July 25, 1944. H. A. REECE 2,354,276

APPARATUS FOR SUPPLYING AIR AND THE LIKE

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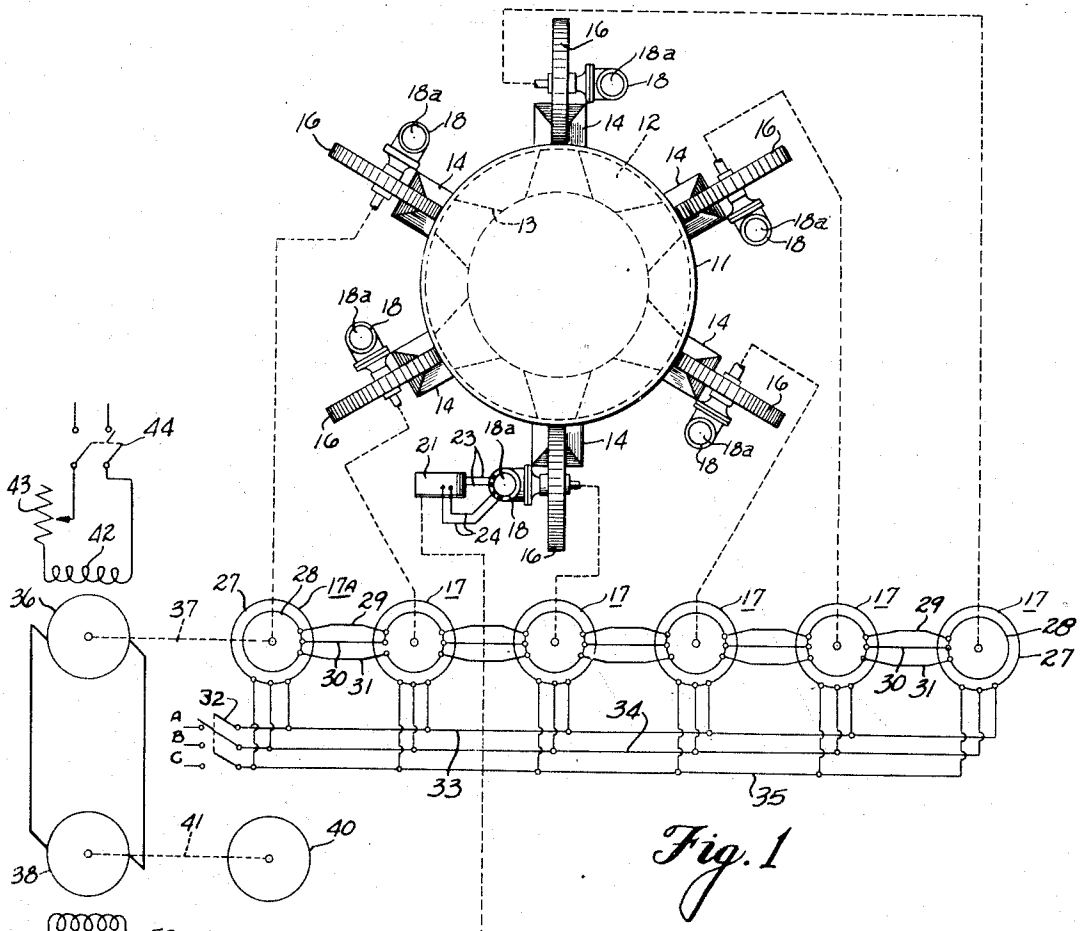


Fig. 1

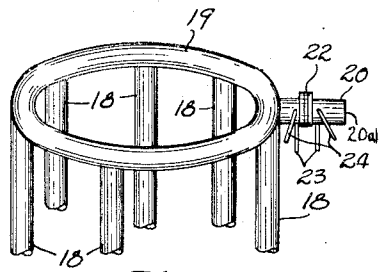


Fig. 3

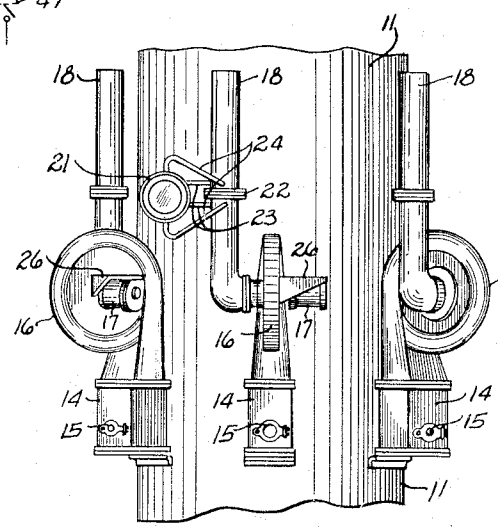


Fig. 2

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APPARATUS FOR SUPPLYING AIR AND THE LIKE

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8 Claims. (Cl. 266—30)

My invention relates to supply apparatus for delivery of air and the like to furnaces, such as metallurgical furnaces.

It has became recognized that the successful operation of furnaces having a plurality of tuyères entering the furnace, such as, for example, a cupola or other metallurgical furnace, depends to a great degree upon the control of the supply of air to the tuyères. The control of air supply producing the best results is one in which the total air blast to the furnace is under adequate control and also in which the proportionate air blast to each of the several tuyères is properly governed.

Heretofore, the supply of air to the plurality of furnace tuyères has been accomplished by the use of a wind box functioning as a common distributing chamber which receives air from a source of an air blast, such as a blower, and supplies the air to the plurality of tuyères communicating with the wind box. The use of wind boxes for supplying air to the tuyères, however, had certain inherent defects and disadvantages. For example, the supplying of air to the several tuyères was not uniform, the velocity of the air entering the several tuyères being unequal. Also, the supply of the total air blast required in the furnace was not maintained at the proper rate nor were necessary changes in the operation of the blower to maintain the said proper rate obtainable without a disadvantageous time lag between the requirements of the furnace and the changes in operation of the blower.

It is an object of the present invention to eliminate the use of a wind box for distributing air to a plurality of furnace tuyères.

Another object is the elimination of the defects and disadvantages inherent in supply apparatus utilizing a wind box.

Another object is the provision for supplying each of a plurality of tuyères with an air blast from a blower for each of the tuyères.

Another object is the provision for independent blower means for each of a plurality of tuyères entering a furnace.

Another object is the provision for operating separate blowers for each of a plurality of tuyères in accordance with the requirements of said tuyères, respectively.

Another object is the provision for synchronizing the operation of a plurality of blowers supplying air to a plurality of tuyères, respectively.

Another object is the provision for correlating the rate of air supply of a plurality of blowers each of which communicates with one tuyère of a plurality of furnace tuyères.

Another object is the provision for synchronous operation of a plurality of blowers delivering air to respective tuyères.

Another object is the provision for synchronously supplying air to a plurality of tuyères in accordance with pre-determined requirements.

Another object is the provision of a plurality of air supply units for a furnace, each of the units comprising a tuyère and a blower for supplying an air blast to said tuyère.

Another object is the provision of a plurality of air supply units for a furnace, each of the units comprising a tuyère, a blower for supplying an air blast to said tuyère, and adjustable speed driving means for said blower.

Another object is the provision of a plurality of air supply units for a furnace, each of the units comprising a tuyère, a blower for supplying an air blast to said tuyère, and control means for controlling the air blast output of said blower.

Another object is the provision for supplying air to a plurality of tuyères in accordance with the requirements for each said tuyère.

Another object is the provision for supplying air to a plurality of tuyères by a blower for each of said tuyères, the operation of the blowers being responsive to the amount of air being delivered to the tuyères.

Another object is the provision of apparatus for obtaining uniform velocities of the air supplied to a plurality of tuyères.

Another object is the provision of apparatus for maintaining the supply of air to a plurality of tuyères at a required minimum rate.

Another object is the provision for controlling the air supply output of blowers delivering air to a plurality of tuyères without appreciable time lag between output by the blowers and delivery to the tuyères.

Other objects and a fuller understanding of my invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawing, in which:

Figure 1 is a plan view of a furnace upon which my apparatus may be mounted and in addition illustrates a diagrammatical embodiment of my electrical control arrangement.

Figure 2 is an elevational view of a side of a furnace upon which my apparatus has been mounted but omits a diagrammatic showing of my electrical control arrangement.

Figure 3 illustrates a modified arrangement of the blower inlet pipes of the apparatus shown in

Figures 1 and 2, in which the several inlet pipes are joined to have one common inlet.

The illustratory furnace of which the outer wall 11 is shown in Figures 1 and 2 is a cupola furnace having all of the usual parts necessary for the operation of the same. For purposes of simplicity of illustration only the wall on one side of the furnace is shown in Figure 2 inasmuch as a view of the opposite side would be a duplicate of the view. The upper and lower ends of the furnace in Figure 2 have been removed as being not necessary for the disclosure of the present invention.

The illustratory furnace to which my invention may be adapted had a plurality of tuyères 13 (six tuyères in the present example) which are of equal size and are uniformly spaced around the periphery of the furnace in a plane passing through the lower part of the furnace. These tuyères extend through the wall of the furnace to communicate with the interior thereof and extend through the furnace wall 11 and fire brick lining 12 in the form of a port or window. The disposition of the six tuyères 13 is shown in dotted lines in Figure 1.

As shown in Figures 1 and 2, there is a housing or conduit 14 mounted to the furnace wall, by any suitable means, over the entrance to each tuyère in such manner that the interior of the housing or conduit 14 is in free communication with the one tuyère with no other tuyère Connected in direct communication with, and above, each housing or conduit 14 is a blower 16, there being one blower for each housing 14 and its respective tuyère. As the blowers 16 may be of any well known construction and type it has not been considered necessary to show the internal structure of the blowers. On the front wall of each housing or conduit 14 there is a peep hole 15 in alignment with the respective tuyère.

As there are six tuyères in the example furnace illustrated there are six blowers 16, each blower being adapted to blow air to only one tuyère through a respective conduit or housing 14. Guide vanes 25 may be positioned within each conduit or housing 14 to properly guide the flow of air to the tuyères.

Inasmuch as the blowers 16 are positioned adjacent the furnace wall and in close proximity to the tuyères the air does not travel any appreciable distance before entering the tuyères. Therefore, there is no appreciable time lag between the delivery output of the blowers and its entry into the furnace through the tuyères. Any change in the rate of speed or rate of delivery of the blowers is almost immediately reflected in the rate of air supply entering the furnace through the plurality of tuyères.

An electric drive unit 17 is mounted upon the side of each blower 16 by a supporting bracket 26 or other suitable means in such a manner that the blowers are driven by the respective units. Each blower 16 has an inlet pipe 18, respectively, which communicates with atmosphere as a source of air. In the view of Figures 1 and 2 each inlet pipe 18 independently communicates with atmosphere through an opening 18a and in the view of Figure 3 the arrangement is modified to provide that the several inlet pipes 18 are joined together by a common communicating pipe 19 having an inlet 20 open to atmosphere through an opening 20a and thus all have a common inlet.

To maintain the supply of air to the tuyères in constant required amounts, a flow meter control device 21 may be incorporated in one of the pipes 18 of the apparatus. As the internal structure and operation of the device 21 are well known the detailed structure thereof has not been illustrated. Any suitable flow meter control device may be utilized in my apparatus, such as, for example, the flow meter control device shown in United States Patent No. 1,977,559 issued to Lewis et al. on October 16, 1934. Such devices indicate amounts of fluid or gas flow by measuring differential pressures in the line of flow and at the same time operate distant devices such as motors, valves, switches and rheostats through suitable connecting means such as mechanical linkages, electrical circuits and fluid operating systems. The requirements for the operation of the distant devices by the control device is in accordance with an adjustable setting on the control device.

The control device 21 is in communication with one of the conduits 18 through which the air passes. The control device may also be connected with the conduit on the outlet side of the blower to determine the flow therethrough. A restricted orifice plate 22 is mounted in the pipe 18 and pressure communicating pipes 23 connect the control device with the interior of the pipe 18 on opposite sides of the orifice plate. The differential pressure on opposite sides of the plate, and hence the amount of air flowing through the pipe 18, is measured and integrated by the control device 21. To compensate for differences in the temperature and barometric pressure of the air being measured circulating pipes 24 by-pass air through the device 21 and suitable compensating mechanism within the device 2 accounts for the temperature and barometric pressure.

It may be assumed that the temperature and barometric pressure of air entering all of the inlet pipes 18 is the same. Upon the assumption that the air entering all the inlet pipes 18 is of the same density, the air passing through one inlet pipe 18 may be used as a sample and the one control device 21 that is connected to the said one inlet pipe may be utilized for uniformly governing the operation of all of the blowers, as for example, by the circuit arrangement of Figure 2. As all the blowers are of the same capacity a uniform speed of rotation will assure a uniform amount of air advanced by all of them.

The arrangement of Figure 3 may also be utilized by connecting one control device 21, through pipes 23 and pipes 24, with the common inlet pipe 20. In this arrangement the amount of total air being advanced by all six blowers as measured at the common inlet to all the blowers is used for operating the one control device 21 governing the operation of my apparatus, for example by using the control circuit of Figure 1.

Figure 1 illustrates a circuit arrangement which may be utilized for synchronously operating all six blowers at speeds which are adjustably pre-determined and maintained by a control device 21. As illustrated in Figure 1, a motor 36 drives through a shaft 37 a synchronous transmitter or generator 17a which in turn is connected to drive the left-hand blower as indicated by the dotted lines. The synchronous receivers or motors 17 receive electrical energy from the transmitter 17a and are operated at the same speed. Each of the motors or receivers drive respectively the other five blowers, as indicated by the dotted lines.

In Figure 1, the stators or primary windings 27 of the respective motors 17 and the generator 17a are connected by conductors 33, 34 and 35 with a suitable source of alternating current designated as A, B and C to be energized thereby. The switch 32 is arranged to disconnect the conductors 33, 34 and 35 from the source of current A, B and C. The rotors or secondary windings 28 of the respective motors 17 and the generator 17a are arranged to be electrically inter-connected through the plurality of conductors 29, 30 and 31. Although the plurality of motors and the generators 17a comprising stators 27 and rotors 28 are shown as polyphase units, single phase units may also be used in the circuit. By the arrangement shown in Figure 1 the several rotors 28 are electrically interlocked to rotate in synchrony and the motors 17 are therefore synchronously operated with the generator 17a. The blowers 16 are, therefore, also operated in synchrony. An example of the manner in which such motors may be synchronously interlocked is to be found in United States Letters Patent No. 2,202,421 issued to Harrell et al. on May 28, 1940, which patent also illustrates other circuit arrangements which may also be included in my apparatus to obtain the operating characteristics desired.

A field winding 42 for the driving motor is connected to a suitable source of electrical energy. A switch 44 is adapted to disconnect the field winding 42 with the source of electrical energy. The adjustable resistance winding 43 is arranged to vary the speed of the driving motor at a predeterminable rate.

A generator armature 38 is arranged in closed circuit relationship through conductors 39 with the armature 36 of the driving motor. A prime mover 40 which may be a motor or other source of power is arranged to drive the generator armature 38 by the shaft 41.

A field winding 45 for the generator is connected by conductors 50 through adjustable resistance windings 46 and 48 and conductors 51 to a suitable source of electrical energy. A switch 47 is adapted to disconnect the conductors 51 from the source of electrical energy. The adjustable resistance winding 46 is arranged to vary the excitation of field winding 45 and thus vary the speed of rotation of the driving motor armature 36 at a predeterminable rate. The adjustable resistance winding 43 may be utilized to adjust the speed of the driving motor in one speed range and the adjustable resistance winding 46 may be utilized to adjust the speed of the driving motor in another speed range.

The flow meter control device 21 responsive to the amount or weight of air determined thereby is connected by a suitable connection 49 with the movable part of the adjustable resistance winding 48 interposed in the electrical circuit of field winding 45. The connection 49 may be a mechanical linkage, fluid drive means, electrical operating means or any other means for effecting a movement in the adjustable resistance winding 48 in accordance with the operation or position of the movable parts of the control device 21. Manipulation of the adjustable resistance winding 46 varies the excitation of the field winding 45 and thus varies the speed of rotation of the driving motor armature 36.

It is therefore seen that the speed of the driving motor armature 36 and consequently the speed of the blowers 16 is responsive to the rate or amount of air flow determined by the control device 21. In operation, the adjustable resistance windings 43 and 46 are set at proper position to obtain the normal speed desired for the blowers 16 in order to produce the supply of air at the required rate or amount per hour and the generator 17a and the motors 17 are driven as described. The control device 21 is set to indicate any variance from that required rate or amount and to operate the connection 49 and adjustable resistance winding 48 in accordance with such variance. When the control device 21 indicates that the required minimum amount of air is not being furnished at said predetermined rate the blowers 16 will be speeded up by the arrangement described. When the control device indicates that the required maximum amount of air is being exceeded then the blowers 16 will be slowed down. By this arrangement the speed of the blowers will be held at the proper rate to assure the supply of air to the tuyères at the desired amount.

In a control device 21 incorporating compensating means for temperature and barometric pressure of the air the weight of the air delivered to the tuyères by the blowers will be held under close control. With the inter-locking system of Figure 1 all of the blowers will speed up or slow down together and thus assure supplying the air to the plurality of tuyères at uniform velocities.

Although I have described my invention with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

I claim as my invention:

1. Apparatus for supplying an air blast to a plurality of tuyère means for introducing air into a furnace at a plurality of locations comprising, a plurality of air blowers having air inlets and air outlets, each of said outlets being in communiction with a respective entrance for each tuyère means to supply air thereto, a separate electric motor for driving each of said blowers, and electrical circuit means connecting said motors for synchronizing the speed of the motors, the synchronous operation of the motors driving said blowers to blow air into the plurality of tuyère means at substantially equal velocities.

2. Apparatus for supplying blown air to a plurality of tuyère means entering a metallurgical furnace at recurring intervals around the circumferential extent of the furnace, comprising a plurality of air blowers mounted upon the said furnace at recurring intervals around the circumferential extent thereof and positioned adjacent the said tuyère means, respectively, for separately blowing air into the said tuyère means, driving means for driving said blowers, and means for collectively governing the rate of air delivery of the plurality of blowers to assure the supplying of air to the plurality of tuyère means at uniform velocities.

3. In a metallurgical furnace having a plurality of tuyère means for the supply of blown air to the interior of the furnace, said plurality of tuyère means being disposed substantially in a horizontal plane passing through the furnace and at recurring intervals around the circumferential extent of the furnace; a plurality of air blowers each mounted adjacent to a separate one of

said tuyère means, respectively, and regularly distributed around the peripheral extent of the furnace; conduit means for conducting blown air in a separate course from each of said blowers to a respective entrance for each tuyère means, and driving means interdependently connected for operating each of said blowers at a speed relative to the speed of the other blowers to assure the delivery of a uniform supply of blown air to the plurality of tuyère means by said blowers.

4. Apparatus for supplying blown air to a plurality of tuyère means introducing the blown air into a furnace comprising the combination of a plurality of air blowers mounted to separately blow air into respective tuyère means, a plurality of electric motors for driving said blowers, respectively, interlocking electrical circuit means for causing said motors to operate at related speeds, variable speed operating means for operating said motors at the required rate of speed, said electric motors, circuit means and variable speed operating means providing for the operation of the blowers to supply blown air to the plurality of tuyère means at the required rate and at related velocities.

5. Apparatus for supplying blown air to the interior of a furnace at a plurality of positions around its circumferential extent comprising a plurality of air supplying units positioned at intervals around said furnace in juxtaposition to said plurality of positions, each of said units including: a blower for blowing air, tuyère means for introducing said blown air into the interior of the furnace, a separate conduit connecting said blower and said tuyère means, and an electric motor for driving said blower; and means electrically interconnecting said electric motors for driving the said electric motors of said units in synchrony to provide for the uniform operation of said air supplying units.

6. The combination of a plurality of blowers arranged to provide independent air supply means for separately supplying blown air to each of a plurality of tuyère means entering a furnace, first means for operating said blowers in unison to uniformly supply blown air to the plurality of tuyère means, second means for adjusting the delivery of said blowers to a pre-determined rate, and third means responsive to the weight of air advanced by a blower for controlling said second means for maintaining the said predetermined rate of delivery to the plurality of tuyère means.

7. A system for supplying air to a plurality of tuyère means entering a furnace comprising separate air blowing means for each of said tuyère means, operating means for operating said air blowing means in unison to deliver substantially uniform amounts of air to the tuyère means, and flow meter means responsive to the delivery of air by said air blowing means and operatively connected to said operating means to jointly control said blowing means for maintaining the supply of air to the tuyère means at a predetermined rate.

8. The combination of a plurality of air blowers for supplying blown air to a plurality of tuyère means entering a metallurgical furnace, each of said blowers being arranged to blow air directly to a respective tuyère means separately from the other tuyère means, operating means for operating said blowers, correlating means for collectively correlating the rate of delivery of the plurality of blowers, and adjustable means governing said correlating means for adjusting the rate of delivery of said blowers, whereby said blowers supply blown air to the respective tuyère means at the required rate determined by said adjustable means and at velocities correlated by said correlating means.

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