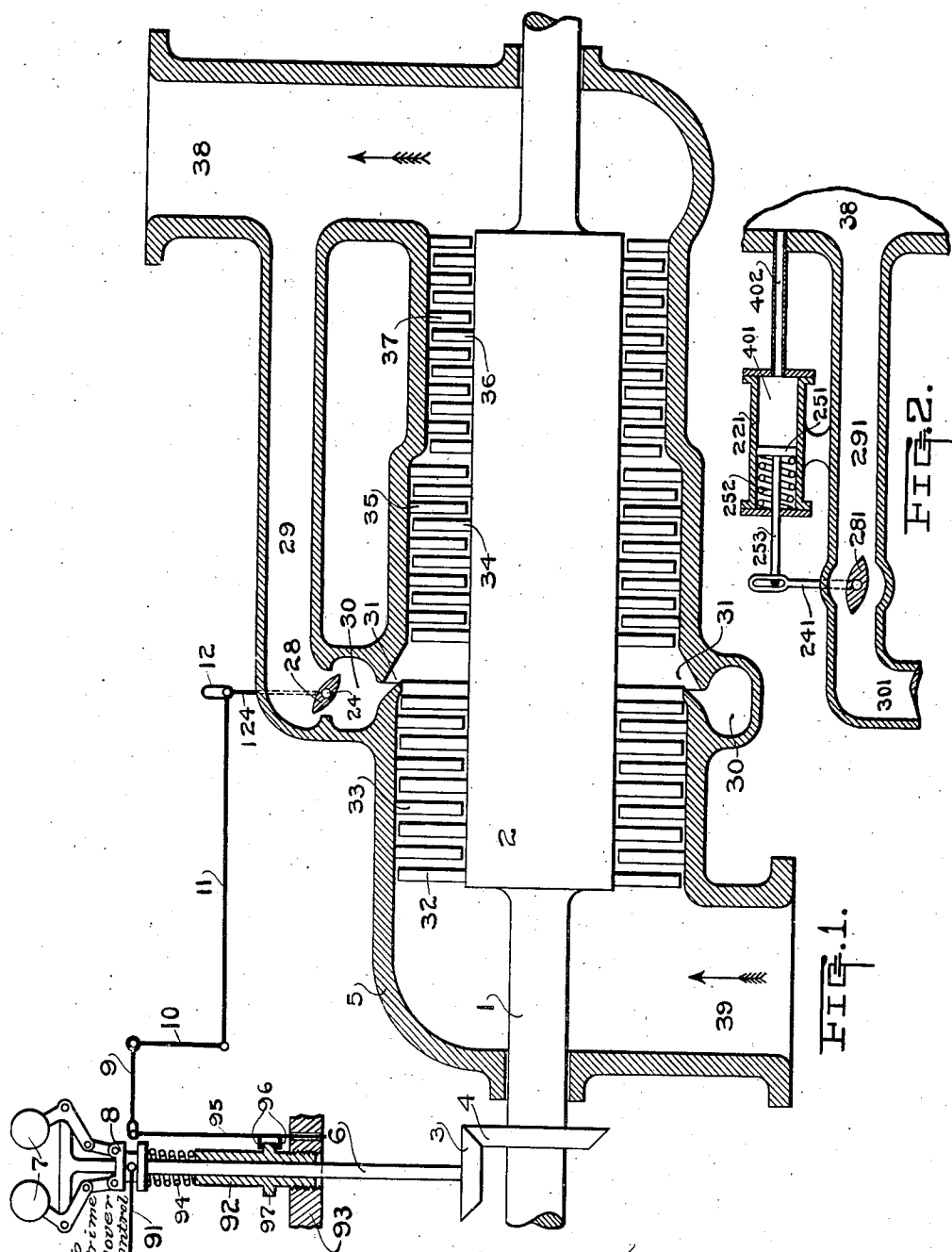


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TURBO BLOWER.
APPLICATION FILED DEC. 24, 1909.

1,111,498.

Patented Sept. 22, 1914.



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TURBO-BLOWER.

1,111,498.

Specification of Letters Patent.

Patented Sept. 22, 1914.

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To all whom it may concern:

Be it known that I, MAX ROTTER, 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 Turbo-Blowers, of which the following is a specification.

This invention relates to improvements in the construction of regulating devices for turbo-blowers, and in particular to improvements in such devices used in connection with blowers furnishing compressed air for blast furnaces or similar purposes.

The object of the invention is to provide a means for regulating turbo-blowers so that the blower will automatically deliver a constant weight of air irrespective of the discharge pressure. It is often desirable, especially in blast furnace work, to have the blower which furnishes compressed air deliver an approximately constant weight of air against a variable pressure. This has heretofore been accomplished by varying the suction opening according to the speed of the blower, but the results thus obtained have not been entirely successful. With the present invention, the suction opening is not varied, there being a by-pass through which the superfluous air is returned to an intermediate stage of the blower.

A clear conception of the invention can be obtained by referring to the accompanying drawing in which like reference characters designate the same or similar parts in different views.

Figure 1 is a central vertical section of a turbo-blower built according to the invention, showing also the regulator for the prime mover of the blower. Fig. 2 is a central vertical section of a modified form of pressure control of the by-pass valve.

In the device shown in Fig. 1, the main shaft 1 of the blower, which is preferably direct connected to the main shaft of the prime mover, not shown, carries a concentric spindle 2, and is supported by bearings in the blower casing 5. The casing 5 has a suction chamber or opening 39 formed therein at one end of the spindle 2, and a discharge chamber 38 similarly formed therein at the opposite end of the spindle 2.

The spindle 2 has a series of sets of rotatable blades 32, 34, 36, mounted radially thereon, these blades 32, 34, 36, extending

outward to within a short distance from the casing 5. The casing 5 has a series of sets of stationary blades 33, 35, 37, mounted thereon and alternating with the corresponding sets of rotatable blades 32, 34, 36, the stationary blades 33, 35, 37, extending inwardly from the casing 5, and radially to the spindle 2, to within a short distance from the spindle 2.

The larger rotatable blades 32 are of about the same length as the stationary blades 33, the blades 32, 33, comprising the first stage of the blower. The intermediate rotatable blades 34 are of about the same length as the stationary blades 35, the blades 34, 35, forming the intermediate stage. The small rotatable blades 36 are of about the same length as the stationary blades 37, alternating therewith, the blades 36, 37, forming the high pressure stage of the blower. It is not necessary to limit the number of stages in the blower to three, as shown, as any number of stages might exist.

A return passage or by-pass 29 extends back from the discharge chamber 38 to an annular chamber 30 formed around the casing 5, between the first and the intermediate stages of the blower. The nozzles 31 connect the chamber 30 to the space within the blower between the first and intermediate stages thereof. A valve 28, having the valve stem 24, is located in the connection between the by-pass 29 and the chamber 30.

The stem 24 of the valve 28 has an arm 124 connected thereto having a slotted end 12. This arm 124 is connected at its end 12, by a link 11, to arm 10 of a bell-crank lever, the other arm 9 thereof being slotted at its end. The arm 9 is connected at its slotted end to a slide rod 95 guided in a bore in some stationary part 93 of the frame. The rod 95 has two lateral extensions 96, taking over the edge of a collar 97 on a sleeve 92, screw threaded in the part 93 of the frame for purposes of adjustment.

The governor shaft 6, supported in any convenient manner by step bearings not shown, passes through the sleeve 92 and partially carries the bell-crank levers of fly balls 7 at its upper end as usual. Links connect the ends of the bell-crank levers to the governor collar 8. A spring 94 surrounds the shaft 6 above the sleeve 92 and rests upon said sleeve, its upper end abut-

ting against the governor collar 8. Lever 91 connects from the collar 8 through linkage to the main throttle of the prime mover not shown. This lever 91 may be floating and operative upon a relay device such as is common in the art, see for instance United States patent to Moore, 322,956, July 28, 1885. The governor shaft 6 is connected by bevel gears 3, 4, to the main shaft 1.

In the modified form of by-pass and valve arrangement, see Fig. 2, there is no connection between the governor collar 8 and the by-pass valve 281. The thoroughfare through by-pass 291, connecting the discharge chamber 38 with the annular chamber 301, corresponding to the chamber 30 in the first form described, is controlled by the valve 281. The valve 281 has an arm 241 on its valve stem connected to the end of the piston rod 253 by a slotted head on the arm 241. The piston 251 is fixed to the opposite end of the piston rod 253 and fits within the cylinder 221. A helical spring 252 coacts against the rod side of the piston 251 and against one of the cylinder heads. The head end of the cylinder 401 connects with the discharge chamber 38 of the blower through a pipe 402.

During the operation of the blower the rotary motion of the prime mover is transmitted through the shaft 1 to the spindle 2. The rotation of the spindle 2 causes the sets of rotatable blades 32, 34, 36, to rotate between adjacent sets of stationary blades 33, 35, 37. This rotation of the blades 32, 34, 36, causes air to be drawn into the first stage through the suction opening 39 and to be forced through the first stage to the intermediate stage, through the intermediate stage to the high pressure stage, and through the high pressure stage to the discharge chamber 38. During the passage of the air through the various stages it is gradually compressed until it is discharged in the chamber 38 at the highest pressure.

As heretofore stated, it is desired to maintain constant the weight of air compressed per unit of time independent of the pressure to which the compression extends. In order to increase the pressure of air discharged so as to meet new requirements of the furnace necessitating higher pressure of air, the speed of the blower must be increased. This is done by adjusting by hand the sleeve 92 downwardly so as to relieve some of the pressure of spring 94 on the governor collar 8. When this is done it is also necessary to readjust the connection between the lever 91 and the main throttle so as to afford a wider opening of the throttle at normal position of governor collar 8 than before if it is desired to maintain the normal position of the collar 8 constant for different adjustments. This relief of pressure of

spring 94 throws more work on the fly balls 7 so that these must have a higher speed to maintain governor collar 8 in normal position. The blower speed will correspondingly be increased and without any by-pass the weight of air compressed would be increased per unit of time. In making this downward adjustment of the sleeve 92, the slide rod 95 is pulled downwardly, operating the linkage to open the valve 28 to a set position for the corresponding higher speed. In this condition the blower will send some of the discharge air back through the by-pass 29 and expanding nozzle 31 to the intermediate stage of the blower as shown, though this return might be made at any point along the blower. This will cause a backing up of pressure at the point of re-introduction and less new air will enter the suction opening 39, to an extent sufficient to maintain constant the weight of air compressed per unit of time. In order to decrease the pressure of air discharged, the reverse sequence of operations is made to and does take place.

In the modification of Fig. 2, the valve 281 will also be automatically regulated, but in this case for any speed of the blower whether brought about by manual setting of the governor or by small changes of speed from the normal speed for which the governor is set. The sleeve 92 having been set for a higher speed, the higher resulting discharge pressure will automatically open valve 281 by acting in cylinder 401 and through linkage connecting to the valve.

It will be seen that the expanding or diverging nozzles 31, being directed forwardly, assist in the operation of the blower. This is probably done in a sort of injector action, and can be easily comprehended by considering the rotor fixed whereupon air admitted through the nozzles would create an influx of air at the suction end of the blower. It will be evident that the by-pass could connect any two points along the blower.

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. A turbo-blower having a casing, a series of stationary and movable blades within said casing and a by-pass connecting points along said casing, said connection including a nozzle diverging toward the blower outlet.

2. A turbo-blower having a casing, and a by-pass connecting points along said casing, said connection including a nozzle directed toward the blower outlet.

3. A rotary pump having a casing, a by-

pass connecting points along said casing, and means in said connection for assisting in the driving of the rotor of the pump.

4. In a multi-stage turbo-blower, the combination of a series of stages, and a return passage between the delivery of one stage and the delivery of another stage, said passage being so directed at the delivery of the preceding stage as to transform the velocity of the fluid passing through said passage into useful work to assist in driving the blower rotor.

5. In a multi-stage turbine pump, the combination of a series of stages, a return passage around stages of said pump, a prime mover for driving said pump, adjustable means for directly controlling said prime mover, and means cooperating with said control means and with said return passage

for maintaining constant the volume of fluid pumped.

6. In a turbo-blower, the combination of a plurality of stages, and a by-pass connecting several of said stages, said connection including a nozzle directed toward the blower outlet.

7. In a turbo-blower, the combination of a plurality of stages, a by-pass connecting several of said stages, and means in said connection for assisting in the driving of the rotor of the blower.

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

MAX ROTTER.

Witnesses:

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F. E. HAMILTON.