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J. F. M. PATITZ.
GAS PRESSOR.
APPLICATION FILED JAN. 3, 1910.

Patented May 6, 1913.

3 SHEETS—SHEET 1.

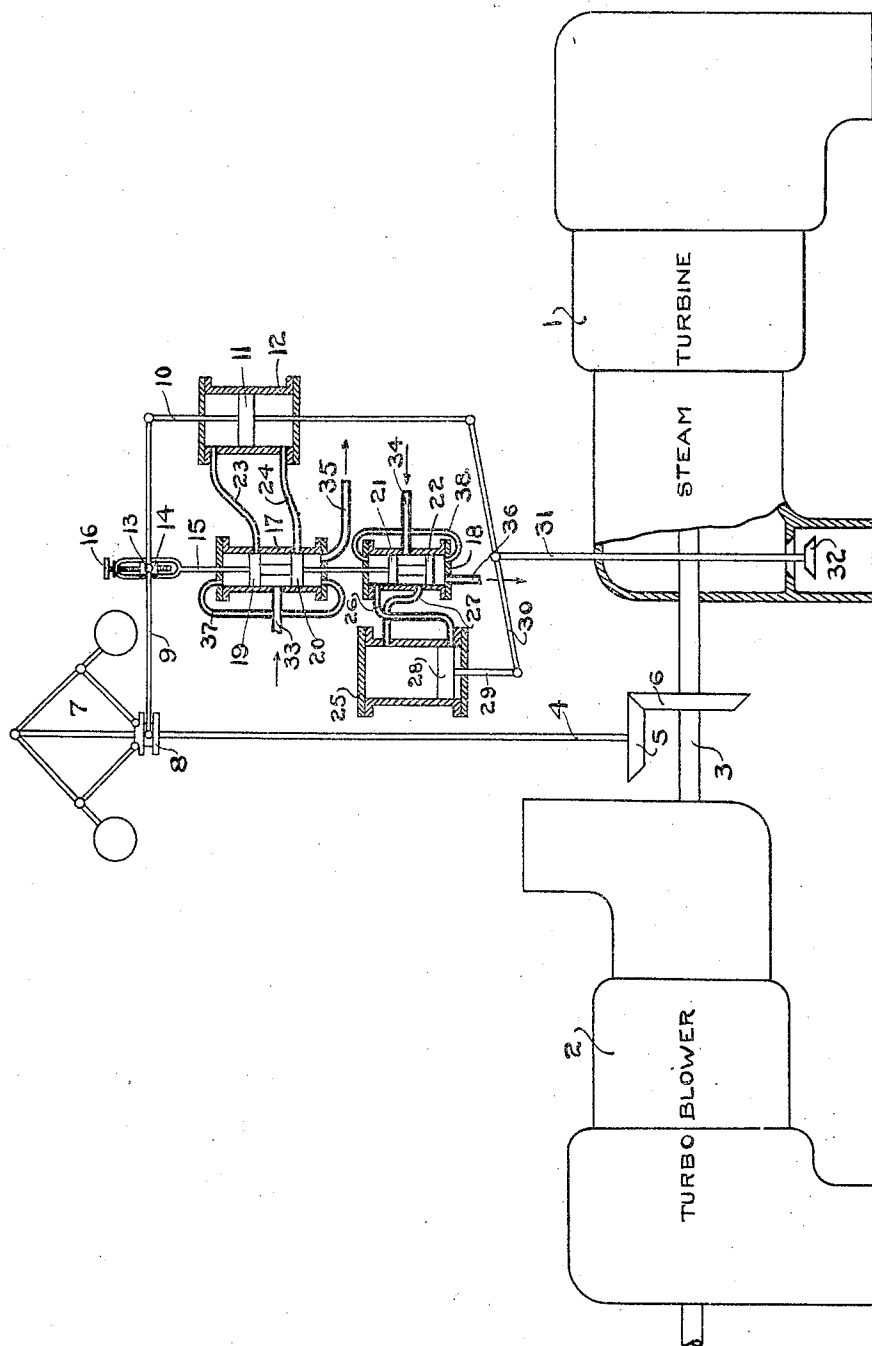


FIG. 1.

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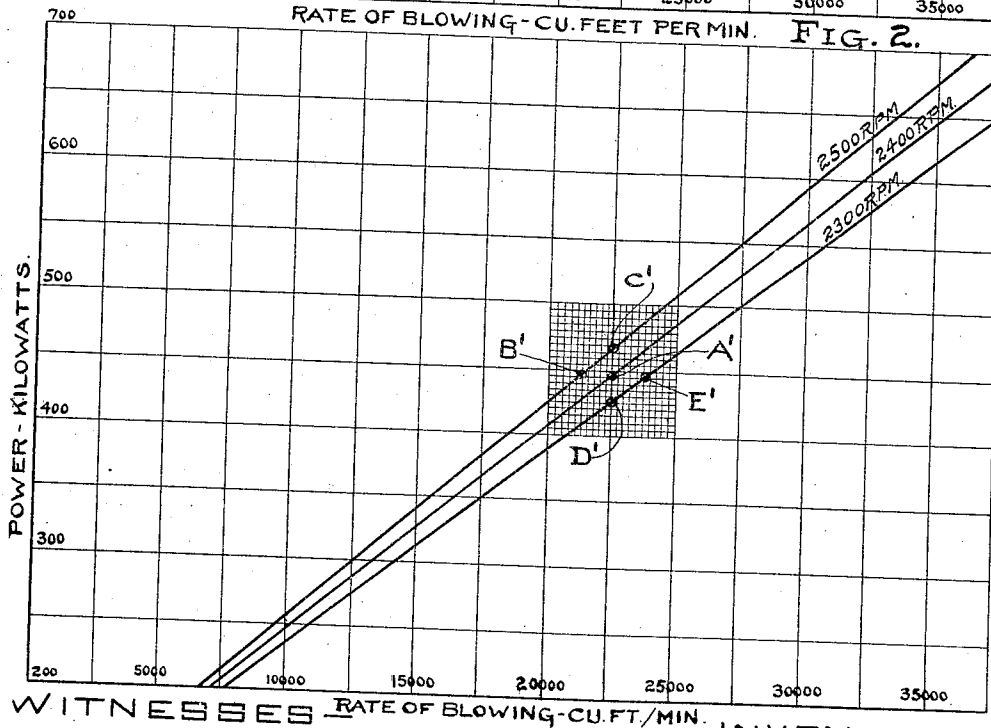
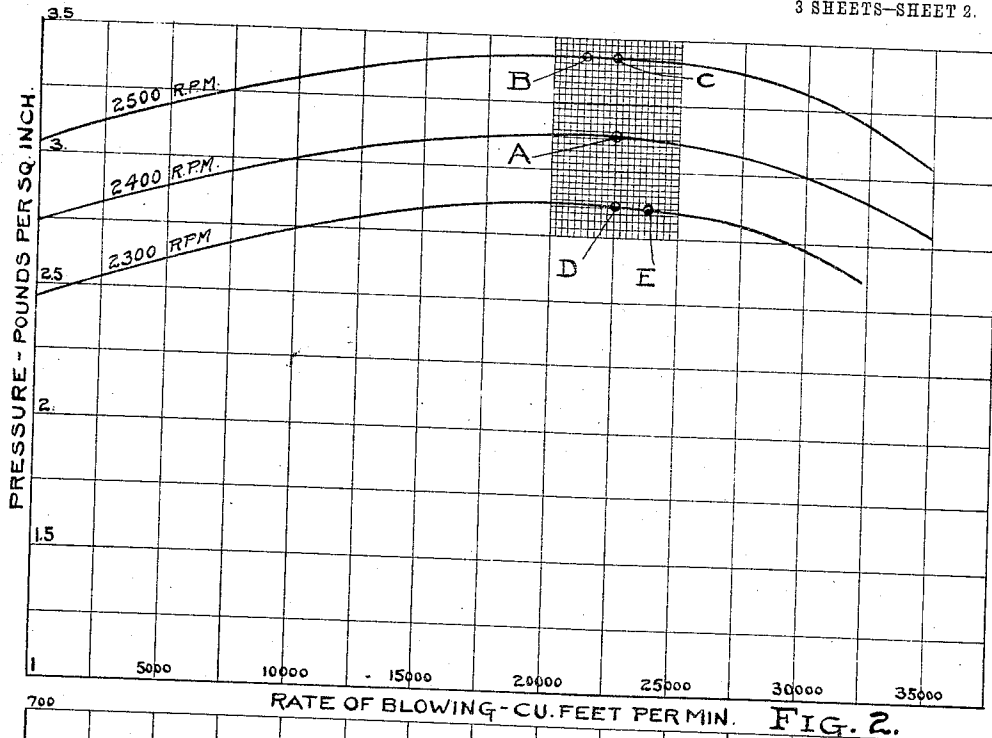
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3 SHEETS-SHEET 2.



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3 SHEETS-SHEET 3.

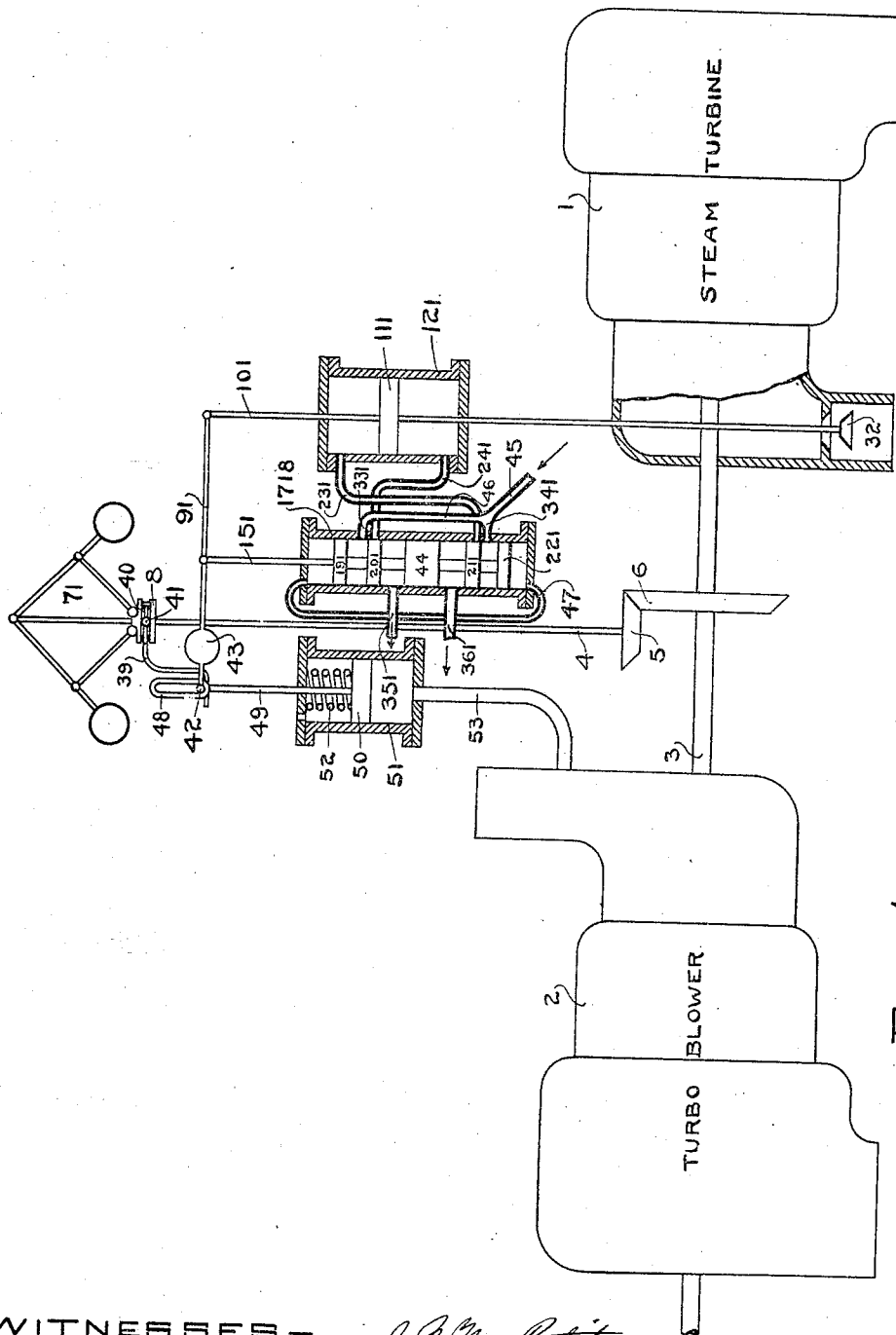


Fig. 4.

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GAS-PRESSOR.

1,061,006.

Specification of Letters Patent.

Patented May 6, 1913.

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To all whom it may concern:

Be it known that I, JOHANN F. M. PATITZ, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Gas-Pressors, of which the following is a specification.

This invention relates to pressors, by which term is meant either blowers or compressors, for gases, usually air, of the type in which the action is other than by positive displacement and which include centrifugal or other fans and bladed pressors.

The object of this invention is the regulation of the pressor for use under certain desired conditions as to pressure or rate of blowing or compressing gas.

The positive displacement pressor may be of the reciprocating type similar to and driven by the ordinary reciprocating engine; or it may be of the rotary type like the Root blower; or of any other of the many types wherein a piston positively displaces the gas from a container. The other type of pressor, with which the present invention deals, may be a fan of centrifugal or other type, or a turbo-blower of the parallel or radial flow types.

The regulation of pressors must be applicable to two situations, depending on the purpose for which the machine is intended. One situation is where it is desired to keep the rate of compressing at a predetermined constant value, as in blowers for blast furnaces where the pressure will vary to meet the varying resistance of the furnace under different conditions. The other situation is where it is desired to keep the pressure at a predetermined constant value, as in shop systems using compressed air for small tools, hoists and the like.

The regulation for the two types of machine for either constant rate of compressing or constant pressure is essentially different. The positive displacement type of pressor delivers at a constant rate against any pressure within its capacity, without necessitating any change in speed. The speed is changed only when the predetermined rate of compressing is to be altered. The other type of pressor, however, delivers at a constant pressure at any rate of compressing within a certain range, without necessitating any change in speed. The speed is

changed only when the predetermined pressure is to be altered.

The invention may be applied to any of the types of pressor wherein there is no positive displacement, and it may even be applied to centrifugal pumps for liquids. It is herein shown applied to a turbo-blower for air, driven by a steam turbine.

In the drawings, in which like reference characters designate the same or similar parts in the different views, Figure 1 is a diagrammatic view of a turbo-blower direct driven by a steam turbine regulated for a constant rate of blowing measured in volume, with the regulating system in section. Fig. 2 is the plat of curves at different speeds of a blower showing the relation between pressure and rate of blowing measured in volume of free air per unit of time. Fig. 3 is the plat of curves at different speeds of the same blower showing the relation between power and rate of blowing measured as before. Fig. 4 is a diagrammatic view of a turbo-blower direct driven by a steam turbine regulated for a constant volume rate of blowing, with a modified regulating system in section.

Referring to Fig. 1 of the drawings, a steam turbine 1 is directly connected to a blower 2 by means of common shaft 3. Regulator shaft 4 is connected to shaft 3 by means of bevel gears 5, 6, on the respective shafts 4, 3. The regulator 7 is static, by which term is meant that the difference in speed between lowest and highest position of its collar 8 is great. The regulator 7 is carried at the top of the regulator shaft 4 and its collar 8 is connected to one end of floating lever 9. The other end of floating lever 9 is pivotally connected to rod 10 carried by piston 11 operating in relay cylinder 12 stationarily mounted on the frame, not shown, in any convenient manner. At a point intermediate the ends of floating lever 9, that lever is connected to pin 13 swiveled in a block 14 slidably mounted in the slotted upper end of rod 15. The block 14 is screw threaded and a set screw 16 is threaded therein and is rotatably mounted in the upper end of rod 15 in any convenient way as by collars.

The rod 15 passes through relay valve cylinder 17 and extends into a second relay valve cylinder 18, carrying two valve disks 19, 20, 21, 22 in each cylinder. The ends of

relay cylinder 12 are connected to relay valve cylinder 17 by means of pipes 23, 24. A second relay cylinder 25 has its ends connected to the second relay valve cylinder 18 by means of pipes 26, 27. A piston 28 operates in the second relay cylinder 25 and its piston rod 29 is pivotally connected to one end of a second floating lever 30 whose opposite end is pivotally connected to the lower end of rod 10 carried by piston 11 and extending through the relay cylinder 12. Intermediate the ends of the second floating lever 30, that lever is pivotally connected to the upper end of stem 31 of throttle valve 32 of the steam turbine 1. Provision is made as usual at the connections of both floating levers 9, 30, to relieve the connecting parts from strain due to angularity of these levers. Inlets 33, 34, lead to the middle of relay valve cylinders 17, 18, respectively, and exhausts 35, 36, lead from the bottom of these valve cylinders respectively. Pipes 37, 38, connect the upper and lower ends of each of these valve cylinders respectively.

Referring to Fig. 4 of the drawings, as before a steam turbine 1 is directly connected to a blower 2 by means of a common shaft 3. Regulator shaft 4 is connected to shaft 3 by means of bevel gears 5, 6, on the respective shafts 4, 3. The regulator 71 is one of the normal type to prevent overspeeding and is carried at the top of the regulator shaft 4 and its collar 8 carries a reversely right angularly bent arm 39 by having a ring 40 formed at the upper end of the arm and seated in the groove in the collar, the ring carrying a series of rollers 41 coacting with the upper and lower sides of the groove in the collar 8. The free end of the arm 39 takes under a pin 42 extending laterally from floating lever 91 carrying a weight 43 adjacent pin 42. The opposite end of lever 91 is pivotally connected to rod 101 carried by piston 111 operating in relay cylinder 121 stationarily mounted on the frame, not shown, in any convenient manner. The rod 101 extends through the cylinder 121 and its lower end carries the throttle valve 32 of the steam turbine 1. At a point intermediate the ends of floating lever 91, that lever is pivotally connected to rod 151, and if desirable, the connection may be adjustable in the same way as described with reference to floating lever 9 Fig. 1. Provision may be made as usual at the connection to floating lever 91 to compensate for angularity of said lever. The rod 151 extends into relay valve cylinder 1718 and carries five valve disks 191, 201, 44, 211, 221. The ends of relay cylinder 121 are connected to relay valve cylinder 1718 by means of pipes 231, 241. In the mid position of the valve disks in cylinder 1718, the pipes 231, 241, connect with cylinder 1718 at

points directly opposite disks 201, 211. Inlets 331, 341, lead to the relay valve cylinder 1718 at points respectively between disks 191, 201, and disks 211, 221, and have a common connecting pipe 46, and common inlet 45. Exhausts 351, 361, lead from the valve cylinder 1718 at points respectively between disks 201, 44, and disks 44, 211. Pipe 47 connects the upper and lower ends of the valve cylinder 1718. It should here be stated that all of the system of linkage and mechanism of Fig. 1 from the floating lever 9 down to and including the throttle valve 32, may be bodily substituted for all of the system of linkage and mechanism of Fig. 4 from the floating lever 91 down to and including the throttle valve 32, and vice versa. Pin 42 on floating lever 91 also rests in the lower end of slotted head 48 formed at the upper end of rod 49 carried by piston 50 operating in pressure cylinder 51. Spring 52 within cylinder 51 reacts against the upper head thereof and against the upper side of piston 50. A pipe 53 connects the lower end of cylinder 51 with the discharge chamber of blower 2.

The curves of Figs. 2 and 3 are shown to aid in explaining the principles of operation of the invention. Referring to Fig. 2, the curves shown for speeds of 2300, 2400 and 2500 revolutions per minute are those of a low pressure blower and are platted to show the pressure of blower discharge in pounds per square inch as ordinates and rate of blowing in cubic feet per minute of inlet or free air as abscissas. Referring to Fig. 3, the curves shown for speeds of 2300, 2400 and 2500 revolutions per minute are those of the same low pressure blower whose curves for pressure of air are shown in Fig. 2. These curves however are platted to show the power in kilowatts of the steam turbine driving the blower as ordinates and the rate of blowing in cubic feet per minute of inlet or free air as abscissas.

As a general example showing the use of the curves of Figs. 2 and 3, let it be required to find the speed and power at which a turbo-blower will deliver a given quantity or weight of air against a certain pressure, for instance 20000 cubic feet against a pressure of 3.425 pounds. Look up volume 20000 on horizontal base line, Fig. 2; run vertically up to a pressure of 3.425. It is found that this point lies on curve for speed of 2500 R. R. M. This is the required speed at which the blower should run. To find the power required, look up volume 20000 on horizontal base line, Fig. 3; run vertically up to a curve for a speed of 2500 R. P. M. It is found that this point lies at a position showing a power of 425 K. W. required to drive the blower. Assuming conditions of a blower operating to supply air to a blast furnace, let the rate of blowing be 22500

cubic feet per minute and the pressure 3.13 pounds. According to the plat, A, Fig. 2, the blower must run at a speed of 2400 R. P. M. According to the plat, A', Fig. 3, it takes 447 K. W. to drive the blower. The rate of blowing should remain constant, that is, the weight of air blown per unit of time should be constant; but the pressure may vary according as the resistance of the furnace varies.

Suppose the blower to be working normally as above assumed and the resistance at furnace to increase an amount requiring the blower to deliver against a pressure of 3.425 pounds. Under these new conditions how must the steam turbine driving the blower be regulated? To deliver air at the same rate of blowing in cubic feet or pounds weight per minute against this higher pressure would obviously require more power. More power cannot be supplied until the throttle of the steam turbine is opened wider, and until this is done the power remains constant and consequently air will be pumped at a lower rate in order to attain the higher pressure, and the speed will increase at the same time. Assume that the regulator does not act until a change of speed of 100 R. P. M. has taken place. According to the plat, B', Fig. 3, the lower rate of blowing at the same power will be 21200 cubic feet per minute at an increased speed of 2500 R. P. M. and the required pressure as seen from the plat, B, Fig. 2, will be 3.425 pounds. Either this increased speed or the required pressure may be utilized to open wider the throttle of the steam engine through appropriate mechanism. When this is done, the power is increased and, at this increased speed and this required pressure, the rate of blowing is reestablished to the normal amount; that is, the power is varied directly as the required pressure varies or a power increase must follow a pressure increase. Two regulating systems may be used, one actuated by change in speed effected by change in delivery pressure, and the other directly by change in delivery pressure. The first system is shown in Fig. 1 and the second in Fig. 4.

The first regulating system, shown in Fig. 1, operates as follows.—Supposing the blower to be operating normally at speed, pressure, rate of blowing and power as indicated on the plats, at A Fig. 2, and A' Fig. 3. The resistance at the furnace increasing, the speed rises as heretofore pointed out, that is, the speed must rise to meet the higher pressure demand, and the power being constant before regulation takes place, this rise in speed will be at the expense of quantity of air pumped, see plats at B' Fig. 3 and B Fig. 2, and the regulator collar 8 moves to a higher position, raising by its movement the rod 15 and disks 19, 20, 21, 22.

This admits oil under pressure entering valve cylinder 17 through inlet 33, to pipe 23 and thence to relay cylinder 12 above piston 11, and at the same time exhausts oil from relay cylinder 12 below piston 11, through pipe 24 to valve cylinder 17 and thence through outlet 35. This causes piston 11 to be forced downwardly, thus moving downwardly the right ends of both floating levers 9, 30, opening the throttle valve 32 and bringing down the rod 15 and its disks to normal position. See plats C Fig. 2 and C' Fig. 3. Should the required pressure increase to an abnormal extent and consequently the speed, the piston 11 will eventually contact with the lower head of relay cylinder 12. Upon further increase of pressure and speed the rod 15 will be raised high enough to bring into operation disks 21, 22, so that oil under pressure will be admitted by inlet 34 and pipe 26 to the second relay cylinder 25 below piston 28 and at the same time oil will be exhausted from second relay cylinder 25 above piston 28 through pipe 27 and exhaust 36, thus raising rod 29, left end of second floating lever 30, and rod 31 to close the throttle valve 32 and shut off the steam entirely to prevent racing. The second relay cylinder 25 comes into action only at dangerously high speeds. The resistance at the furnace decreasing, referring to the first system of regulation, the speed falls as heretofore pointed out, and the reverse action of the mechanism takes place to close the throttle valve 32 more so as to reestablish the normal rate of blowing. On the plats Figs. 2 and 3, this action from the normal is shown first at points E E' and then at points D D'. The hand adjustment between floating lever 9 and rod 15 serves for changing the rate of blowing relatively to the pressure.

The second regulating system, shown in Fig. 4, operates as follows.—Supposing the blower operating normally at speed, pressure, rate of blowing and power as indicated on the plats, at A Fig. 2 and A' Fig. 3, as before. The resistance at the furnace increasing, the pressure required to be developed by the blower will increase and this increased pressure is communicated to pressure cylinder 51 below piston 50, raising same against pressure of spring 52. As the power cannot increase until the throttle valve 32 is opened, the new conditions are found on the plats at B' Fig. 3, and B Fig. 2. The piston 50 rising, raises rod 49 and left end of floating lever 91 and rod 151, positioning disks, 191, 201, 44, 211, 221, in valve cylinder 1718 so that oil under pressure is admitted to relay cylinder 121 above piston 111 and at the same time exhausting oil from cylinder 121 below the piston 111 through pipe 241, to valve cylinder 1718 and thence through exhaust 351. This

causes piston 111 to move downwardly, depressing rod 101 and opening throttle valve 32. At the same time rod 101 depresses the right end of floating lever 91 and restores rod 151 and its disks to the normal position. The opening of the throttle increases the power and the conditions are shown on the plats at C' Fig. 3 and C Fig. 2. Should the required pressure increase to an abnormal extent, the piston 111 will eventually contact with the lower head of relay cylinder 121. Upon further increase of pressure the rod 151 will be raised high enough to bring into effective operation disks 211, 221, so that oil under pressure will be admitted by a common inlet 45 connecting pipe 46, inlet 331 to valve cylinder 1718 and thence through pipe 241 to relay cylinder 121 below piston 111, and at the same time oil will be exhausted from the relay cylinder 121 above the piston 111 through pipe 231 to valve cylinder 1718 and thence through the exhaust 361, thus raising the rod 101 to close the throttle valve 32 and shut off the steam entirely to prevent racing. During this action the disk 221 closes inlet 341 and disk 44 closes the exhaust 351. This safety portion of the mechanism comes into action only at dangerously high speeds caused by abnormal increase of pressure required.

The pressure cylinder 51 may only operate to open the throttle valve in its upward travel and after that regulator 71 will independently come into operation to check dangerous speeds incident to increased pressure. This way of working will protect against danger resulting from clogging of pipes and consequent increase of pressure in the pressure cylinder 51. This independent operation of regulator is possible by the slotted head connection of rod 49 and pin 42. This pin 42 remains normally at the lower end of the slotted head 48, due to weight 43 on the floating lever 91, but when the rod 49 has reached its upper limit of motion to open the throttle valve 32, the pin 42 may be further raised in the slotted head 48 by the regulator 71. The resistance at the furnace decreasing, referring to the sec-

ond system of regulation, the pressure required falls and the reverse action of the mechanism takes place to close the throttle valve 32 more so as to reestablish the normal rate of blowing. On the plats Figs. 2 and 3, this action from the normal is shown first at points E E' and at points D D'.

It should be understood that it is not desired to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

It is claimed and desired to secure by Letters Patent,—

1. In a pressor of the impositive displacement type, the combination of a motor, means connecting the motor to the pressor for driving same, means for varying the power of the motor, and means controlled by the discharge pressure developed by the pressor for actuating the power varying means to vary the power directly as said pressure varies.

2. In a pressor of the impositive displacement type, the combination of a motor, means connecting the motor to the pressor for driving same, means for varying the power of the motor, and means actuated directly by the discharge pressure developed by the pressor for actuating the power varying means to increase the power when the said pressure increases.

3. In a pressor of the impositive displacement type, the combination of a motor, means connecting the motor to the pressor for driving same, means for varying the power of the motor, means controlled by the discharge pressure developed by the pressor for actuating the power varying means to vary the power directly as said pressure varies, and means for actuating the power varying means to decrease the power upon an abnormal increase in said pressure.

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

J. F. M. PATITZ.

Witnesses:

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