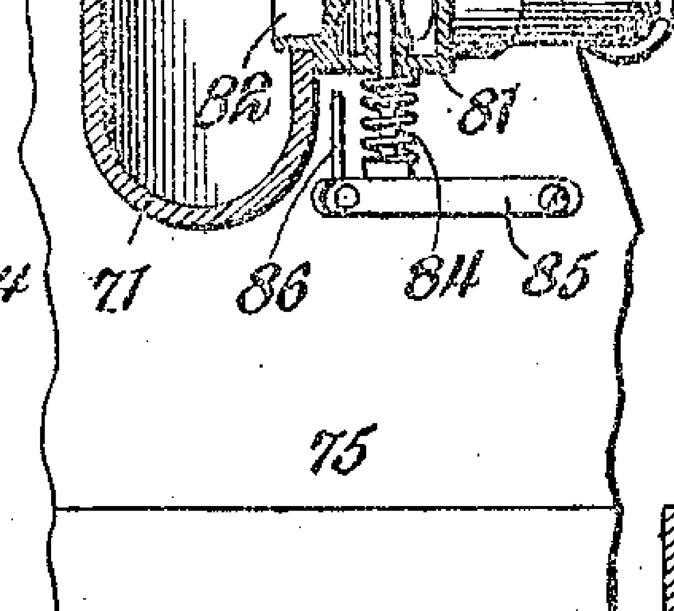

Fig. 20.

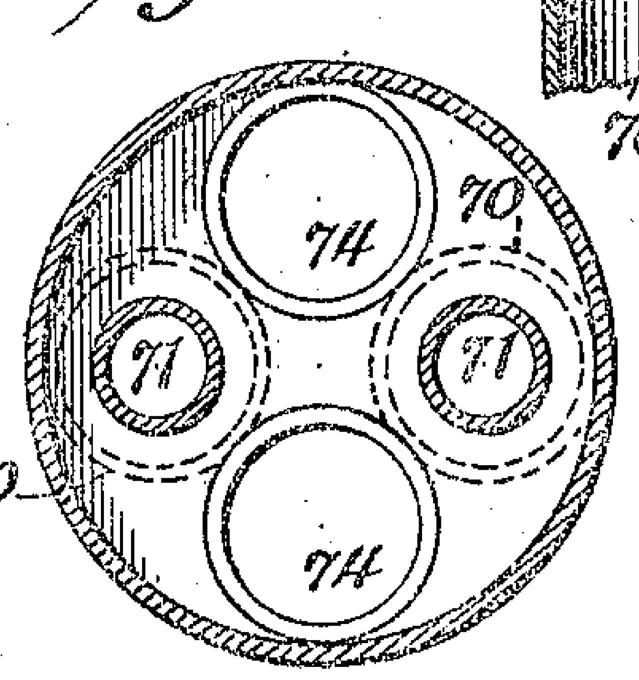

Fig. 21.

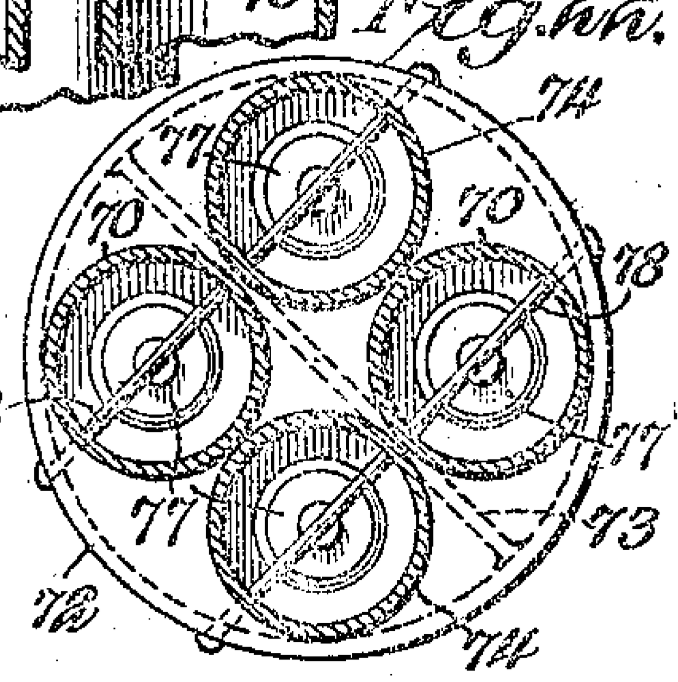

Fig. 22.

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Patented Nov. 18, 1924. 1,516,006

UNITED STATES PATENT OFFICE.

CHARLES HENRY FOX, OF BAKERSFIELD, CALIFORNIA.

PUMP.

Application filed October 5, 1922. Serial No. 592,499.

To all whom it may concern:

Be it known that I, Charles H. Fox, a citizen of the United States, residing at Bakersfield, in the county of Kern and State of California, have invented new and useful Improvements in Pumps, of which the following is a specification.

My invention relates to fluid pumps, and more particularly to pumps of that type in which the explosion of a combustible mixture is utilized for advancing the fluid to be pumped.

One of the important objects of my invention is to provide improved means for utilizing the explosive power of the fuel mixture whereby the same is transmitted to the fluid to be pumped without any dissipation or loss of energy.

A further object of the invention is to provide a device of the character described in which the explosive means acts to cause a practically continuous flow of the fluid being pumped.

A still further object of the invention is to provide a pump of this character with means for compressing the fuel charge prior to its introduction into the explosion chamber, whereby a more rapid and efficient operation is made possible.

Other objects and advantages of my invention will be apparent from the following description, and the novel features will be pointed out in the claims.

In the drawings, which form a part of this specification,

Fig. 1 is a vertical sectional view of a well having my invention installed therein.

Fig. 2 is a similar view, showing the lower portion of the well and the pump cylinder on an enlarged scale.

Fig. 3 is a vertical sectional view, on a still further enlarged scale, of the water inlet portion of the pump.

Fig. 4 is a horizontal sectional view on the line 4—4 of Fig. 3.

Fig. 5 is a similar view on the line 5—5 of Fig. 3.

Fig. 6 is a similar view on the line 6—6 of Fig. 3.

Fig. 7 is a side elevation partly in section, showing the explosion chamber and the outlet therefrom.

Fig. 8 is a sectional detail view showing the means for attaching the valve cage to the pump cylinder.

Fig. 9 is a vertical sectional view through the valve cage.

Fig. 10 is a horizontal sectional view taken on the line 10—10 of Fig. 9.

Fig. 11 is a similar view taken on the line 11—11 of Fig. 9.

Fig. 12 is a bottom plan view of the valve cage.

Fig. 13 is a horizontal sectional view on the line 13—13 of Fig 9.

Fig. 14 is a vertical sectional view of the upper portion of the fuel inlet pipe, with the valve-operating rod operating therein.

Fig. 15 is a vertical sectional view of a modified form of pump cylinder.

Fig. 16 is a vertical sectional view of the valve cage and explosion chamber shown in Fig. 15.

Fig. 17 is a side elevational view of another modification of my invention.

Fig. 18 is a vertical sectional view of the intake and exhaust ports of the form shown in Fig. 17.

Fig. 19 is a vertical sectional view showing a portion of the valve-operating mechanism in the form shown in Fig. 17.

Fig. 20 is a sectional detail view of the exhaust mechanism.

Fig. 21 is a horizontal section on the line 21—21 of Fig. 18.

Fig. 22 is a horizontal sectional view on the line 22—22 of Fig. 17.

Referring more specifically to the drawings, the numeral 1 indicates the casing of a well in which my invention may be used. The numeral 2 indicates what may be termed the pump cylinder, from which the water or other fluid is forced upwardly through a discharge pipe 3, provided at its upper end with an outlet 4. The pump may be supported in any suitable manner from a base 5 at the mouth of the well, and it is one of the purposes of my invention to introduce an explosive mixture into the cylinder 2, by means to be hereinafter described, there to explode the mixture, and by the force of the explosion, deliver the water into the pipe 3.

For the purpose of supplying a suitable fuel mixture under pressure to the pump, I prefer to install near the well a compressing device, which, as shown, comprises a shaft 6 suitably mounted on a base 7 and driven by a small motor or other source of power. The shaft 6 operates a compressor 8 which draws in the charge through a carbureter 9, the gasoline being supplied from a tank 10. This fuel mixture is fed from the compressor through a pipe 11, and suitable pipes 12 and 13, to one or the other of the valve chambers 14, through which the mixture is fed at the proper time into the respective explosion chambers.

Within each pipe 12 and 13 is a tubular valve-operating rod 15, which is operated at the proper time by means of a cam 16 carried by the shaft 17, which is rotated by means of gearing 18 from the shaft 6. The rod 15 is provided at its lower end with an enlarged head 19 within the chamber 14, and to the head 19 is secured a cage 20, within which is reciprocally mounted a comparatively long stem 21 of the valve 22, which cooperates with the seat 23 to cut off or admit the fuel mixture into the explosion chamber. The stem 21 is provided near its upper end with a stop nut 24, which is normally held in its uppermost position by the spring 25, and in the position shown in Fig. 8 rests against the seat 26.

Within the stem 21 is reciprocally mounted an electric conducting medium 27, which is insulated by a sleeve 28 and carries at its lower end an electrode 29, which cooperates with the adjustable screw 30 to provide an ignition spark at the proper time, the screw 30 being supported by a bracket 31 secured at the lower end of the casing. The member 27 is urged downwardly by a spring 32, which connects the electrode to a source of electricity through a wire 33, which is insulated as shown at 34.

In Fig. 9, the valve 22 is shown in the position in which the fuel is being admitted to the explosion chamber. After the fuel has been admitted, the rod 15 is raised and the valve 22 is closed through the medium of a spring 25, while the electrode 29 is still held downwardly by the spring 32. As soon as the valve 22 strikes its seat 23, however, the movement of the valve and the nut 24 stops, and the cage 20 continuing its movement, the flange 26 strikes the nut 26ª on the stem 27 and quickly opens the spark gap between the electrodes 29 and 30. Upon the continuation of the operation, the fuel will next be admitted to the other explosion chamber in the same manner. When it is time to again open the valve 22, the rod 15 again descending, first closes the spark gap by reason of the action of the spring 32, and upon continued movement downward, the valve 22 is opened as before.

The lower end of the chamber 14 is provided with a foot piece or plug 35 having upstanding lugs 36, which form a positive stop for the downward movement of the cage 20, thus preventing any unnecessary strain upon the threads which support it. Likewise, an adjustable stop bolt 37 may be provided at the upper end of the chamber 14.

In order that the valve chambers may be easily attached to or removed from the pump cylinder for the purpose of adjustment or repairs without removing the cylinder from the well, the foot-piece 35 of each chamber is formed at its lower extremity with a nipple, provided with quarter threads 38, which may be engaged with corresponding female quarter threads 39 formed in the cover plate 40, which is secured to the upper end of the cylinder, preferably by welding. Surrounding the orifice in which the quarter threads 39 are formed, are a plurality of lugs having inclined faces 41, which, by the engagement with the outwardly extending shoulders 42, direct the lower threaded end of the valve chamber into proper relation to engage the threads 39.

It will be understood that the cylinder 2 is divided by a vertical central partition 43 into two compartments, in the upper ends of which the fuel is introduced, and the explosions take place alternately in the two compartments.

The foot-piece 35 is formed with a recess 44, which encloses the valve 22 and the spark plug 29, and the walls of this recess are preferably tapered downwardly to form a sort of vortex, whereby the fuel charge as it is forced under pressure into the explosion chamber will be directed across the electrodes, thereby preventing the accumulation of soot or the like.

In order to procure the greatest efficiency and the maximum flow of water, the compartments in the cylinder 2 should be provided with inlet openings of considerable extent. In the form shown in Figs. 2 to 6, inclusive, I have shown each compartment provided in its bottom with three inlet nipples 45 of comparatively large size and controlled by gravity valves 46 of a well known type. The side of each compartment is also provided with three inlet nipples 47 of elbow shape, each being provided at its upper end with a valve seat 48 and gravity valve 49. It will be noted that the lower wall 47ª of each elbow forms an abutment or stop for the corresponding valve 43, while the valve cage 48 is provided with an inwardly-turned lip 48ª that forms a stop which is engaged by the foot 49ª of each valve 49. The wall of the cylinder 2 is preferably provided with removable plates 50 which provide ready access to the valves.

The two compartments of the cylinder 2 are provided with large outlet nipples 51 and 52, respectively, which are secured in the cover 40, and extend downwardly to a point near the valves 49, as will be seen from Figs. 2 and 3. A connecting member for directing the streams from the nipples 51 and 52 into the pipe 3, is formed from a swage nipple, the larger end of which is somewhat elongated, as shown at 53, in Fig. 4, and the upper end tapers as at 54 (Fig. 3) to connect with the lower end of the pipe 3.

As soon as the fuel charge is introduced into the upper end of one of the compartments in the cylinder 2, the valve 22 closes and immediately thereafter the fuel charge is ignited, the expansion of the ignited gases forcing the water upwardly through one of the nipples, as 51. This stream of water being discharged through the passage 54 will also draw a considerable volume of water through the other nipple 52 by a suction action, and will, at the same time, completely scavenge the chamber in which the previous explosion has taken place. Ports 55 may also be provided in the lower part of the wall of the swage nipple 53, in order to increase the flow of water being delivered. Toward the end of the explosion action, a considerable portion of the burned gases will escape with the stream of water, and preferably there is provided a duct 56 through which the remaining products of combustion may subsequently be exhausted.

At this period of the operation, the other compartment has been filled with water by the suction action above described, and the fuel charge is next forced under compression into said compartment preparatory to the next explosion. The operation of the compressor 8 and the cam shaft 17 is so timed that the water which is siphoned into the explosion chamber, as it completes the scavenging of the burned gases, meets the incoming fuel charge and increases the compression thereof, whereby a very high degree of compression is obtained at the moment of ignition.

The preferred means for operating the fuel inlet valves and the ignition device through the rod 15, is illustrated in Fig. 14. Each of the pipes 12 and 13, where it is connected to the pipe 11 leading from the compressor, is also provided with an extension nipple 57, to which is secured a sleeve 58, a suitable packing gland 59 being provided to prevent the escape of the fuel mixture around the rod 15. This rod extends upwardly through the sleeve 58, and is provided at its upper end with a head 60, in which is journaled a roller 61 that coacts with the cam 16 as the shaft 17 is rotated. A suitable compression spring 62 surrounds the upper end of the rod 15 within the sleeve 58, and maintains the roller 61 at all times in contact with the cam 16, the tension of the spring being suitably adjusted by means of lock nuts 63, and adjustable nuts 64 being also provided as a stop at the upper end of the sleeve 58.

In Figs. 15 and 16, I have shown a modified arrangement which is in the nature of a single acting pump having a single firing chamber 65. As shown in the drawings, this firing chamber may be attached to the side of the cylinder 2 near the upper end, and is provided in its bottom with a large valve 66 controlled by a spring 67 and covering the major portion of the bottom area. The lower electrode 30 of the spark plug is secured to the side wall of the firing chamber, as by means of a bracket 31ᵃ. In this form also, a single inlet 68 is provided in the bottom of the cylinder and controlled by a spring 69. Upon the explosion taking place in the chamber 65, the water is forced upwardly through the pipe 3, the lower end of which, 51ᵃ, terminates near the top of the cylinder 2.

It is also to be observed that in the construction shown in Figs. 2 and 3, the water pipes 51 and 52 necessarily terminate at their lower ends at a considerable distance above the lower end of the cylinder 2, in order to allow for the inlet ports 45 and 47. This permits a considerable water hammer in the lower end of the cylinder, and in heavy work, unless the cylinder is made exceptionally strong, it is liable to burst. Under such conditions, therefore, I prefer to construct the cylinder 2 as shown in Figs. 17, 18, 21 and 22. In this construction, each of the firing chambers is in the form of a cylindrical tube 70, which is connected at its upper end with an intake pipe 71 secured to the lower end of the valve chamber 14. These cylindrical firing chambers are connected at their lower ends to a cylindrical box 72 which is separated diametrically by a partition 73. The water passes from the cylindrical box 72 upwardly through the respective pipes 74, through the connector or swage nipple 75 into the pipe 3. The box 72 is provided in its bottom with a number of inlet nipples 76 which are controlled by gravity valves 77. The lower ends of the cylindrical chambers 70 and 74 are welded or otherwise secured to the upper wall of the box 72. The box is strengthened against lateral strain by means of bolts 78, which also provide stops to limit the upward movements of the valves 77.

In this form of the invention, when the explosion takes place in the upper end of the cylinder 70, it will be seen that the expansive force of the explosion is directly utilized to force the water downwardly in the cylinder 70 and upwardly in the cylinder 74, and there is practically no space below the moving current of water where a water hammer could result.

It is also preferable in some cases to provide an exhaust outside of the water column in the pipe 3, in order to keep the water free from impurities. Also, since the proper scavenging of the firing chamber, when there is no independent exhaust pipe, depends upon the suction action induced by the explosion in the other firing chamber, it will be found that when the outlet nozzle is restricted, as in the case of a fire hose, or wherever it is desired to expel the water with considerable force, the scavenging in such cases may not be complete.

In Figs. 17, 19 and 20, I have shown an exhaust pipe 79 alongside of the water column 3, and provided at its lower end with a manifold 80 which is connected at each end with a valve box 81 having a nipple 82 connected with the intake and exhaust passageway 71. The exhaust is controlled by a valve 83, which is normally closed by a spring 84, and may be opened at the proper time by means of a lever 85 which is connected by a rod 86 to a lever 87, mounted above the well and actuated by a cam 88 on the shaft 17. With this structure, the burnt gases will be completely exhausted from the firing chamber under all conditions of use.

From the foregoing description, it will be seen that I have provided a pump of the internal combustion type which is operable under all conditions of use to cause a continuous flow of water, and wherein the power is transmitted directly and without any appreciable loss of energy to the work to be performed. I have described and illustrated in the drawings what may be considered at present the preferred forms of my invention, and I have described a number of the ways in which it may be utilized. It is to be understood, however, that other modifications and adaptations may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:—

1. In a device of the character described, a combustion chamber having a valve-controlled inlet port near its lower end, a discharge passageway leading from the chamber, a tubular valve controlled rod leading to the chamber, means for compressing a fuel mixture and subsequently introducing the same through said rod into the chamber, and means leading through the rod for igniting the mixture within the chamber.

2. A cylinder divided longitudinally into two compartments, each provided with inlet check valves near the lower end and with an outlet nipple extending upwardly and downwardly from the upper end, a swage nipple receiving the upper ends of the first-mentioned nipples and having a reduced end leading to a common outlet, means for introducing and igniting an explosive mixture in each of the compartments alternately, and a small duct between the swage nipple and the upper end of each compartment for exhausting the burned gases trapped above the lower end of the nipple therein.

3. A device of the character described comprising two compartments having water inlet and outlet ports, means for mixing, compressing and forcibly introducing and igniting a fuel mixture in each compartment alternately above the water outlet ports to force the water through said outlet ports, a common discharge pipe in constant free communication with both of said outlet ports, whereby the discharge through one port induces a flow of water through the other port, and means for timing the introduction of the fuel mixture so that it meets the incoming water in the respective compartments above the outlet ports and is further compressed thereby.

4. A device of the character described, comprising two compartments, each provided with a valve controlled inlet port near its lower end, a constantly open discharge nipple leading from the upper end of each compartment, a common discharge pipe constantly in communication with both nipples and leading upwardly therefrom, whereby the discharge through one nipple induces a flow of water through the other, and means for introducing and igniting a fuel mixture in the two compartments alternately, the introduction and ignition being so timed that the induced flow meets the incoming charge and increases the compression thereof.

5. In an internal combustion pump, the combination of two compartments, each provided with a valve controlled water inlet port near its bottom, and a valve controlled fuel inlet port near the top thereof, external means for mixing and compressing fuel charges and subsequently introducing them alternately through said fuel inlet ports into the upper portions of each of the two compartments, which constitute explosion chambers, and there igniting them, a water discharge passageway leading upwardly from a point near the bottom of each compartment, a hood receiving the upper ends of said passageways and terminating in a single water conduit, and means for so timing the introduction of the fuel charge that it meets the incoming water and is further compressed thereby.

6. A device of the character described, comprising two compartments, each provided with a valve-controlled inlet port near its lower end, a discharge passageway leading from its upper end, a tubular valve controlled rod leading to each chamber, means for mixing and compressing successive fuel charges, subsequently introducing them through said rods into the two compartments

alternately, and means leading through each rod for igniting the mixture in the chamber upon the closure of the fuel inlet valve.

7. An internal combustion pump, comprising a fluid and combustion chamber adapted to be inserted into a well, a water discharge pipe leading from the chamber, a pipe and valve cage for introducing a fuel mixture into the chamber, an inlet port with which said valve is detachably connected, and guide lugs around the port having inclined faces, whereby the cage may be easily guided into engagement with the port while the pump is at the bottom of the well.

8. In an internal combustion pump, a combustion chamber, a valve cage connected therewith, a valve in the cage having a tubular operating rod, an electric conductor extending through the operating rod and having a spark plug at its inner end, and means for operating said valve rod and said spark plug in properly timed relation.

9. An internal combustion pump having two compartments, each having water inlet and outlet ports and a fuel inlet port, and a common discharge pipe in constant communication with each compartment through the respective outlet ports and in such a position that the forcible expulsion of water from one compartment induces a flow of water through the other compartment to expel the burned gases therefrom.

10. An internal combustion pump having two compartments each having water inlet and outlet ports and a fuel inlet port, a common discharge pipe associated with the outlet ports in such a position that the expulsion of water from one compartment causes a siphoning action through the other compartment to expel the burned gases therefrom, and means for introducing fuel charges alternately into the two compartments and igniting them, the introduction and ignition being so timed that the siphoned water meets the incoming charge and increases the compression thereof.

11. In a device of the character described, a valve chamber through which the fuel charge is introduced, a valve having a tubular operating rod which is reciprocable to open and close the passage through said chamber, an electric conductor extending through said operating rod and having its lower portion reciprocable therein to open or close a spark gap in contact with the charge.

12. In a device of the character described, a compartment for receiving the water to be pumped, a passageway for introducing a fuel mixture into the upper end of the compartment, a valve for controlling the introduction of the mixture and having a tubular operating rod extending through the passageway, an electric conductor extending through the operating rod, means for reciprocating said operating rod to open or close the valve, and means for reciprocating the lower portion of the conductor to cause a spark to ignite the mixture in said compartment.

13. In a device of the character described, a compartment for receiving the water to be pumped, a passageway for introducing a fuel mixture into the upper end of the compartment, a valve for controlling the introduction of the mixture and having a tubular operating rod extending through the passageway, an electric circuit extending through the operating rod and having electrodes within the compartment, means for moving said operating rod and valve to admit the fuel to the compartment, said circuit being closed when the valve is open, and means for opening a gap between the electrodes while the valve is closed.

14. An internal combustion pump comprising a box provided with a valve-controlled water inlet port, a firing chamber and a water discharge pipe, both in communication with said box and extending directly upwardly therefrom, a valved tube for introducing a fuel charge into the upper end of the firing chamber, and means reciprocable within the tube for actuating its valve and igniting the fuel charge in properly timed relation thereto.

15. An internal combustion pump comprising a box having its bottom wall provided with a valve-controlled water inlet port, a firing chamber and a water discharge pipe, both in communication with said box through its upper wall, external means for compressing a fuel charge, a valved tube for subsequently introducing it under compression into the upper end of the firing chamber, and means reciprocable within the tube for actuating its valve and igniting the fuel charge.

16. An internal combustion pump comprising a box divided into two compartments, each compartment being provided with a valve-controlled water inlet port, a firing chamber and a water discharge pipe, both in communication with said compartment, independent means for compressing fuel charges and introducing them alternately into the two compartments and igniting the same, a valve-controlled exhaust pipe for each compartment, and means operable by the compressor for actuating the exhaust valve in timed relation to the ignition.

17. An internal combustion pump comprising a box divided into two compartments, each compartment being provided with a valve-controlled water inlet port in its bottom wall, a firing chamber and a water discharge pipe both in communication with said compartment through its upper wall, external means for compressing the fuel charges, means for subsequently introduc-

ing said charges alternately into the two compartments and igniting them, a valve-controlled exhaust passageway leading from the firing chamber, and means connected with the compressing means for operating said exhaust valve.

18. An internal combustion pump, comprising a box divided into two compartments, each compartment being provided with a valve-controlled water inlet port in its bottom wall, a firing chamber and a water discharge pipe both in constant communication with said compartment through its upper wall, means for introducing fuel alternately into the two compartments and igniting the same, and a common discharge pipe in constant communication with the discharge pipe from each compartment, whereby the forcible expulsion of water from one compartment will induce a flow of water through the other compartment and through the firing chamber and discharge pipe connected with it.

19. An internal combustion pump comprising a box divided into two compartments, each compartment being provided with a valve-controlled water inlet port, a firing chamber and a water discharge pipe both in communication with said compartment, means for mixing and compressing successive fuel charges and subsequently introducing them alternately into the two compartments, and igniting them, a common discharge pipe connected with the discharge pipes from the two compartments whereby expulsion of water from one compartment will siphon water through the other compartment and through the firing chamber and discharge pipe connected with it, and means for timing the introduction of the successive charges so that the siphoned water meets the incoming charge and increases the compression thereof.

20. In an internal combustion pump, a box having a water inlet port in the bottom thereof, a gravity valve controlling said port, a combustion chamber and a discharge pipe in communication with the box through its upper wall, and a transverse reinforcing member for securing the side walls of the box against lateral distortion, said reinforcing member being in a position to act as a stop for the valve.

21. In an internal combustion pump, a box having a valve-controlled inlet port, a firing chamber and a discharge pipe in communication with said box, a pipe for introducing fuel into the firing chamber, means extending through the fuel inlet pipe for igniting the fuel within the firing chamber, an exhaust pipe connected with the firing chamber, and a mechanically-operated valve for controlling the exhaust.

22. In an internal combustion pump, a box having a valve-controlled inlet port, a firing chamber and a discharge pipe in communication with said box, means for introducing fuel into the firing chamber and igniting the same, means for compressing the charge prior to its introduction, a valve-controlled exhaust passageway leading from the firing chamber, and means connected with the compressing means for operating said valve.

23. An internal combustion pump comprising two water compartments, each having a valve-controlled inlet, a firing chamber and a discharge pipe, a valve-controlled fuel intake pipe leading to the firing chamber, an exhaust port, a valve normally closing the exhaust port, a common discharge pipe connected with the discharge pipes leading from the two compartments whereby the discharge from one compartment siphons water through the other compartment and into its discharge pipe and firing chamber, and mechanical means for opening the exhaust port valve to permit the siphoning action to scavenge the firing chamber.

24. The method of propelling liquids which consists in causing the explosion of fuel charges in contact with two guided bodies of liquid alternately to propel the same through a common discharge pipe, and utilizing the momentum of the liquid expelled from one body to induce a flow of liquid through the other body to expel the burned gases therefrom.

25. The method of propelling liquids which consists in causing the explosion of fuel charges in contact with two guided bodies of liquid alternately to propel the same through a common discharge pipe, and utilizing the momentum of the liquid expelled from the one body to induce a flow of liquid through the other body to expel the burned gases therefrom, and to meet the next incoming charge and increase the compression of the latter.

In testimony, that I claim the foregoing as my own, I have hereto affixed my signature.

CHARLES HENRY FOX.