

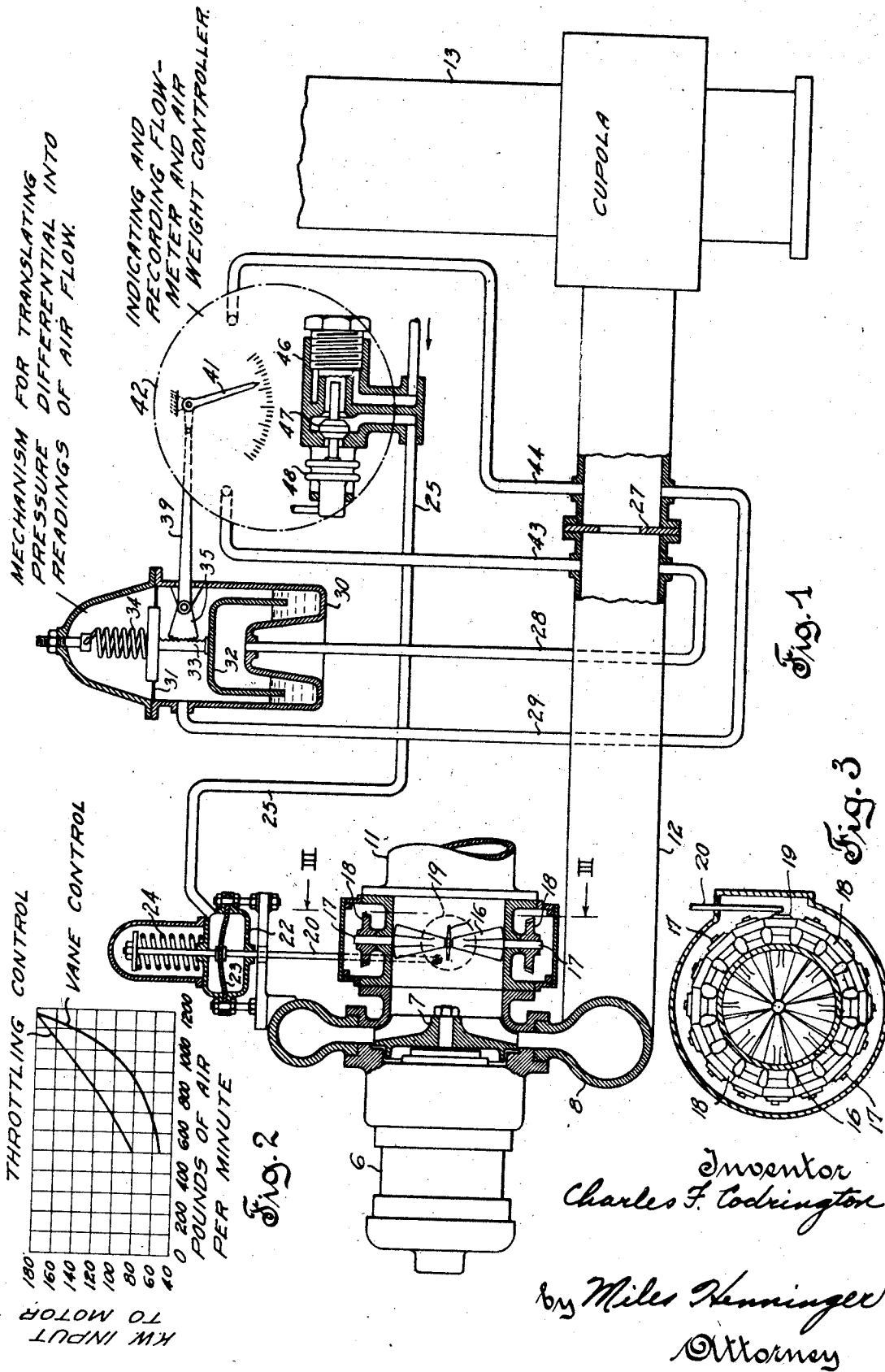
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BLOWER CONTROL SYSTEM

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BLOWER CONTROL SYSTEM

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3 Claims. (Cl. 230-114)

This invention relates to improvements in centrifugal blowers and particularly to centrifugal blowers used for supplying the air necessary for combustion of the fuel used in metal melting cupolas.

Metal melting cupolas are charged with both the metal to be melted and fuel sufficient for melting the metal and for bringing the molten metal to the proper casting temperature. The weight of the metal to be melted determines the weight of the fuel required. Only the calculated weight of fuel is supplied to a cupola, for several known reasons, and it is therefore necessary to supply the exactly required quantity of oxygen to secure as nearly perfect combustion of the fuel as possible. Fuel being supplied by weight, the amount of oxygen required must also be determined by weight while the pressure at which the oxygen is supplied must be varied to overcome the varying resistance of the cupola charge during the melting operation. Supply of the required weight of oxygen at the desired pressure is obtained by forcing air through the cupola by means of a blower or compressor and the power consumed by the blower is substantially directly proportional to the weight of air supplied and is constant for a given weight of air regardless of the pressure at which such air is supplied.

During normal operation of the cupola a given weight of air, determined by the cupola charge, is required at a relatively low discharge pressure and a certain amount of power is therefore required for driving the blower. However, when conditions arise during cupola operation which require an increase in the pressure of the air supplied, it is necessary that the blower be capable of supplying the predetermined constant weight of air at an increased pressure. It is therefore necessary that the blower be designed for the maximum pressure output which may be required therefrom under any conditions. Designing of the blower for such maximum pressure conditions, however, requires that the blower be operated normally below the maximum output pressure. Such lower output pressure has been obtained for many years by placing a valve, usually of the known butterfly type, in the discharge line of the blower to throttle the discharged air to the pressure required for normal operation. Such throttling, however, consumes the same power for a given weight of air even at the throttled lower discharge pressure and the quantity of power consumed may amount to as much as one-third more than would be required for the given weight of air at the lower discharge pressure with

vane control. Such waste of power continues during the time that the blower is running at normal output which is by far the greater portion of its operating time. If means are provided for obtaining the desired normal output, that is, a given weight at a lower pressure, without throttling losses and which will also permit the same given weight to be obtained at a higher pressure when required, the size of both the blower and its drive and the power required for operating the blower over its entire range may be reduced by the amount of the throttling losses eliminated. Elimination of the valve also reduces the length of the discharge piping required and avoids the introduction of turbulence in the discharge line which must be smoothed down.

It is, therefore, an object of the present invention to provide a control system for blowers of the centrifugal type in which the quantity of air inspired into the blower is controlled by a characteristic of the air discharged from the blower.

Another object of the invention is to provide a control system for blowers of the centrifugal type in which the quantity of air inspired into the blower is controlled by a characteristic of the air discharged from the blower.

Another object of the invention is to provide a control system for centrifugal type blowers in which the quantity of air delivered by the blower is variable without the losses and turbulence due to throttling the discharge of the blower.

Another object of the present invention is to provide a control system for centrifugal blowers in which air inlet control means are controlled by air weight responsive means for controlling the weight of air discharged from the blower regardless of the discharge pressure.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawing, in which:

Fig. 1 diagrammatically illustrates an air inlet control system according to the present invention as applied to a single stage blower for supplying a constant weight of air at variable pressure to a device involving the combustion of fuel; and

Fig. 2 graphically illustrates the saving in power consumed by the present control system as compared to the power consumed by blowers with the discharge throttling control of the prior art, and

Fig. 3 diagrammatically illustrates the manner in which a plurality of vanes is mounted in the inlet into the casing and the manner in which

such vanes are mechanically interconnected exteriorly of the casing inlet to provide for movement of the vanes in the same direction and by the same amounts.

Referring to the drawing by characters of reference, the reference numeral 3 designates driving means, shown as an electric motor, for a single impeller 7 of the centrifugal type rotating within a casing 8, the impeller being shown as mounted on an extension of the motor shaft and the casing being shown as mounted directly on the motor stator housing. Air is drawn into the central portion of the impeller 7 through the casing 8 through an inlet conduit 11 coaxial with the impeller 7 and is discharged from the periphery of the impeller 7 into the casing 8 and into a conduit 12 which is connected with a known metal melting cupola generally indicated at 13. The blower inlet conduit 11 is provided with a plurality of vanes 16 of substantially sector shape arranged in an annular series coaxial with and spaced from said impeller and mounted on axles 17 journaled in the wall of the inlet conduit and extending outwardly therefrom and the outer ends of the axles 17 are severally equipped with bevel gears 18 mechanically interconnected. The vanes and the axles extend radially into the inlet conduit for rotation to shut off any desired amount of the area of the conduit and the gears on the vane axles externally of the conduit mesh with each other around the entire periphery of the inlet conduit.

The meshing circle of gears 18 mesh with an operating gear 19 which is eccentrically connected with a rod 20 leading to a servomotor shown as being of the flexible diaphragm type suitably mounted adjacent the inlet vanes 16. Such servomotor comprises a casing 22 divided into two chambers by a flexible diaphragm 23 connected with the vane operating rod 20 which extends externally of the casing 22 into a chamber in which a compression spring 24 acts between the casing 22 and the end of the rod 20 to bias the rod 20 and the diaphragm 23 upwardly. The lower chamber of the servomotor casing 22 is vented to and hence under atmospheric pressure while the upper chamber thereof is connected to a pipe 25 leading to a suitable source of high pressure fluid. The admission of fluid under pressure to the upper chamber of the servomotor causes flexing of the diaphragm 23 to move the rod 20 downwardly against the compression of spring 24. Such downward movement of the rod 20 rotates the gear 19 and gears 18 to rotate the vanes 16 toward position for opening or closing the inlet conduit 11. Releasing of the pressure from above the diaphragm 23 allows the spring 24 to expand to draw the rod 20 and the diaphragm 23 upwardly and to rotate the vanes 16 toward the position for opening the inlet conduit 11 to its fullest extent.

Flow of pressure through the high pressure pipe 25 is controlled by a mechanism for translating pressure changes in the discharge conduit 12 into movement for the operation of an indicating and recording means and for the operation of a control valve for the pressure flow. An orifice plate 27 is mounted in the discharge conduit 12 between the blower and the cupola to produce a pressure difference on the two sides of the plate. A pipe 28 is connected with the discharge conduit 12 on the one side of the plate 27 and a pipe 29 is connected with the discharge conduit on the other side of the plate 27. Pipe 28 is connected with the bottom of a housing 30

having a flexible support 31 extending across the housing at approximately the central portion thereof and the pipe 29 is connected with the upper portion of the housing 30. A bell 32 floats in mercury in the lower portion of the housing 30, the mercury forming a seal against the escape of air supplied beneath the bell by the pipe 28. The bell 32 is connected by way of a rack 33 with the flexible support 31 and is under the pressure of a compression spring 34 acting between the flexible support and an adjustable connection with the top of the housing 30. The bell 32 is therefore responsive to air pressure differences across the plate 27 and such differences exaggerate the variations in pressure due to cupola operation. Movement of the rack 33 is transmitted to a pinion segment 35 which acts through a system of levers 39 on the indicating and recording pointer 41 of an instrument generally indicated at 42 for indicating and recording variations in the weight of the air flowing through the discharge conduit 12.

The casing of the instrument 42 is connected by way of pipes 43 and 44 to the discharge conduit 12 on the two sides of the orifice plate 27 to transmit the variations of pressure into the instrument case where such variations act on known temperature and barometric responsive means not shown, to operate a pilot valve including a valve housing 46 and a valve body 47. The pilot valve 47 is double seated and controls the flow of pressure through the pipe 25 to the servomotor 22, 23 and also controls the admission of pressure to diaphragms 48 which actuate the valve 47. For a detailed description of the instrument 42 and its several parts and the manner in which the several parts cooperate to control the pilot valve 47, reference is made to United States Letters Patent 1,582,868, A. M. Dixon, April 27, 1926, which discloses an instrument which may be employed in the present system.

In operation, the pressure in the discharge conduit 12 varies as changes in the conditions of the charge in the cupola 13 occur and such varying pressure acts on the instrument 42 to cause operation of the pilot valve 47. Assuming that the charge resistance in cupola 13 to the passage of air therethrough has decreased, thus causing a decrease in pressure in the conduit 12, the action of the instrument 42 is such as to cause movement of pilot valve 47 toward the left to allow fluid under pressure to flow through the pipe 25 from the high pressure source. Such pressure forces the diaphragm 23 downwardly and rotates the operating gear 19 and the vane gears 18 to rotate the vanes 16 in the conduit closing direction. Closing movement of the vanes 16 continues as long as the valve 47 allows the pressure on the diaphragm 23 to increase. However, when the pressure in the conduit 12 and hence in the instrument 42 reaches its predetermined value, the pilot valve 47 moves toward the right to interrupt further pressure flow into the vane servomotor 22, 23 and the vanes remain in their then position until a further change in cupola and conduit pressure occurs.

When the resistance of the charge in the cupola increases, valve 47 is moved toward the right, thus allowing air under pressure to escape from the upper chamber of servomotor 22 and allowing spring 24 to flex the diaphragm upwardly. The driving gear 19 and vane gears 18 then rotate vanes 16 in a direction to open the discharge pipe to the maximum free open-

ing. Opening movement of vanes 16 continues as long as valve 47 is in position to allow escape of air from servomotor 22 through the valve.

Consideration of the curves shown in Fig. 2 which are test results on a system according to the present invention now in operation, shows that the power consumed for given atmospheric conditions is less at all points of operation, excepting maximum output, than when throttling control is used for the same blower. The saving in power varies from 30 kw. to 45 kw. at various points of operation when the power consumption by the vane controlled blower varies from 50 kw. to 80 kw. In addition to the saving in operating power, elimination of the throttling losses allows the blower to be designed for more nearly the actual pressure employed in normal operation, thus resulting in a smaller blower and motor for any given operating condition. Elimination of the usual throttling blast gate in the blower discharge eliminates the turbulence in the discharge which is unavoidable when such gate is used and eliminates the losses due to increased friction resulting from such turbulence. The gate losses amount to 2 to 3 ounces of pressure even when the gate is in its farthest open position because the gate must even then be set at about 35° to the pipe axis to secure sufficiently accurate control thereof. It will therefore be apparent that the present invention provides a control system for blowers which are provided with means shown as vanes operated by a servomotor which may also be an electric motor operated by a contactor in place of valve 47, for varying the quantity of air flowing into the blower before such air is compressed, rather than varying the pressure of the air after the energy required for compression has been expended thereon, and provides means for operating the air quantity varying means. The means for operating the vane servomotor are responsive to the air weight as a result of the combination of pressure responsive means with compensation for variation of barometric conditions. Such pressure responsive means include the spring pressed bell 32 in the housing 30 and the connections of the several portions of the housing with opposite sides of the orifice plate in the discharge line and the compensation for changing barometric conditions, which compensating means are already known to the art.

Although but one embodiment of the present

invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. In a control system for blowers delivering a constant weight of air, a centrifugal blower comprising a casing and an impeller within said casing, said casing having an inlet aperture for inspiration of air into said blower, a plurality of adjustable guide vanes mounted in the inlet in said casing and extending radially of the axis of and adjacent said impeller and adjustable on their axes to vary the quantity of air and to impart a whirl to the entering air inspired into said impeller, and means responsive to the weight of air discharged by the blower to adjust said vanes.

2. In a control system for blowers delivering a constant weight of air, a centrifugal blower comprising a casing and an impeller within said casing, said casing having an inlet aperture for inspiration of air into said blower, a plurality of adjustable guide vanes mounted in the inlet in said casing and extending radially of the axis of and adjacent said impeller for adjustment on their axes to vary the quantity of air and to impart a whirl to the entering air inspired into said impeller, a servomotor for adjusting said vanes to vary the quantity of air inspired into said casing, and means responsive to the weight of air discharged by the blower to control operation of said servomotor.

3. In a control system for blowers delivering a constant weight of air, a centrifugal blower comprising a casing and an impeller within said casing, said casing having an inlet aperture for inspiration of air into said blower, a plurality of adjustable guide vanes mounted in the inlet in said casing and extending radially of the axis of and adjacent said impeller and adjustable on their axes to vary the quantity of air and to impart a whirl to the entering air inspired into said impeller, a fluid pressure operated servomotor for adjusting said vanes, a pilot valve controlling the supply of fluid pressure to said servomotor, and means responsive to the weight of air discharged by the blower to operate said pilot valve.

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