E. SCHULTE.

REGULATOR FOR GAS PUMPING SYSTEMS.

APPLICATION FILED APR. 3, 1907.

958,185.

Patented May 17, 1910.

4 SHEETS—SHEET 1.

Fig. 1.

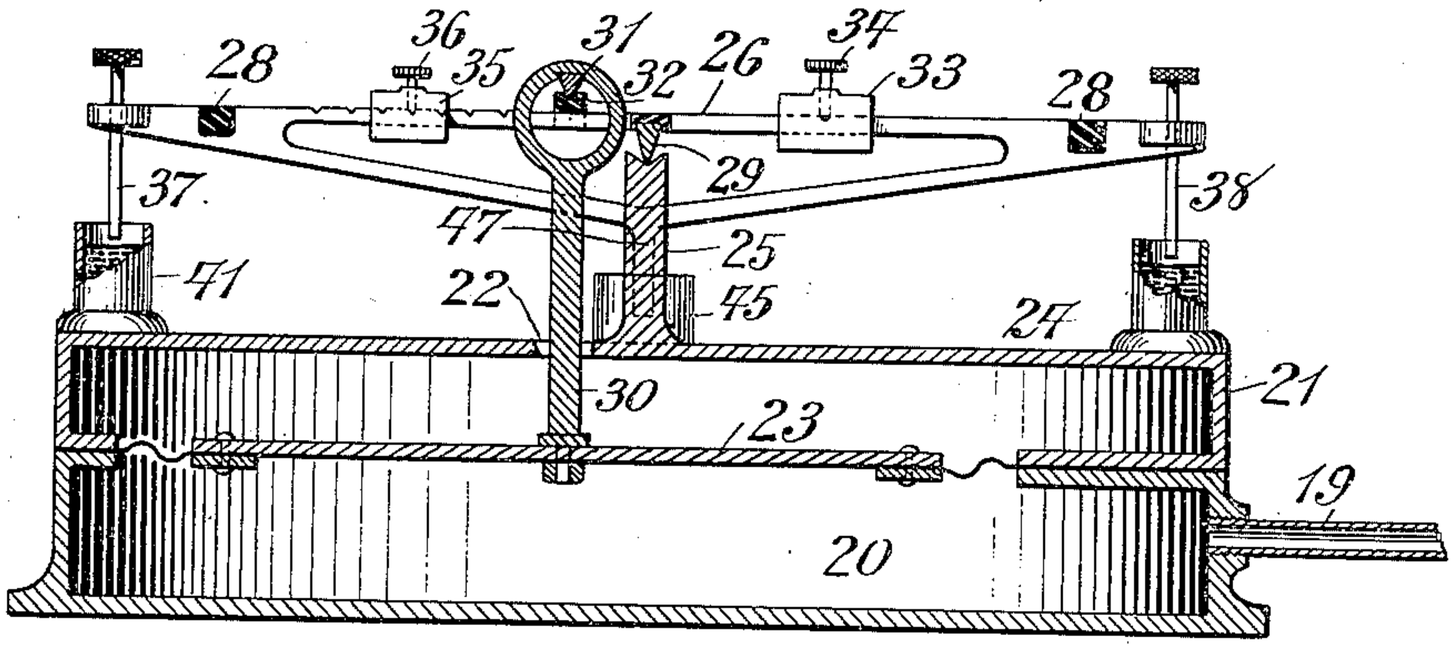
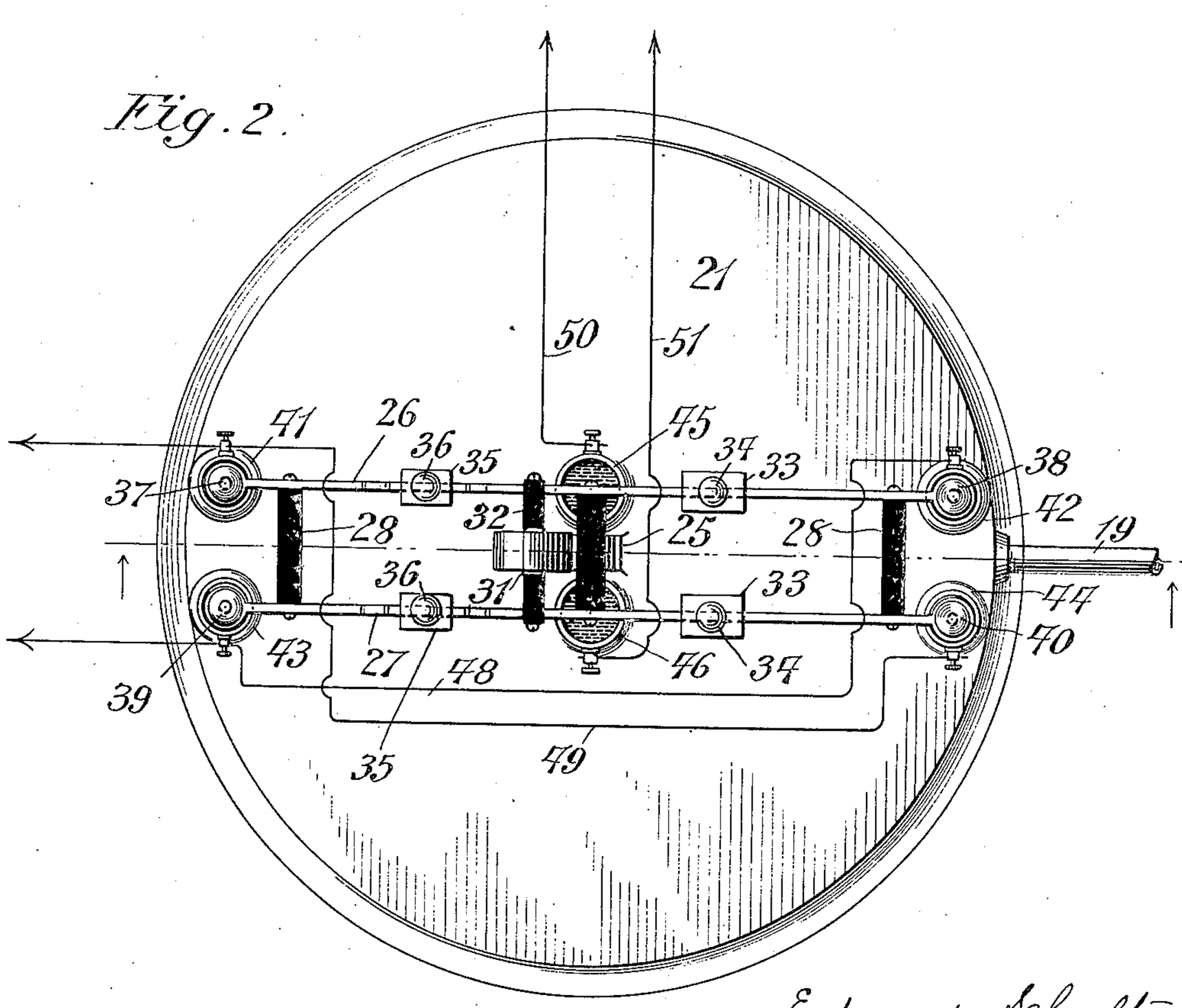


Fig. 2.



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4 SHEETS—SHEET 2.

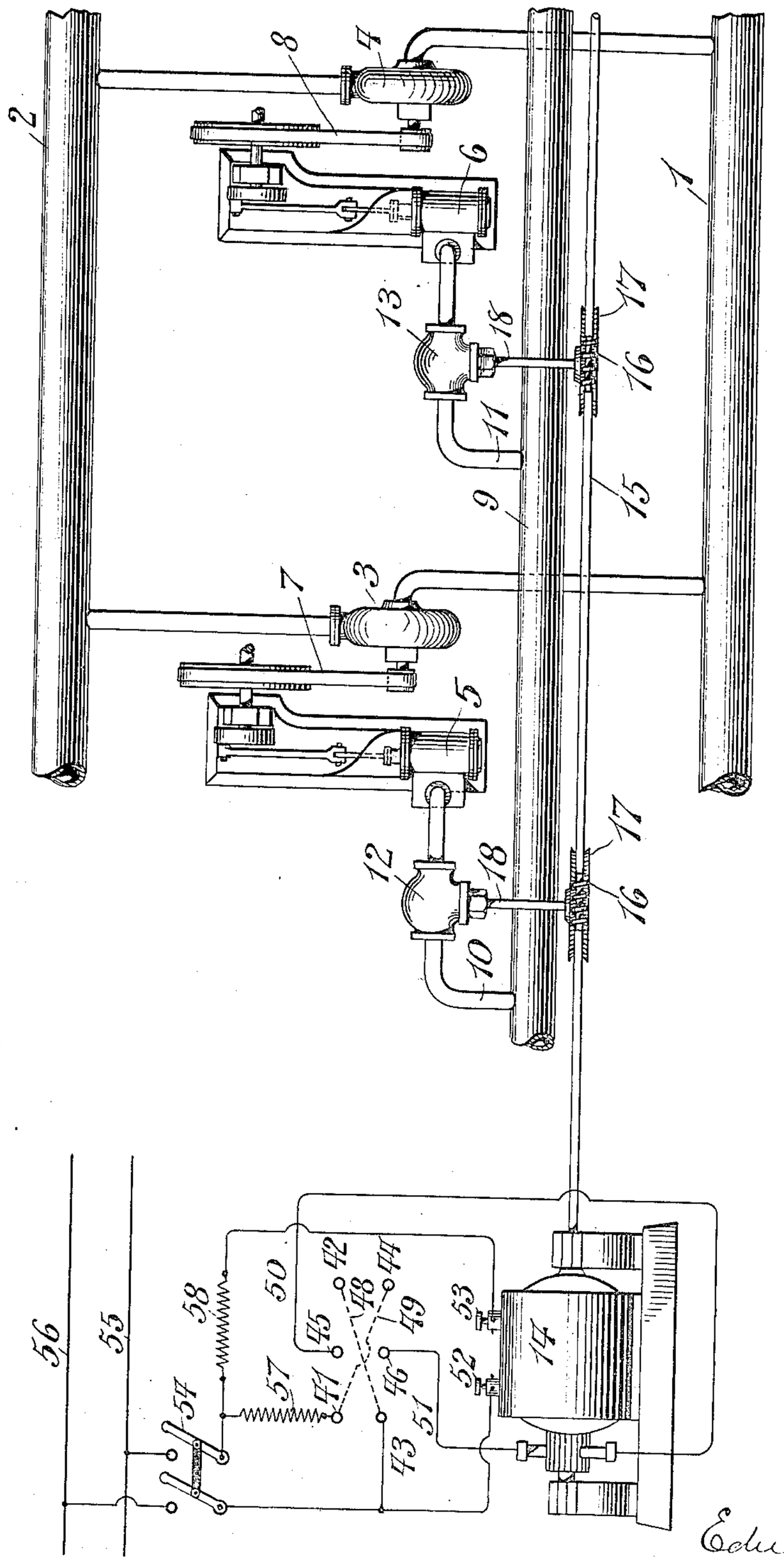

Fig. 3.

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4 SHEETS—SHEET 3.

Fig. 4.

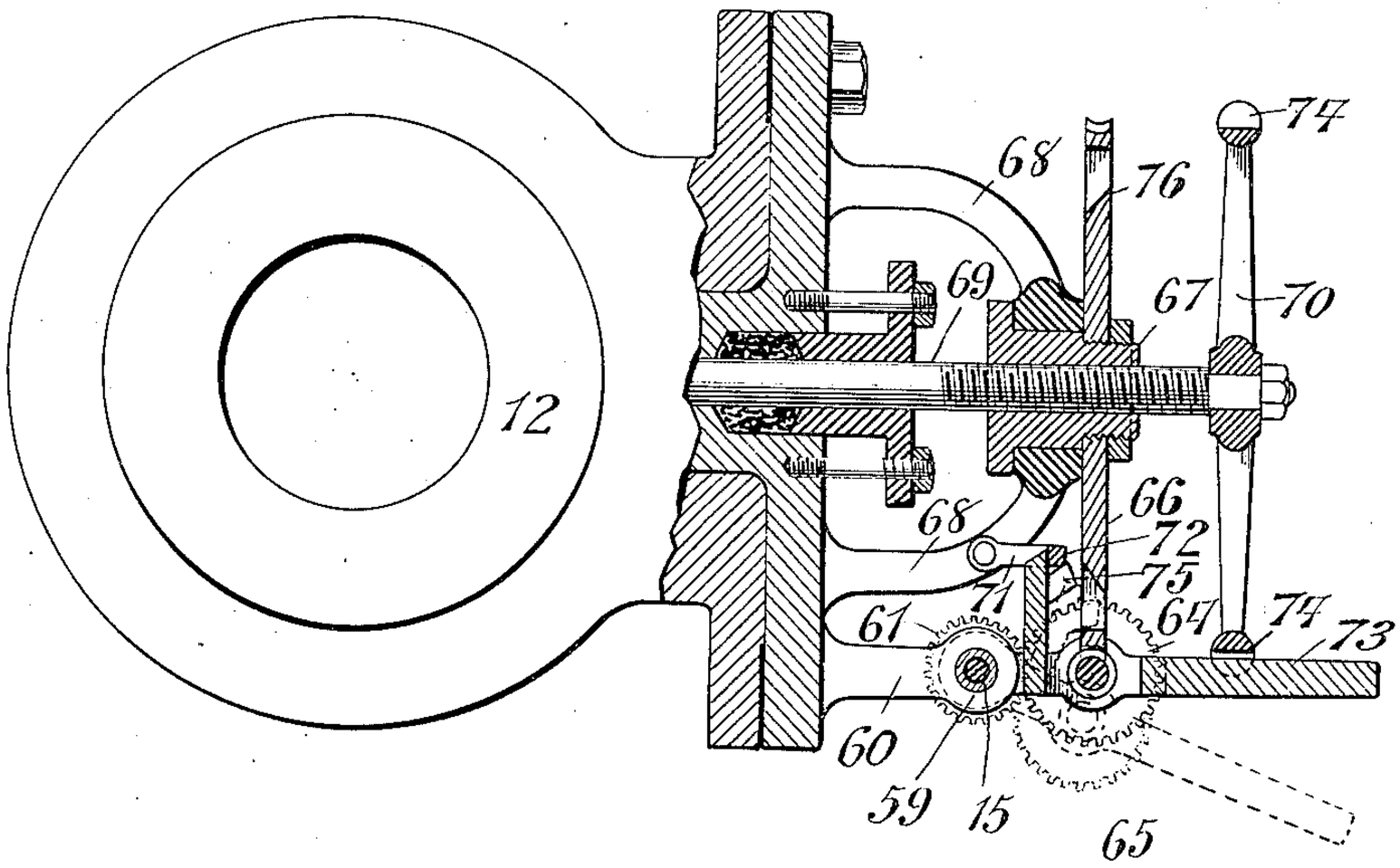
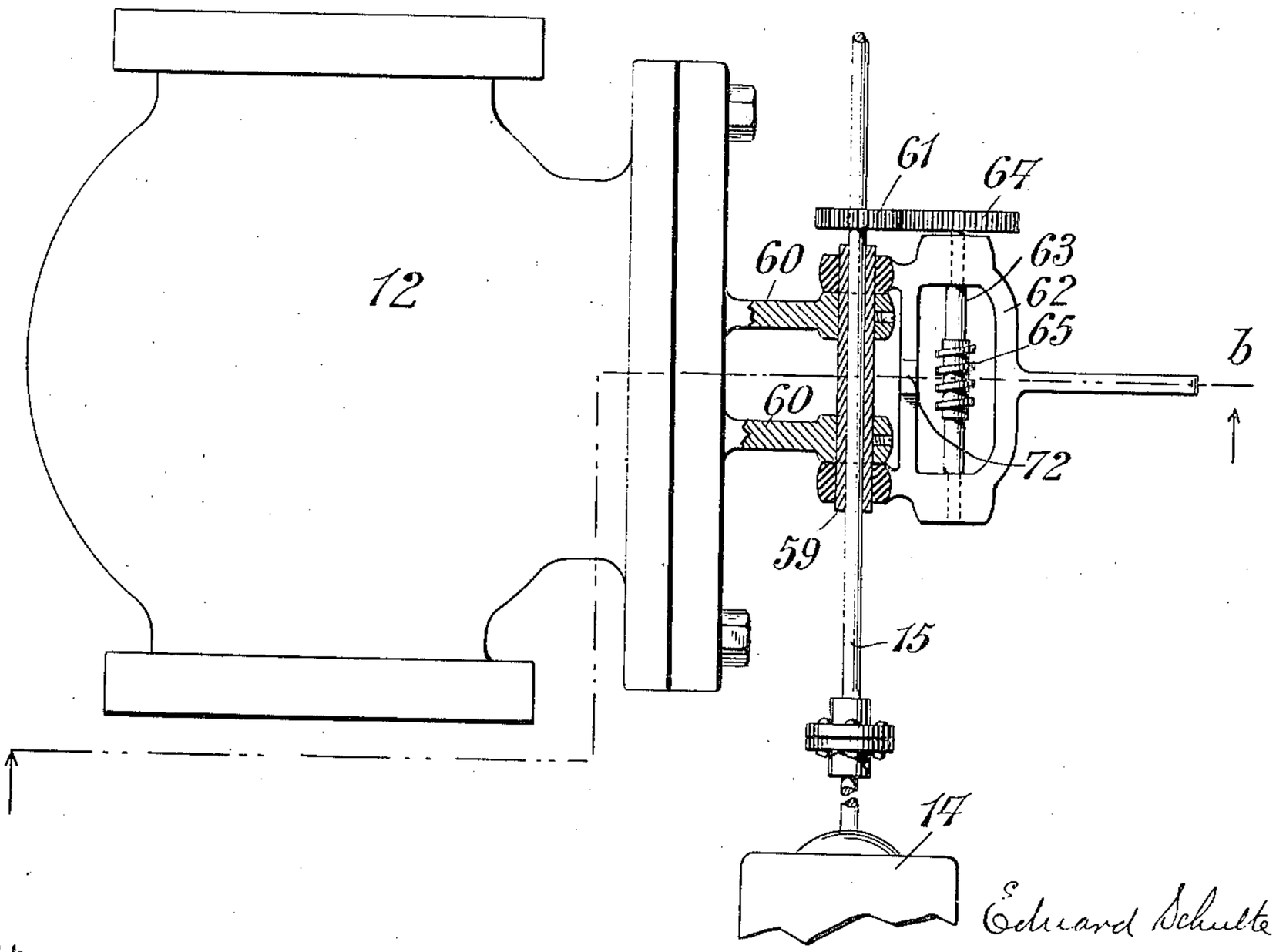


Fig. 5.



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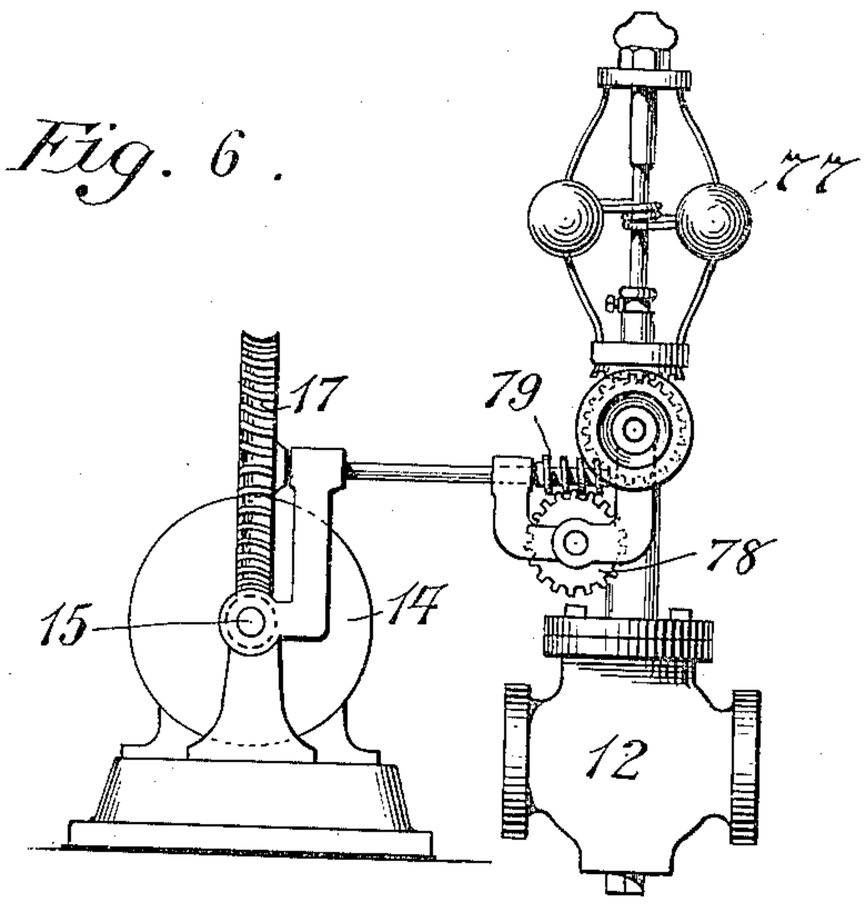
4 SHEETS—SHEET 4.

Fig. 6.



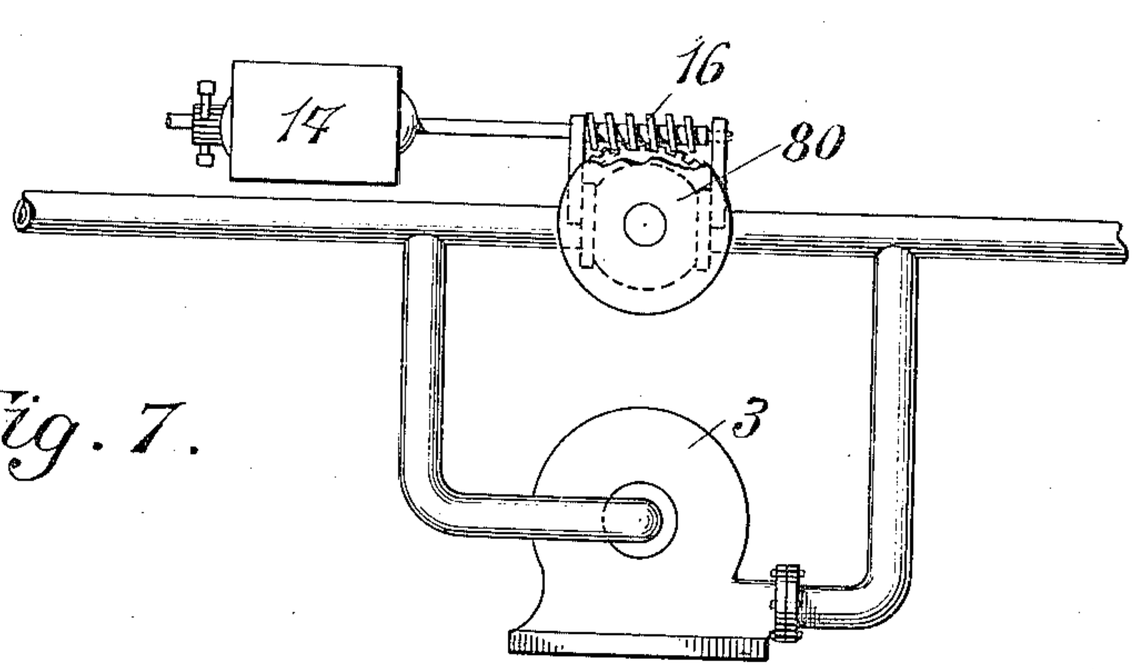
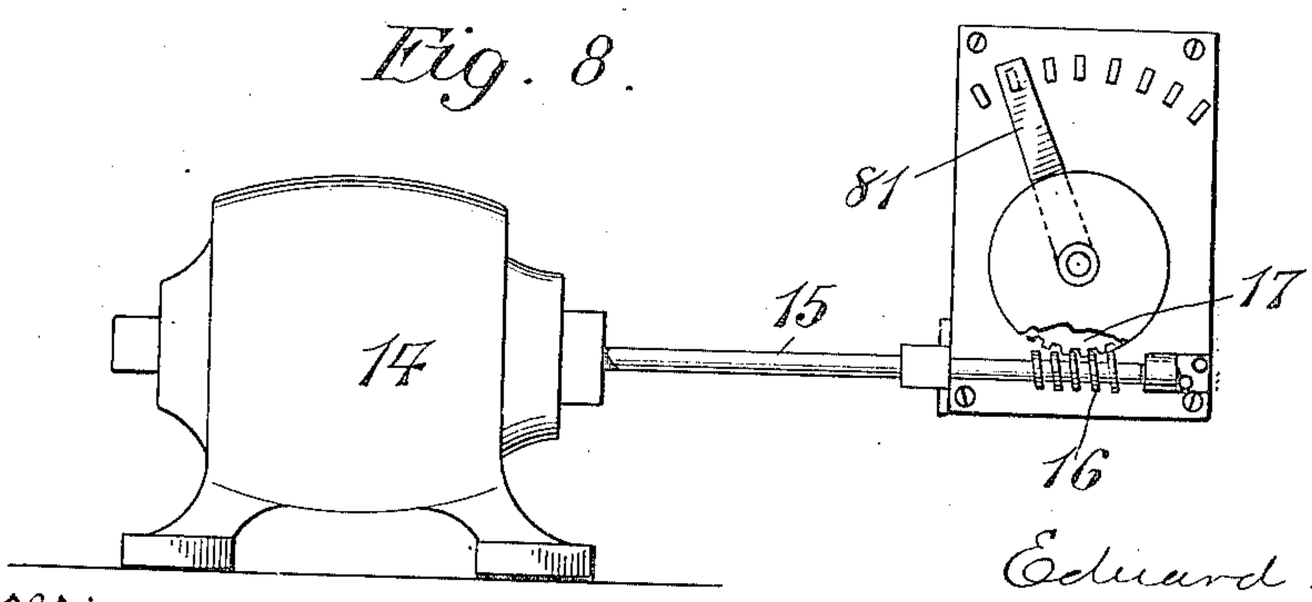


Fig. 7.

Fig. 8.



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UNITED STATES PATENT OFFICE.

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REGULATOR FOR GAS-PUMPING SYSTEMS.

958,185. Specification of Letters Patent. Patented May 17, 1910.

Application filed April 3, 1907. Serial No. 366,168.

To all whom it may concern:

Be it known that I, EDUARD SCHULTE, a subject of the Emperor of Germany, residing in the borough of Manhattan, city, county, and State of New York, have invented a certain new and useful Improvement in Regulators for Gas-Pumping Systems, of which the following is a specification.

This invention has relation to an improved apparatus for automatically governing machinery employed in modifying air or gas pressures, and the same may be applied either to compression systems or to exhausting blowers.

One principal object of this invention is the provision of simple and effective mechanism for the above named purpose whereby very small changes in air or gas pressures are made to affect the pumping, blowing or exhausting devices; and in this connection the preferred form of my invention is made adjustable, not only for initially accommodating a given regulating device to a given air or gas pumping apparatus, but also for quickly compensating, from time to time, for minor changes in working conditions.

Another principal object of this invention is the provision of means whereby groups or gangs of coöperating pumping engines or motors may be simultaneously governed with relation to the air or gas pressures, and preferably by means producing a uniform change of useful output in all, independently of differences in efficiency which may exist.

Certain other advantages of my invention are pointed out hereinafter.

A preferred illustrative embodiment of this invention is shown in the accompanying drawings, wherein—

Figure 1 is a vertical central section of the automatic governing switch, Fig. 2 is a plan view of the same, Fig. 3 shows a regulating system for a group of two blowers, Fig. 4 is a partial vertical section on *a*—*b* in Fig. 5, Fig. 5 is a plan, partly in section of a preferred combination valve controller, Figs. 6, 7 and 8 are elevations of modified controlling means.

In Fig. 3 are shown two air or gas mains, 1 and 2, which I shall refer to as the supply main 1 and the delivery main 2. One or more blowers or pumps are employed in transferring the air or gas from the supply main to the delivery main, and in Fig. 3 two of these are shown at 3 and 4. Each blower is driven by an appropriate prime mover, as for instance, the steam engines 5 and 6, which transmit power by belts 7 and 6, or otherwise. The steam for driving these engines is supplied from the steam main 9 by pipes 10 and 11 leading to appropriate valves 12 and 13.

This invention is applicable to a system wherein a separate electric motor is used to actuate the governing device in each prime mover in the system, but in Fig. 3 I have shown the application of my invention to the use of a single electric motor or equivalent device so arranged as to simultaneously govern a plurality of prime movers. This system is not limited to the use of two prime movers and the shaft driven by the electric motor is broken off at the end of the figure to indicate indefinite length for connection to an indefinite number of prime movers.

In Fig. 3 the electric motor is shown at 14 and it is made to drive a shaft 15 supplied at proper intervals with worms 16 engaging worm wheels 17 (one for each prime mover). The shaft 18 of each worm wheel operates one or the other of the valves 12, 13 in a well known manner, so that, when the shaft 15 revolves in one direction it will slowly open the valves 12, 13 simultaneously, and it will close these valves when turned in the opposite direction. The electric motor 14 is normally at rest and it is made to run in one direction or the other when required for regulation of the system by means of the automatic governing switch shown in Figs. 1 and 2.

The mode of use of the governing switch and its adjuncts will depend upon whether it is desired to regulate pressure in the supply main 1 or in the delivery main 2. If the pressure of the gas within the supply main is to be regulated then the entrance pipe 19 shown in Figs. 1 and 2 must be connected to the supply main. If the pressure

of the gas delivered is to be regulated, the pipe 19 must be connected to the delivery main.

The pipe 19 leads to the lower part 20 of a casing 21, the upper part of which is open to the atmosphere as by the opening 22. The two parts of the space within the casing 21 are horizontally divided by a flexible or movable diaphragm preferably composed of a solid central disk 23 supported by a corrugated annular strip of flexible material, 24, such as thin leather. Upon a standard 25 fixed to the top of the casing 21 a balancing beam is supported, which beam is preferably composed of two light metal frames 26, 27 joined by insulating cross pieces 28 and supported upon the standard 25 by the knife edge 29. The weight of the disk 23 is partly supported by the suspension bar 30 attached to the disk preferably at its center, which bar is provided at its upper end with a knife edge 31 resting upon an appropriate insulating cross piece 32 whose ends are fixed to the frames 26, 27.

Fig. 1 shows a balanced condition of the governor which is the position assumed when the pressure transmitted through the pipe 19 conforms to what is desired in the system to be regulated. In this position, assuming the pressure regulated to be less than the atmosphere, the combined weight of the suspension bar 30, of the flexible diaphragm and of the atmosphere on the one hand is balanced by the upward pressure of the gas in the chamber 20 and by the tipping effort of the balancing beam 26, 27. In any given case a rough preliminary adjustment of the device is accomplished by sliding the weight 33 to the proper position on its arm and fixing the same once for all in that position by means of the binding screw 34. After this the smaller weight 35 can be moved along its arm to accomplish final adjustment where changed conditions in the system render it desirable. Notches are preferably provided with which the end of the screw 36 may engage. By these means the balancing of the apparatus is accomplished to suit any desired conditions so that the balancing beam remains horizontal when the gas pressure to be regulated is correct. At each end of each frame 26, 27, a long metal contact pin is provided, the same being shown at 37, 38, 39 and 40, and each being preferably provided with a milled edge whereby its position may be adjusted by hand either by providing a thread on the pin for screwing it up and down or otherwise. Under each of these pins is placed a cup in which mercury is poured to such a level that the pins are not quite immersed but stand a little above the liquid when the balancing beam is horizontal. These cups are shown at 41, 42, 43 and 44. Any conducting liquid may be used in these cups. Similar mercury cups 45, 46 are provided under the middle of each frame 26, 27 and a depending arm (shown in dotted lines in Fig. 1) connects each frame permanently with the mercury in said cups. The wire 48 electrically connects the cup 43 with the cup 42, and the wire 49 connects 41 and 44. Wires 50, 51 connect two cups 45, 46 with the two armature brushes of the motor 14 as shown in Fig. 3. The terminals 52, 53 of the motor 14 are connected with switch 54 to the electrical mains 55, 56. At 57 and 58 are shown the resistances ordinarily used in the armature and field magnet circuits of the motor.

From the description above given it will be obvious that, so long as the gas which enters the pipe 19 remains at the pressure desired and the pins on the balancing beam do not touch the conducting liquid below them, the armature circuit of the motor 14 will not be closed and there will be no change in the position of the valves 12 and 13. If, however, the pressure in the chamber 20 becomes excessive, the pins 38 and 40 will touch the liquid in the cups 42 and 44 and circuit will be closed through one side of the switch 54, by cup 43, wire 48, pin 38, cup 42, frame 26, arm 47, cup 45, wire 50, through the armature, by wire 51, cup 46, arm 47, frame 27, pin 40, cup 44, wire 49, cup 41, and resistance 57. This will drive the motor 14 in such a direction as to increase the opening of valves 12 and 13 and thus cause the blowers 3 and 4 to exert more exhausting action upon the supply main 1. If, on the contrary, the pressure in the chamber 20 becomes deficient the circuit will be closed by the armature in the opposite direction and the action of the blowers will be decreased.

The above description conforms to the conditions existing when the apparatus shown in Figs. 1 and 2 is connected by pipe 19 to the supply main 1. It is of course obvious that, where the pipe 19 is connected to the delivery main 2, the electrical connections will be reversed. The arrangement of balancing weights shown in Figs. 1 and 2 is that adopted when the normal pressure in the chamber 20 is insufficient to support the weight of the diaphragm, the suspension bar and the atmosphere. It is obvious that suitable changes in the weights can be made for other normal conditions of interior gas pressure.

In many cases it will be found desirable to be able to operate one or more of the valves 12, 13 manually at will, and to facilitate this I have devised the construction shown in Figs. 4 and 5. Here the shaft 15

of motor 14 turns within a bushing 59 supported on the arms 60 which project from the front of the valve 12, and a pinion 61 is fixed on the shaft 15 at each valve. A frame 62 is pivoted on the bushing 59 and carries a rotary shaft 63 having a pinion 64 at one end which engages with the pinion 61. The shaft 63 also carries a worm 65 which, when the frame 62 is raised, engages with the worm wheel 66 to which there is centrally attached a hub 67 turning in bearings supported from the valve by the arms 68. The stem 69 whereby the valve 12 is operated is threaded in the nut or hub 67 and carries at its outer extremity a hand wheel 70. The frame 62 is held up in the position shown in Fig. 4 by means of the hand latch 71 which engages with the upward projection 72 on the frame 62; and in this position a horizontal locking projection 73 on the frame 62 engages with notch 74 on the wheel 70. These notches are placed at close intervals all around the wheel.

It is clear that in the position shown in Fig. 4 the locking projection 73 prevents the hand wheel 70 and the screw 69 from turning and in this position the shaft 15, acting through pinions 61 and 64 and the worm 65, will operate the worm wheel 66 so as to move the stem 69 in or out according to the direction of rotation. If it is desired to operate the valve by hand, the frame 62 is lowered as shown in dotted lines in Fig. 4, thus freeing the hand wheel 70 and locking the worm wheel 66 and nut 67 by means of the bolt 75 on the projection 72 entering an opening 76 in the wheel 66. These holes 76 are placed at close intervals in a circle on the wheel 66. Thus, with the frame 62 depressed, the nut 67 is held fast so that revolution of the hand wheel may operate the valve.

My invention is applicable to other controlling means for the blowers than that shown in Fig. 3.

In Fig. 6 is shown a well known form of speed governor 77 which operates to maintain a constant speed in the steam engine which drives the blower, which governor is adjustable for different speeds of the engine by means of the worm wheel 78. This form of governor is found on the market combined with a convenient handle for turning the worm 79 which engages with said worm wheel. In adopting this device to my improvement I apply to the shaft of the worm 79 one of the worm wheels 17 driven, as heretofore described, by the motor 14 and worm shaft 15. This embodiment of my invention possesses conspicuous advantages in those systems where a plurality of steam engines is operated as in Fig. 3. Where a number of engines work simultaneously upon a number of blowers operating in parallel, it is important that the change of rate of work or output of all the blowers should be equally affected by any regulating action. Otherwise one or more engines will assume an undue load while others will be relatively idle. Where steam engines are used in groups they often differ so greatly in efficiency (owing to differences in lubrication or in details of construction or adjustment) that equal changes in steam supply produce very unequal changes in speed. For this reason a mode of adjustment such as shown in Fig. 6 which directly affects the governor upon which the speed of the engine automatically depends, is to be recommended.

In Fig. 7 is shown another form of controller where each blower 3 is provided with a by-pass valve 80 whose opening is governed by motor 14.

In Fig. 8 the motor 14 operates through a worm 13 and a worm wheel 17 to operate an electrical controller 81 which can be applied to the controlling of an electrical prime mover in a well known manner.

Many changes can be made in this apparatus without departing from my invention and I do not limit myself to the details herein shown and described.

What I claim is:—

1. In a gas distributing system, and in combination with branch distributing pipes and a common main connected thereto, a blower for each of said branch pipes, a prime mover for each blower, a controlling device for regulating the speed of each prime mover, an electric motor, a shaft driven thereby, separate means connected operatively to said shaft for individually operating each of said controlling devices, and an automatic governing switch operated by pressure from said main for stopping said electric motor and starting the same in one direction or the other, substantially as described.

2. In a gas distributing system, and in combination with branch distributing pipes and a common main connected thereto, a blower for each of said branch pipes, a prime mover for each blower, an independent automatic speed governor for each prime mover adapted to be adjusted for maintaining various speeds, an electric motor, mechanical connections between said motor and the adjusting mechanisms of all of said governors, and an automatic governing switch operated by pressure from said main for stopping said electric motor and starting the same in one direction or the other, substantially as described.

3. In a gas distributing system, and in combination with branch distributing pipes and a common main connected thereto, a

blower for each of said branch pipes, a prime mover for each blower, a speed controller for each prime mover, manual operating means for each speed controller, an operating wheel connected to each controller, an electric motor, a driving shaft for all the controllers driven by said motor, a pivoted frame centered on said shaft at each controller, and means on each frame for transmitting motion from said shaft to said operating wheel, all arranged so that by tilting any one of said frames the corresponding controller may be freed to permit manual control thereof, substantially as described.

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