No. 719,548. PATENTED FEB. 3, 1903.

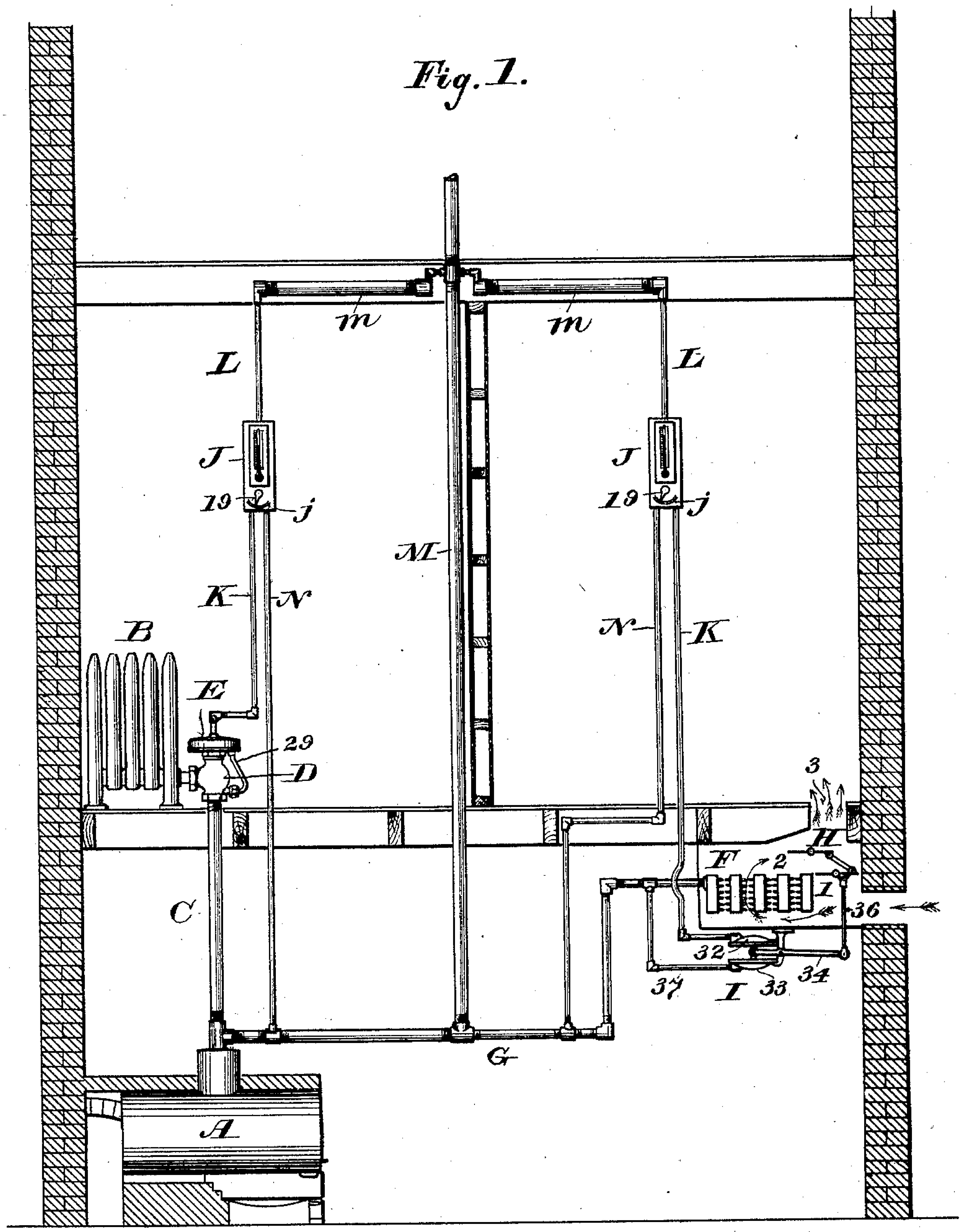
H. WINKENWERDER & B. SWARTZ.

HEAT REGULATING APPARATUS.

APPLICATION FILED OCT. 25, 1900.

NO MODEL. 5 SHEETS—SHEET 1.

Fig. 1.



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NO MODEL. 5 SHEETS—SHEET 2.

Fig. 2.

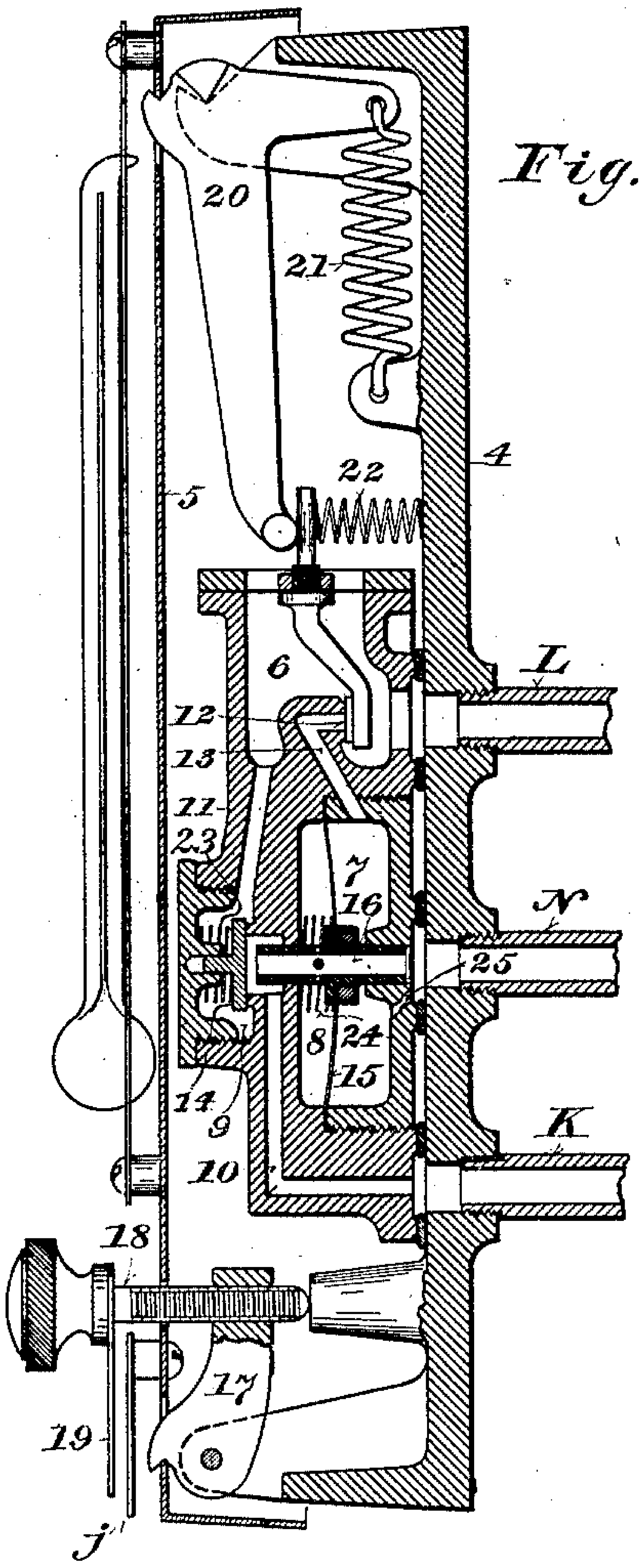

Fig. 3.

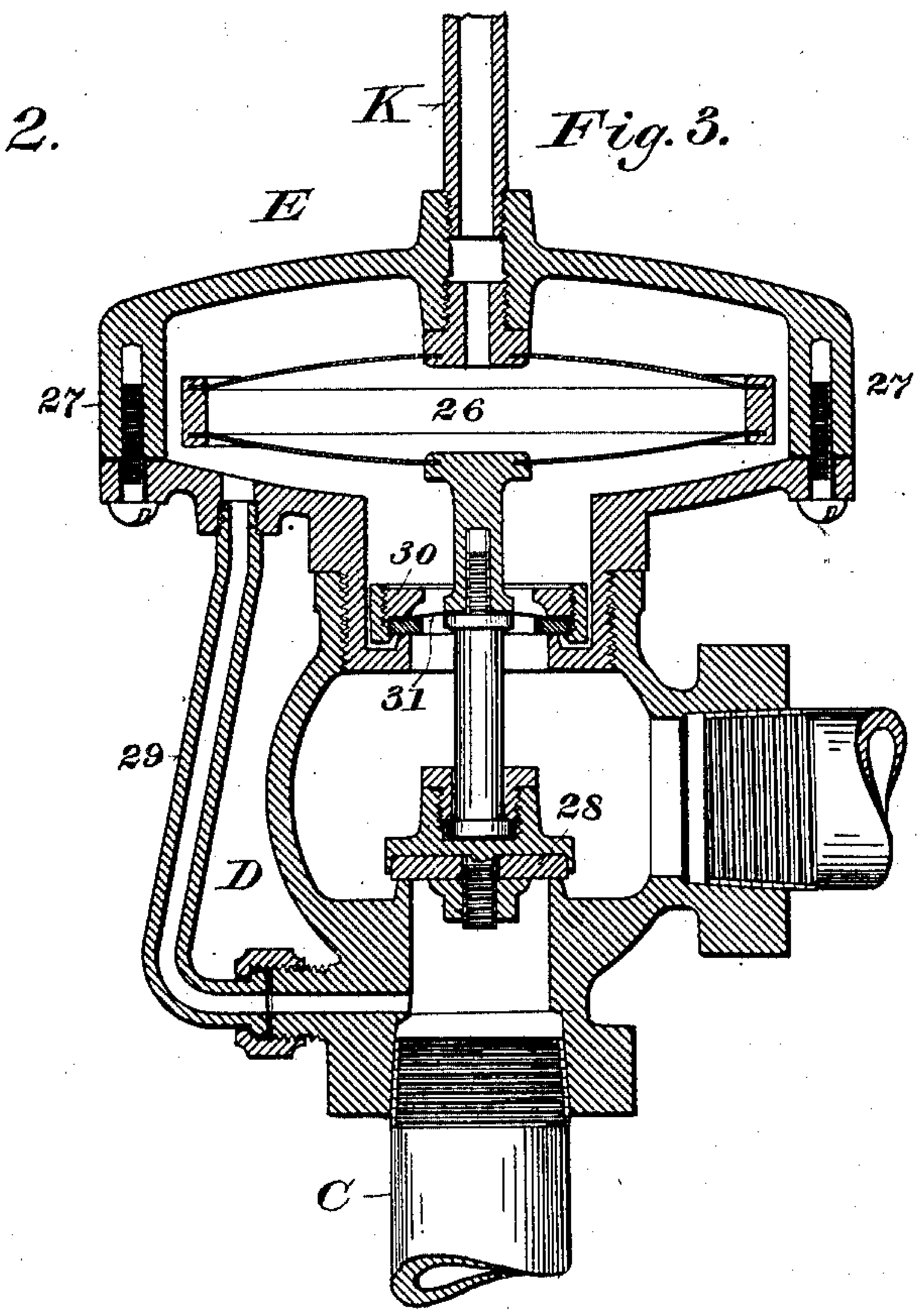

Fig. 4.

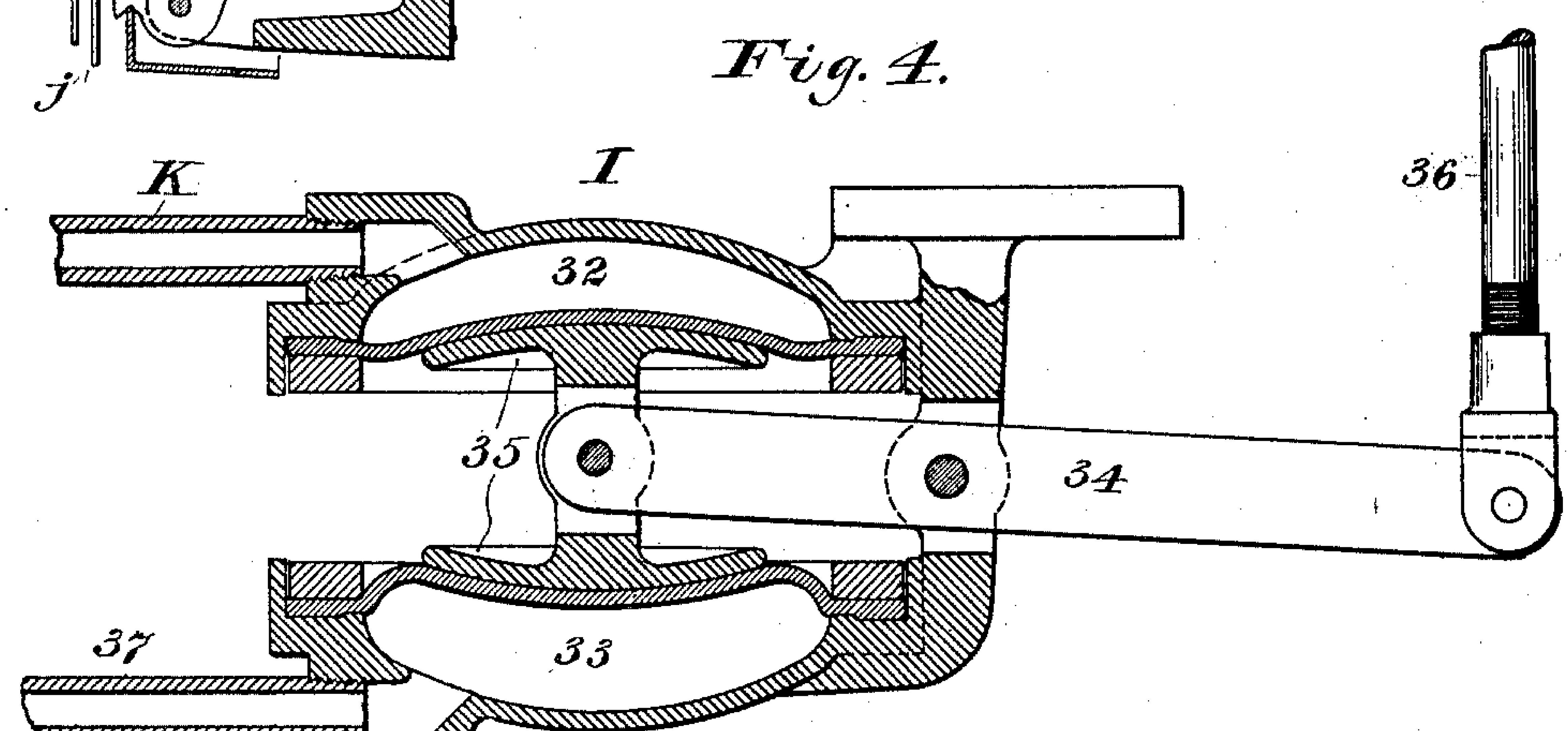

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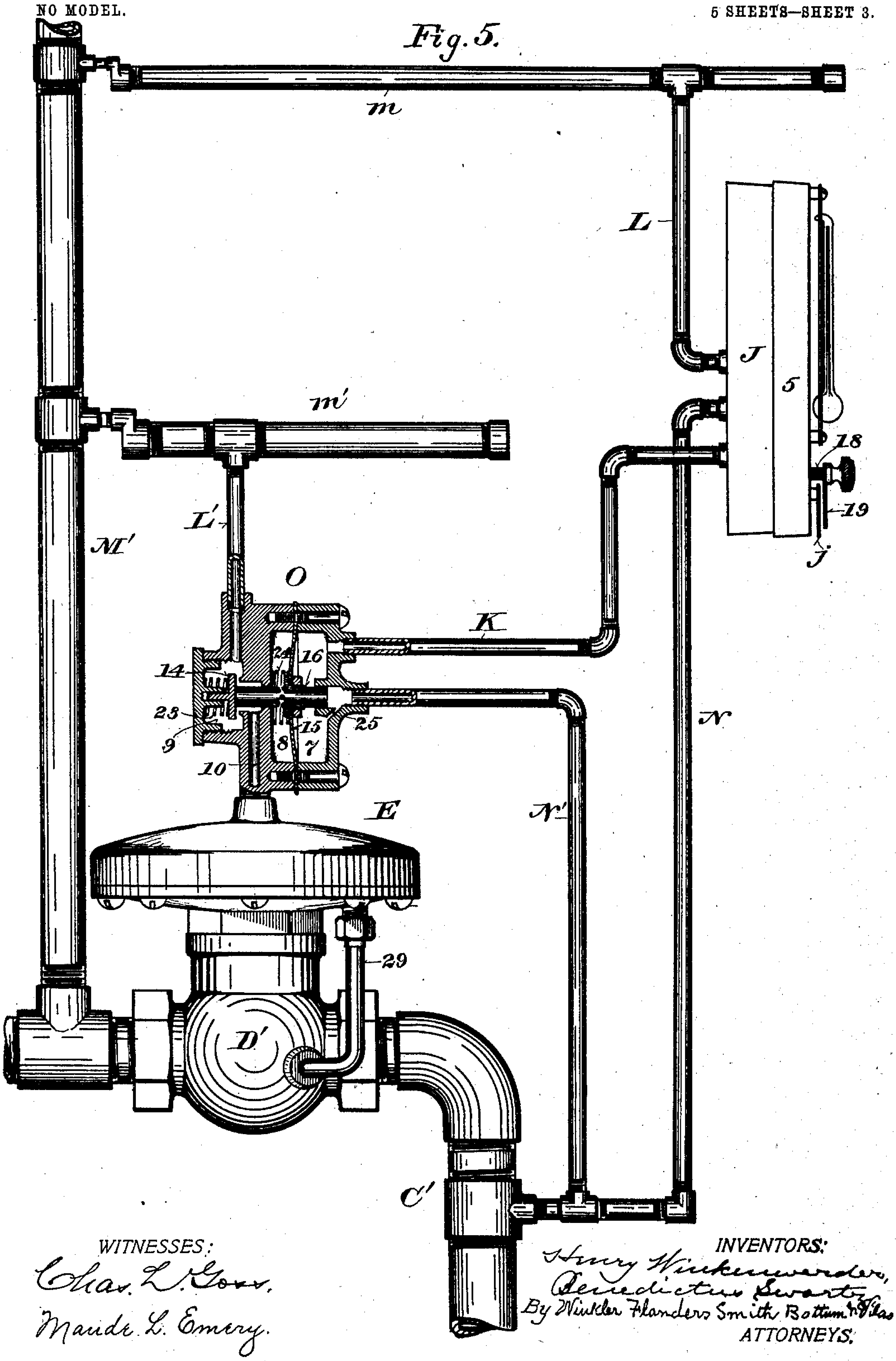
Fig. 5.



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NO MODEL. 5 SHEETS—SHEET 4.

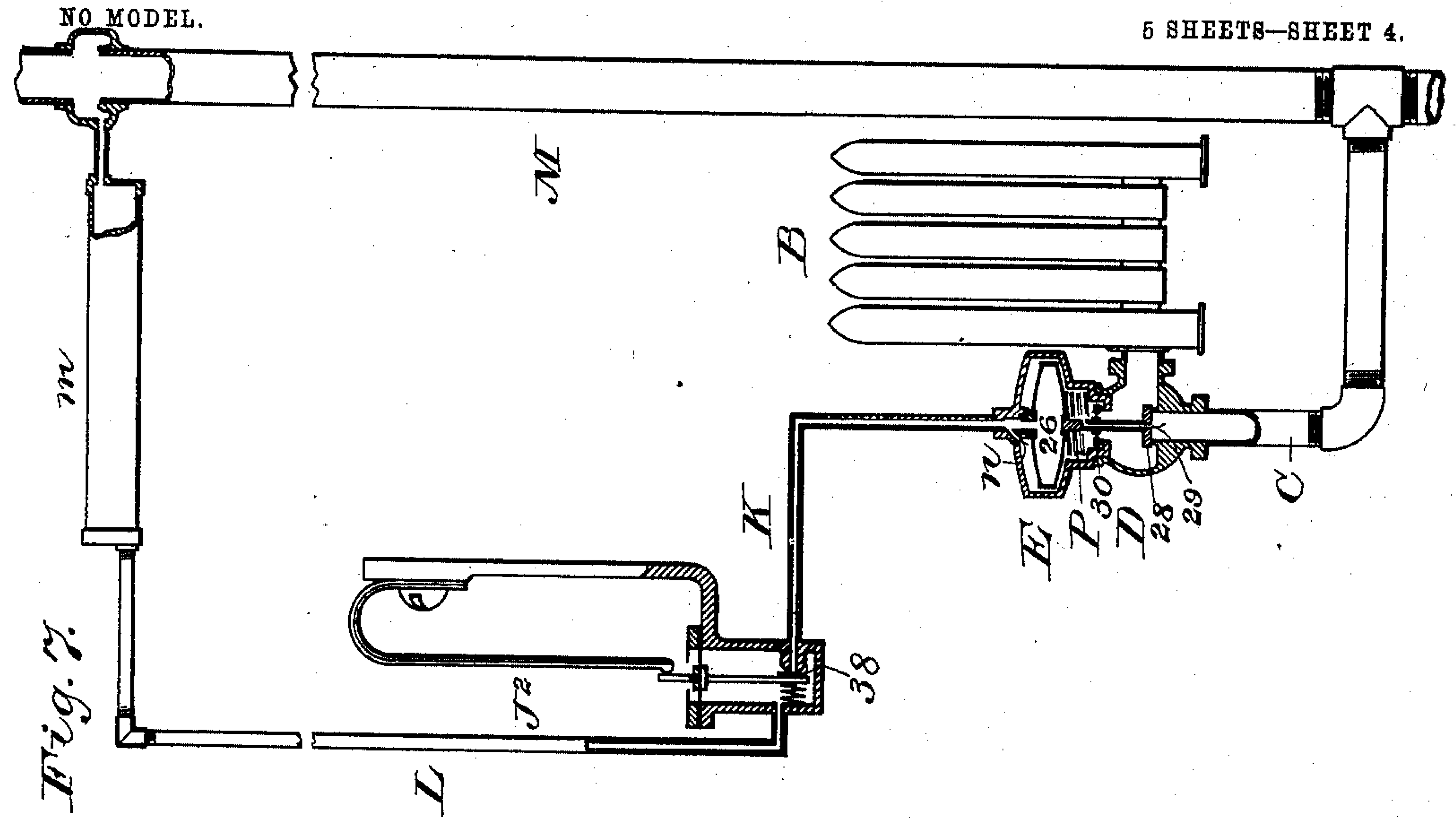

Fig. 7.

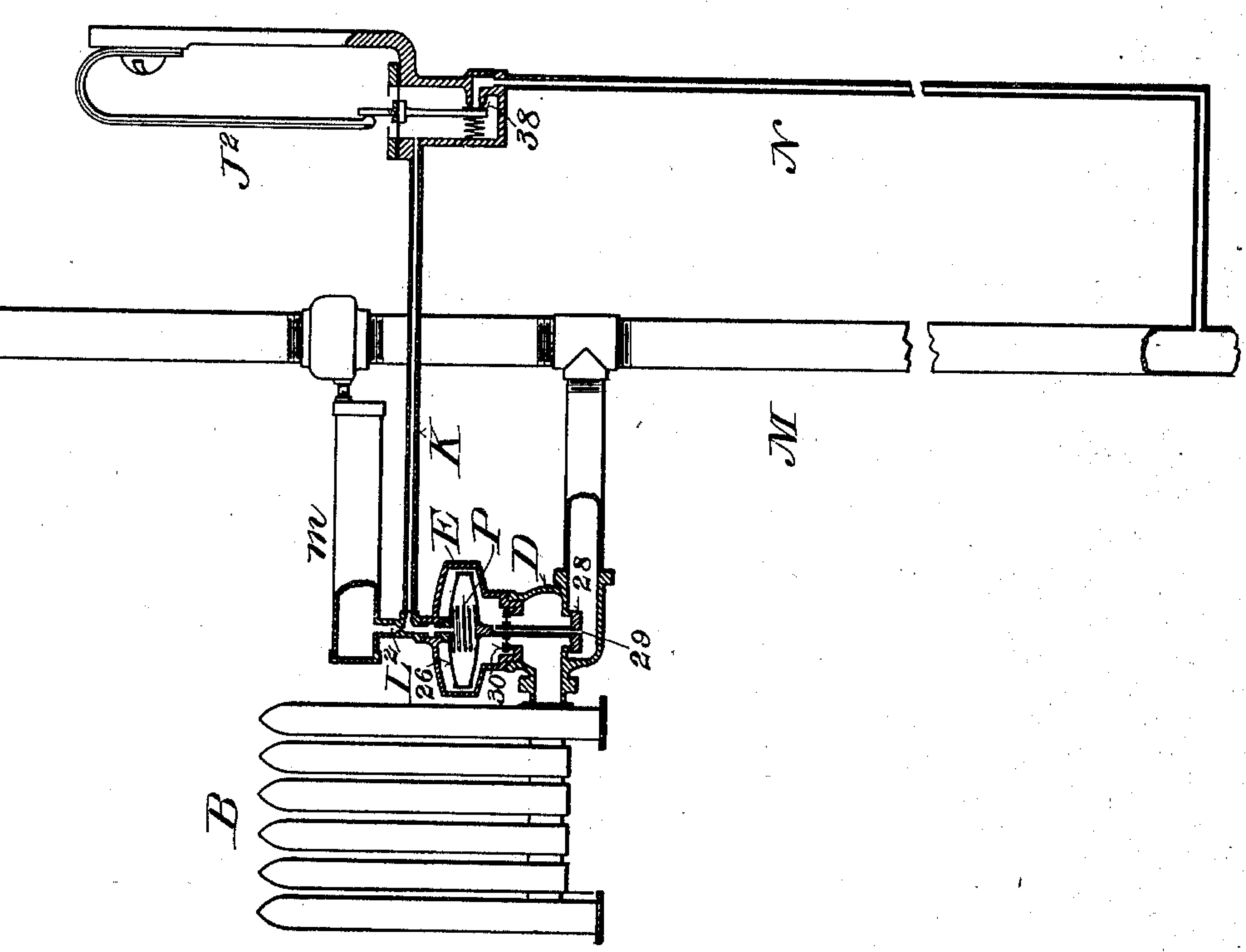

Fig. 6.

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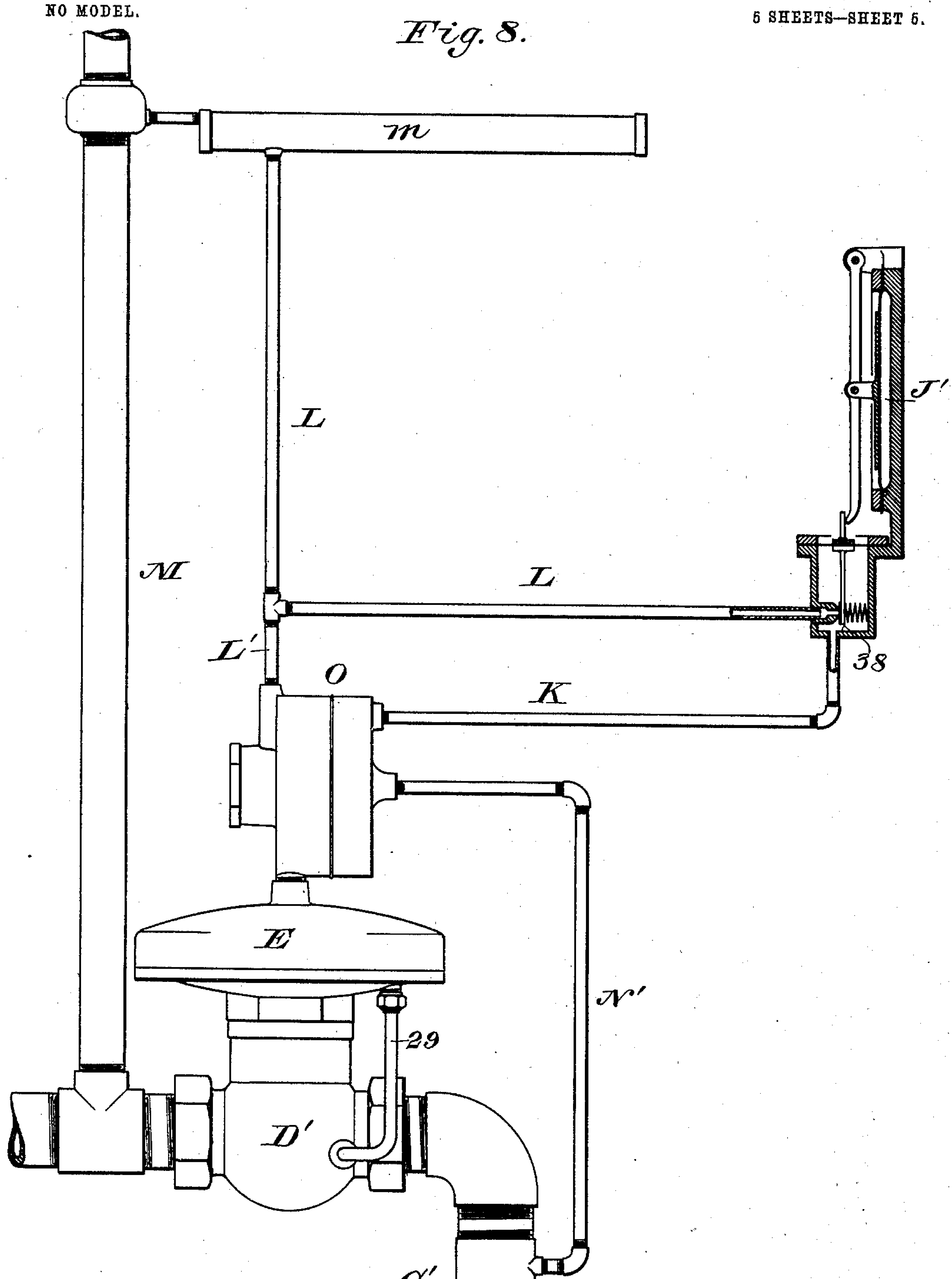
NO MODEL. 5 SHEETS—SHEET 5.

Fig. 8.



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UNITED STATES PATENT OFFICE.

HENRY WINKENWERDER AND BENEDICTUS SWARTZ, OF MILWAUKEE, WISCONSIN.

HEAT-REGULATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 719,548, dated February 3, 1903.

Application filed October 25, 1900. Serial No. 34,271. (No model.)

To all whom it may concern:

Be it known that we, HENRY WINKENWERDER and BENEDICTUS SWARTZ, citizens of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Heat-Regulating Apparatus, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

Our invention relates more particularly to the regulation or control of steam heating apparatus, but may with little modification be applied to other systems of heating. Its main objects are to dispense with a force or power medium other than that afforded by the heating medium for controlling the heating apparatus and regulating the temperature, to avoid the expense, care, and annoyance required to produce and maintain an extra force or power for the regulation of the heat produced by the apparatus, and generally to improve the construction and operation of apparatus of this class.

It consists in the construction, arrangement, and combination of parts hereinafter particularly described, and pointed out in the claims.

In the accompanying drawings like letters and numerals designate the same parts in the several figures.

Figure 1 is a general view showing one way of applying our invention to direct and indirect steam heating apparatus. Fig. 2 is a vertical section, on a greatly-enlarged scale, of one of the thermostats forming a part of the apparatus. Fig. 3 is a similar view of a motor for operating a steam-valve. Fig. 4 is a similar view of a motor for operating a damper in indirect heating apparatus. Fig. 5 is a general view, partly in vertical section, of a modification of the apparatus as designed to operate extra large valves or valves that are located at a considerable distance from the thermostats controlling them; and Figs. 6, 7, and 8 are similar views of other modifications.

Referring to Fig. 1, A designates a boiler for supplying steam in a heating system. B is a radiator arranged for direct heating and connected by a pipe C with the boiler. D is a valve in said pipe C for controlling the supply of the heating medium to said radiator. E is a fluid-motor connected with said valve. F is an incased heating-coil arranged for indirect heating. It is connected by a pipe G with the boiler. H is a double damper controlling cold and hot air ducts or openings 1 and 2, through which cold or hot air, or both, are delivered to a common duct or opening 3, communicating with the room which is to be supplied with heat and the temperature of which is to be regulated. I is a fluid-motor for operating said damper. J J are thermostats having pipe connections K, which may be called the "service" connections, with the motors E and I, pipe connections L, which may be called the "supply" connections, with a riser or pipe M of the heating system extending above the thermostats, and pipe connections N, which may be called "exhaust" connections, with the pipe G or a part of the heat-distributing system below the motors E and I.

As shown in Fig. 2, each of the thermostats J comprises a base 4, of metal or other suitable material; a cover 5, of metal or other material having a different coefficient or rate of expansion from that of the base; a valve-chamber 6, with which the supply-pipe L is connected; a diaphragm or expansion chamber 7 8, with which the exhaust-pipe N is connected; a valve-chamber 9, with which the service-pipe K is connected through a passage 10 and with which the valve-chamber 6 is connected through a passage 11; a valve 12, controlling a passage 13, leading from the chamber 6 into part 7 of the diaphragm-chamber; a valve 14, controlling communication between the passages 10 and 11, and a flexible diaphragm 15, separating the parts 7 and 8 of the expansion-chamber from each other and provided with a tubular stem 16, passing through it and closely but movably fitted at its ends in the opposite walls of said expansion-chamber. The cover 5 is engaged at or near its lower end with a hook or projection on a lever 17, which is fulcrumed to the base 4 and provided with an adjusting-screw 18, having an index 19. The index 19 projects over a scale *j* on the cover 5 and indicates thereon different degrees of temperature at which the main valves or dampers will be operated for corresponding adjustments of the screw 18, to which said index is attached. At its upper end said cover 5 is engaged with a hook or projection on a bell-crank lever 20, which is fulcrumed near its elbow to the base 4 and has its shorter arm connected by a spring 21 with said frame and its longer arm adapted to engage with the stem of valve 12. The stem of said valve 12 projects through and is attached to a flexible diaphragm forming the top or upper wall of chamber 6. A spring 22 tends to force the protruding end of said valve-stem toward the longer arm of lever 20 and to open the valve 12. The valve 14 is held normally closed against its seat by a spring 23. The diaphragm 15 is pressed normally toward the exhaust-pipe N by a spring 24. One end of the tubular stem 16 is in constant and open communication with the exhaust-pipe N, and the other end when withdrawn toward the exhaust-pipe from engagement with the valve 9 communicates with the service-passage 10. The passage through said tubular stem communicates constantly through lateral openings with part 8 of the expansion-chamber. Part 7 of said expansion-chamber communicates constantly with the exhaust-pipe N through a restricted passage or opening 25 of smaller area than the supply-passage 13.

The motor E for operating the valve D, as shown in Fig. 3, consists of an expansible chamber 26, inclosed in a casing 27, which is mounted upon a valve-case. The chamber 26, which may be conveniently constructed of two flexible disks of sheet metal or other suitable material secured at their edges in a metal ring, is attached centrally at the top to the top of casing 27 and communicates with a service-pipe K. It is also attached centrally on the lower side to the stem of the main valve 28. A by-pass 29 connects the pipe C at a point below the main valve 28 with the space inclosed by the casing 27 around the expansion-chamber 26. A valve 30, yieldingly connected by a diaphragm 31 with the stem of the main valve 28, is arranged to close the opening or passage between the main-valve chamber and the casing 27 when the main valve is closed and also to balance the pressure on the main valve. This valve 30 takes the place of a stuffing-box to prevent the flow of the heating medium through the by-pass 29 into the radiator when the main valve is closed and admits of a perfectly free operation of the main valve.

The motor I for operating the damper H consists of two opposing diaphragm-chambers 32 and 33 and a lever 34, pivoted at one end to the stem connecting the diaphragm-plates 35 and connected at the other end by a link 36 with the damper. The chamber 32 is connected by a service-pipe K with a thermostat J, and the chamber 33 is connected by a pipe 37 with the heating-pipe G or other convenient part of the heating system.

In steam-heating systems the vertically-disposed parts of the supply-pipes L are preferably connected at their upper ends with horizontally-disposed headers *m* of larger diameter than said pipes, such headers being connected, as shown in Fig. 1, at a level above them with the riser M or some convenient part of the heat-distributing system and serving as reservoirs to collect and hold a sufficient quantity of water of condensation for the operation of the heat-regulating mechanism.

The apparatus hereinbefore described operates as follows: Assuming that the several movable parts of the thermostat J, which is associated with the valve D and motor E, are in positions, as shown in Fig. 2, for holding the main valve 28 open and admitting the heating medium to radiator B, if the temperature rises to the degree at which the thermostat is adjusted to close the valve the expansion of the cover 5 will permit the spring 21 to throw the longer arm of the lever 20 outward and allow the spring 22 to open the valve 12. When this occurs, water under pressure of the column which fills the associated pipe L and header *m* will flow through the passage 13 into part 7 of the expansion-chamber faster than it can escape from said chamber through the restricted opening 25. The diaphragm 15 will thereupon be flexed outward toward part 8 of the expansion-chamber against the tension of spring 24, and the outer end of the tubular stem 16 will be carried against the face of valve 14 and force it off from its seat against the tension of spring 23. This will close communication through the tubular valve-stem 16 between the service-pipe K, leading to the motor E, and the exhaust-pipe N, leading to the pipe G below said motor, and at the same time open communication through the passage 10, chamber 9, passage 11, and chamber 6 between said service-pipe K and the supply-pipe L. The weight of the column of water in the pipe L and the associated header *m* being thus added to the weight of the column of water in the thermostat and service-pipe K will expand chamber 26 and close the main valve 28 and the auxiliary valve 31, as shown in Fig. 3, thereby shutting off the heating medium from the radiator. As long as the thermostatic valve 12 is held open the main valve 28 will be held closed and the heating medium excluded from the radiator. As the temperature falls the contraction of the cover 5 or expansion-strip of the thermostat will move the longer arm of lever 20 inward against the tension of spring 21, and when the temperature reaches that degree at which the thermostat is adjusted, as indicated by the index 19, to open the main valve said lever 20 will close the valve 12 against the tension of spring 22. When this occurs, the weight of the column of water in the exhaust-pipe N will tend to exhaust part 7 of the expansion-chamber through the restricted opening 25 and will immediately equalize the pressures in the two parts 7 and 8 of said chamber. Diaphragm 15 will thereupon be flexed inwardly by the spring 24 and move the tubular stem 16 away from the valve 14, allowing said valve to be closed by the spring 29. The superincumbent weight of the column of water in the supply-pipe L will thus be taken off from the column of water in the service-pipe K, and the weight of the column of water in the exhaust-pipe N, acting through the tubular stem 16 and passage 10, will be exerted to lift the column of water in the pipe K and to exhaust the expansion-chamber 26, or, in other words, the pipe N being connected at its upper end with the upper end of the pipe K will act therewith as a siphon and will contract the chamber 26 and open the main valve 28, at the same time opening the auxiliary valve 30. The space inclosed by the casing 27 around the expansible chamber 26 being in constant communication with the heat-distributing system through the by-pass 29, the walls of said chamber are subjected on the outside to the same pressure as that exerted upon the water in the headers *m* or to the pressure existing at any given time in the heat-distributing system. By this means the force exerted by the water columns, as above explained, to operate the main valve is unaffected by fluctuations in the pressure employed to circulate the heating medium, and such force is rendered determinate and constant.

The action of the apparatus in the operation of the damper H is like or similar to its action in the operation of the valve D. The damper H in the position in which it is shown in Fig. 1 closes the duct 1 and opens the duct 2, admitting hot air into the room in which the controlling-thermostat is located. When the temperature of the room reaches the degree at which the thermostat is adjusted to shut off the hot air and open the cold-air supply, the expansion of the cover 5 or lengthening of the expansion-strip of the thermostat will permit the opening of the valve 12, as hereinbefore explained. This will close communication between the service-pipe K and the exhaust-pipe N and will open communication between said pipe K and the supply-pipe L. As soon as this occurs the weight of the water column in pipe L added to that in pipe K will be exerted upon the diaphragm of chamber 32, and the end of lever 34, with which the diaphragm is connected, will be depressed, while its opposite end is elevated and shifts the double damper H so as to open the cold-air duct 1 and close the hot-air duct 2. The same pressure is exerted in chamber 33 in opposition to that in chamber 32 as is exerted in the heat-distributing system, so that the water columns in the pipes K, L, and N, which communicate therewith, will act with a certain predetermined force to operate the damper H, as hereinbefore explained in connection with the by-pass 29 in relation to the motor E. As the temperature falls the valve 12 will be closed, communication between the pipes K and L will be again cut off, and communication between the pipes K and N established, as hereinbefore explained. The water column in the pipe N will now tend to exhaust the chamber 32 and will shift the lever 34 and the damper H so as to close the direct cold-air duct 1 and open the hot-air duct 2.

Referring to Fig. 5, which illustrates a modification of the apparatus for operating large valves or valves located at a considerable distance from the controlling-thermostats, O is a relay comprising an expansion-chamber divided into two parts 7 and 8 by a diaphragm 15, a valve-chamber 9, and valve mechanism similar to that of the thermostats hereinbefore described. The service-pipe K connects part 7 of the expansion-chamber with the passage 10 of the thermostat, and the passage 10 of the relay communicates directly with the expansible chamber 26 of the motor E. The valve-chamber 9 of the relay is connected by a supply-pipe L′ and a header *m*′ with a riser M′ or a part of the heat-distributing system above the relay. A pipe N′, communicating with the end of the tubular stem 16 opposite the valve 14 and through a restricted opening 25 with part 7 of the expansion-chamber of the relay, leads downwardly therefrom and connects with the pipe C′ or a part of the heat-distributing system below the motor E. The thermostat associated with the relay is connected with the heat-distributing system by supply and exhaust pipes L and N, as hereinbefore described. This modified arrangement of the apparatus operates as follows: The lengthening of the cover 5 or expansion-strip of the thermostat caused by a rising temperature allows the valve 12 to open, as hereinbefore explained. The pressure in part 7 of the expansion-chamber of the relay is thus augmented, flexing the diaphragm 15 against the tension of spring 24 toward the valve 9. The tubular stem 16 of the relay being thus forced against the valve 14 unseats said valve, first closing communication between the service-passage 10 and the exhaust-pipe N′, through said stem, and then opening communication between said service-passage and the supply-pipe L′. The expansible chamber 26 of the motor E is then subjected to the pressure of the water column in the supply-pipe L′ and header *m*′, and the main valve D′ is closed. As the temperature falls and the cover or expansion strip of the thermostat contracts, the valve 12 is closed, communication between the pipes L and K is cut off, and communication between the pipes K and N is established, thereby tending to exhaust part 7 of the expansion-chamber of the relay. The pressure in the parts 7 and 8 of said expansion-chamber being thus equalized, the diaphragm 15 is flexed by the spring 24 toward the exhaust-pipe N′. This allows the valve 14 to close, cutting off communication between the service-passage 10 and the supply-pipe L′ of the relay, and establishes communication between said passage 10 and the exhaust-pipe

N′. A part of the water in the expansible chamber 26 of the motor E is siphoned off through the passage 10, hollow stem 16, and pipe N′ into the pipe C′, the upper and lower walls of said chamber are forced toward each other, and the main valve is opened, allowing the heating medium to pass from the pipe C′ to the heating apparatus beyond said valve. The relay accelerates the operation of the motor E, and the opening and closing of the valve D′ relieves the thermostatic-valve mechanism of excessive duty and avoids the necessity of providing larger pipe connections between the thermostat and motor, on the one hand, and the heat-distributing system on the other.

Various changes in details of construction and arrangement of parts may be made within the spirit and intended scope of our invention—as, for example, in place of the thermostatically-controlled liquid-supply pipe L a simple restricted liquid-supply connection L^2, leading to the motor, may be employed, as shown in Fig. 6, in connection with the thermostatically-controlled exhaust connection N, or in place of said thermostatically-controlled exhaust connection a simple restricted waste connection *n*, leading from the motor, may be employed, as shown in Fig. 7, in connection with the thermostatically-controlled liquid-supply pipe L. In case of the omission of either of these thermostatically-controlled connections a spring *p* should be substituted to act in its place upon the movable part of the motor in opposition to the remaining fluid connection, and a simple thermostatic valve 38 may be employed in place of the thermostatic-valve mechanism shown in Fig. 2. We prefer, however, to employ both the supply and exhaust connections, and thus dispense with springs in the main motors.

Any well-known form of thermostatic device—such as an expansible chamber J′, containing a volatile liquid, as shown in Fig. 8, or an expansion-strip J^2, made of two materials having different coefficients of expansion, as shown in Figs. 6 and 7—may be substituted in place of the device shown in Fig. 2 for operating the primary thermostatic valve 12, and in the modification shown in Fig. 5 a simple thermostatic valve, such as the valve 58, (shown in Figs. 6 and 7,) may be employed to control communication between the pipes L and K, and in that case the exhaust-pipe N, leading downward from the thermostat, may be dispensed with, as shown in Fig. 8. The supply-pipe L′ of the relay O may be connected with the same header *m* with which the supply-pipe L of the thermostat is connected, as shown in Fig. 8.

We claim—

1. In heat-regulating apparatus, the combination with a heating system, of a heat-controlling valve or damper, a fluid-pressure motor for operating said valve or damper, one side of said motor being exposed at all times to the pressure of the medium in the heating system, means for producing hydrostatic pressure on the motor in opposition to the pressure produced by the heating medium, said means being in communication with the heating system above the pressure-motor, and thermostatically-controlled means for governing said hydrostatic pressure, substantially as described.

2. In heat-regulating apparatus the combination with a heating system, of a heat-controlling valve or damper, a fluid-pressure motor for operating said valve or damper, a water-conduit connected with said motor and having supply and waste connections communicating with the heating system at different levels, and thermostatic-valve mechanism controlling the application of the weight of the water in said conduit and either of its connections to the operation of said motor, substantially as described.

3. In heat-regulating apparatus, the combination with a heating system, of a heat-controlling valve or damper, a fluid-pressure motor for operating said valve or damper, a water-conduit connected with said motor and having supply and waste connections communicating with the heating system at different levels, one of said connections being above said motor, and thermostatic-valve mechanism controlling the application of the weight of the water in said conduit and its connection with the heating system above the motor to the operation of said motor, substantially as described.

4. In heat-regulating apparatus, the combination with a heating system, of a heat-controlling valve or damper, a fluid-pressure motor for operating said valve or damper, a water-conduit connected with said motor and having supply and waste connections communicating with the heating system at different levels, one of said connections being below the motor, and thermostatic-valve mechanism controlling the application of the weight of the water in said conduit and its connection with the heating system below the motor to the operation of said motor, substantially as described.

5. In heat-regulating apparatus, the combination with a heat-distributing system, a heat-controlling valve or damper and a fluid-pressure motor for operating said valve or damper, of a liquid-exhaust pipe having a liquid-supply connection with the heat-distributing system and connected with said motor and with the heat-distributing system below said motor and below its supply connection, and thermostatic-valve mechanism controlling the flow of liquid through said exhaust-pipe, substantially as described.

6. In heat-regulating apparatus, the combination with a heat-distributing system, of a main heat-controlling valve or damper and a fluid-pressure motor for operating said valve or damper, and thermostatically-controlled liquid supply and exhaust connections com-

municating with said motor, and with the heat-distributing system above and below said motor, substantially as described.

7. In heat-regulating apparatus, the combination with a heat conveying or distributing system, a main heat-controlling valve or damper, and a fluid-pressure motor for operating said valve or damper, of liquid supply and exhaust pipes connected with the heat conveying or distributing system above and below said motor respectively, and thermostatically-controlled valve mechanism adapted to automatically open or close communication between said motor and either said supply or exhaust pipe according to variations in temperature, substantially as described.

8. In heat-regulating apparatus, the combination with a heat-controlling valve, of a motor for operating the same comprising an expansible chamber connected with said valve, a casing inclosing said chamber and having free communication with the heat-supply pipe, fluid supply and exhaust pipes connected with the heating system above and below said motor, and thermostatic-valve mechanism controlling communication between the expansible chamber of said motor and said supply and exhaust pipes, substantially as described.

9. In heat-regulating apparatus, the combination with a heating system including a heat-controlling valve, of a motor for operating said valve, consisting of an expansible chamber connected with said valve on one side and a casing inclosing said chamber and attached to the other side thereof, a by-pass connecting the inclosed space around said chamber with the heating system on the opposite side of said valve, an auxiliary valve having a yielding connection with the main valve and adapted to close the opening between the main-valve chamber and the motor when the main valve is closed, fluid supply and exhaust pipes connected with the heating system above and below said motor, and thermostatic-valve mechanism controlling communication between the expansible chamber of said motor and said supply and exhaust pipes, substantially as described.

10. In heat-regulating apparatus, the combination with a heating system, of a heat-controlling valve or damper, a fluid-pressure motor having a waste connection for operating said valve or damper, a liquid-reservoir the upper part of which is connected with said heating system above said motor, a pipe connecting said reservoir with said motor, and thermostatic-valve mechanism operated by variations in temperature controlling the flow of liquid through said pipe, substantially as described.

11. In heat-regulating apparatus, the combination with a heating system comprising a heat-controlling valve or damper, of a fluid-pressure motor for operating said valve or damper, a reservoir connected with the heating system above said motor, a vertically-disposed fluid-supply pipe of smaller size connected at its upper end with said reservoir, an exhaust-pipe connected with the heating system below the motor, and thermostatic-valve mechanism controlling communication between said motor and said supply and exhaust pipes, substantially as described.

12. In heat-regulating apparatus, the combination with a heating system comprising a heat-controlling valve or damper, of a fluid-pressure motor for operating said valve or damper, valve mechanism comprising a chamber divided into two parts by a flexible diaphragm having a tubular stem open at the ends, which project into and are movably fitted in openings in the walls of said chamber on opposite sides of the diaphragm, a valve-chamber having a fluid-supply connection and a service connection leading to the motor, a valve controlling communication between said connections and adapted to be opened by said tubular stem and when so opened to close the contiguous end of said stem, a thermostatically-controlled fluid-supply connection with one part of the diaphragm-chamber and exhaust connections with both parts of said diaphragm-chamber, the exhaust connection with that part having the thermostatically-controlled supply connection being restricted and the exhaust connection with the other part being through said tubular stem, substantially as described.

13. In heat-regulating apparatus, the combination with a heating system including a main heat-controlling valve, of a pressure-chamber opening into the valve-chamber on one side of the main valve and connected by a passage with the heating system on the opposite side of said valve, and an auxiliary valve having a yielding connection with the main valve and adapted to close the opening between the pressure-chamber and the valve-chamber when the main valve is closed, substantially as described.

In witness whereof we hereto affix our signatures in presence of two witnesses.

HENRY WINKENWERDER.
BENEDICTUS SWARTZ.

Witnesses:
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Chas. L. Goss.