United States Patent

Nieboer

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[54] DEVICE FOR DISTRIBUTING MATERIAL INTO A FURNACE

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Aug. 17, 1968 Germany ..... P 17 58 840.8

[52] **U.S. Cl.** **214/36,** 193/3, 193/23, 266/27

[51] **Int. Cl.** **F27b 11/12**

[58] **Field of Search** ..... 214/35, 35 A, 36, 37, 17.64, 214/18 V; 193/3, 17, 23; 266/27

[56] **References Cited**

UNITED STATES PATENTS

1,465,273	8/1923	Kluttz	214/37
3,080,033	3/1963	Scott et al.	193/23
3,310,184	3/1967	Dauer	193/3 X
3,417,982	12/1968	Tsutsumi et al.	214/36 X
2,753,056	7/1956	Eastman et al.	214/18 V

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[57] **ABSTRACT**

A device for uniformly distributing material into a blast furnace and the like is formed by a hopper arranged to supply the material into a distributor pipe. The pipe is supported by pivot means at its upper end so that it can be displaced laterally below its upper end and swiveled about its normal vertical axis for selectively spreading the material into the furnace. The distributor pipe is moved laterally by means of rams actuated by hydraulic piston assemblies.

13 Claims, 6 Drawing Figures

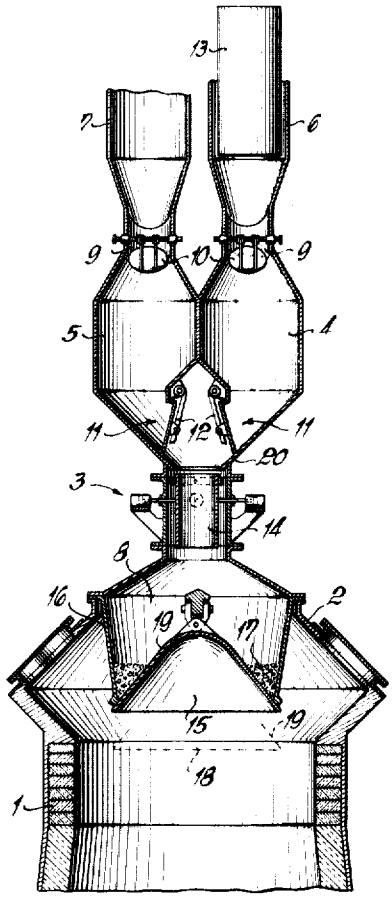

FIG. 1

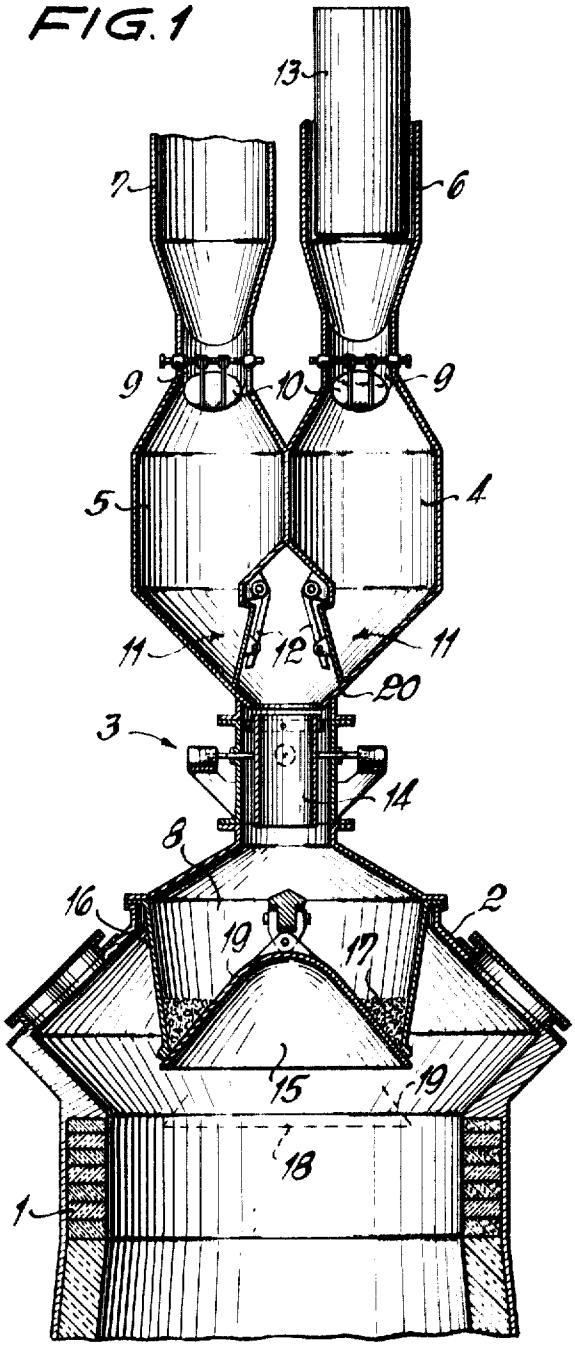

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FIG. 2

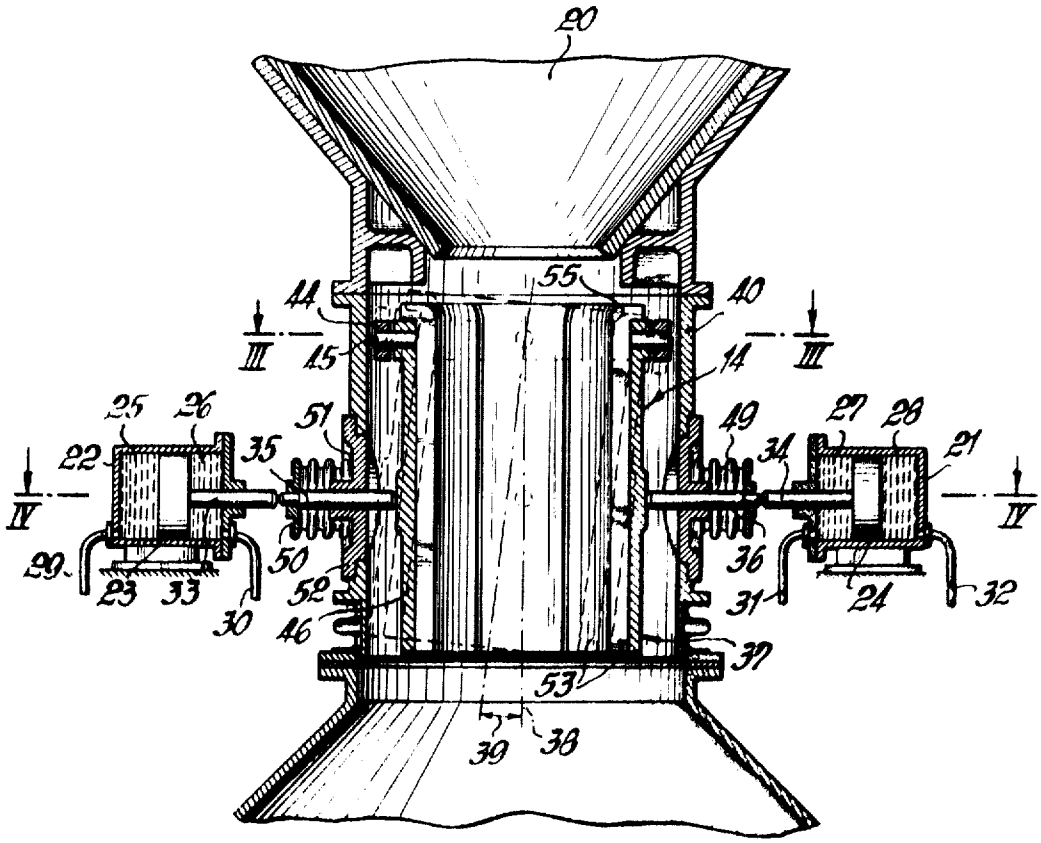

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FIG. 3

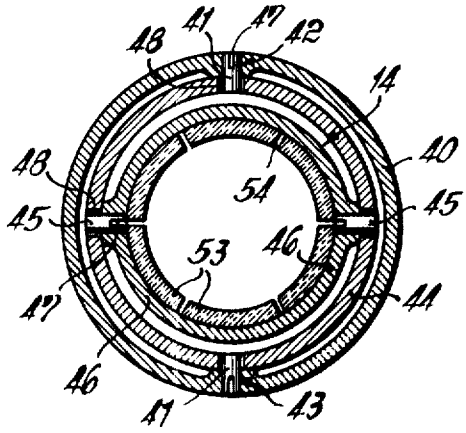

FIG. 4

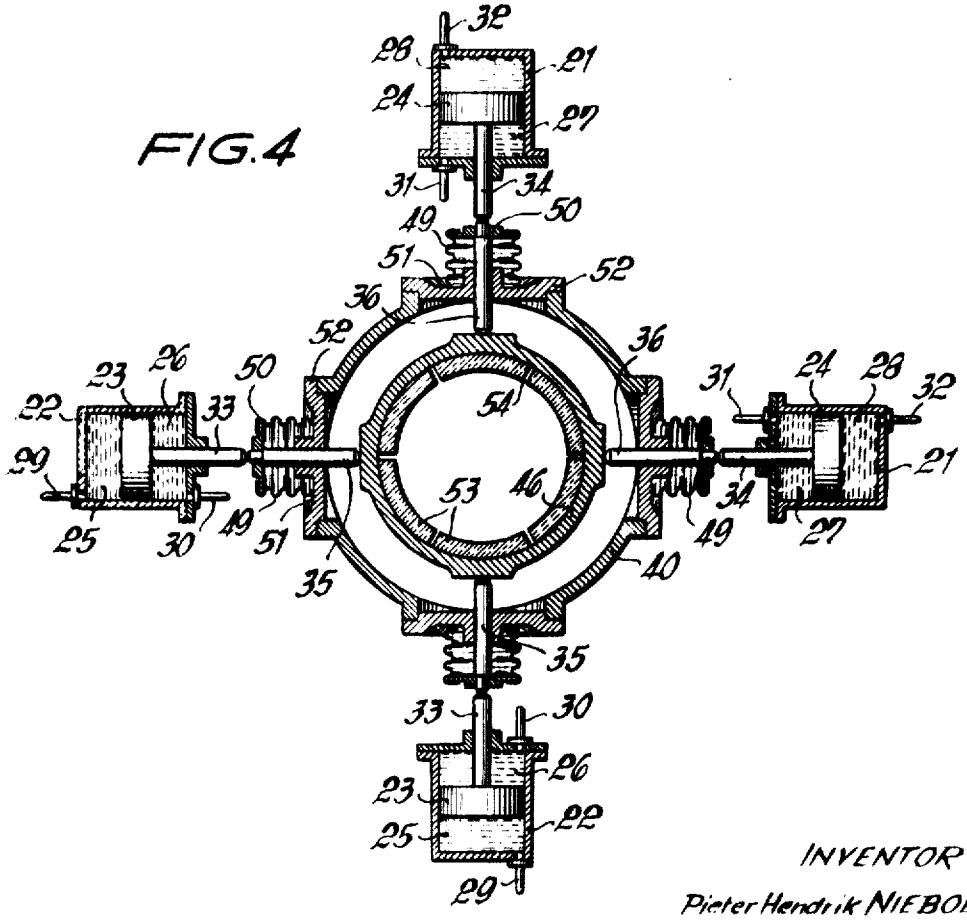

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FIG. 5

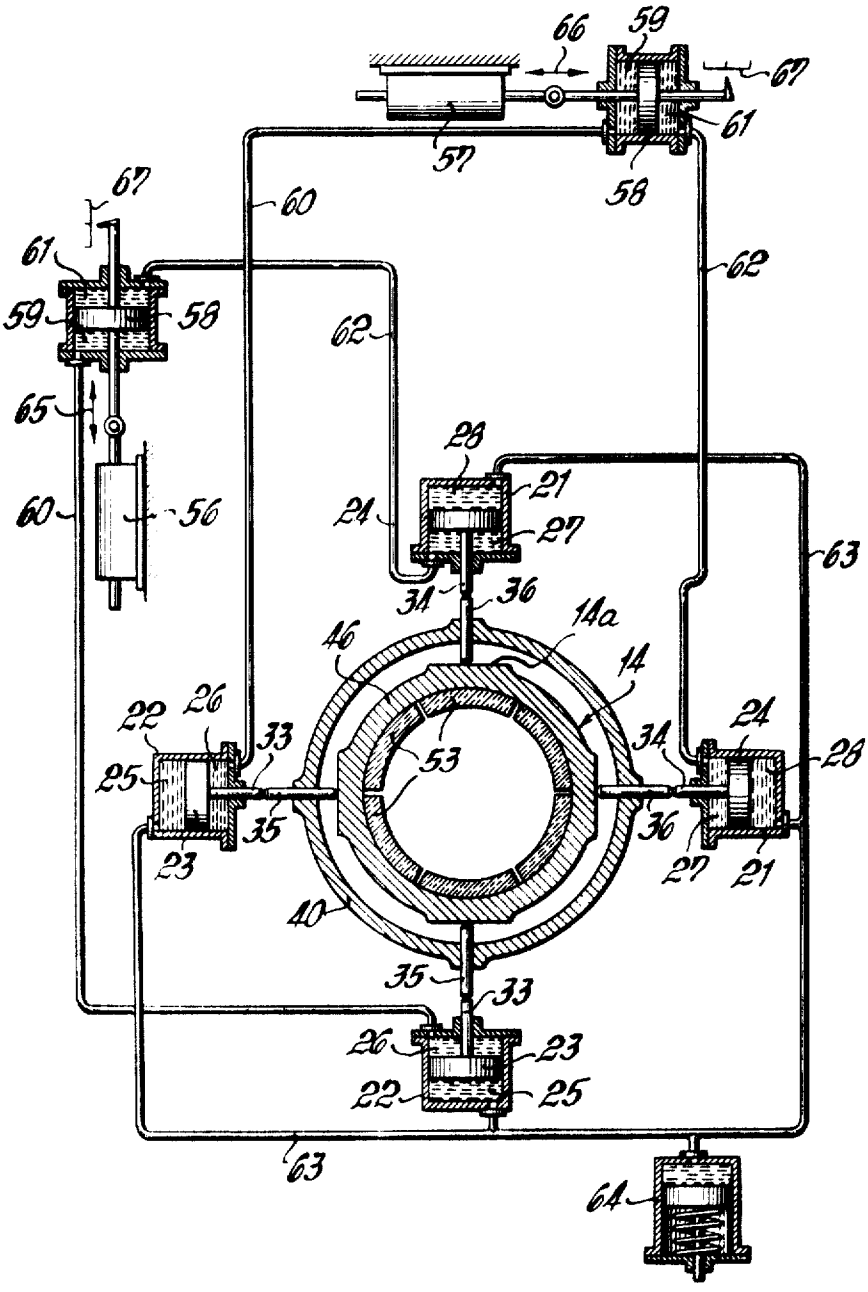

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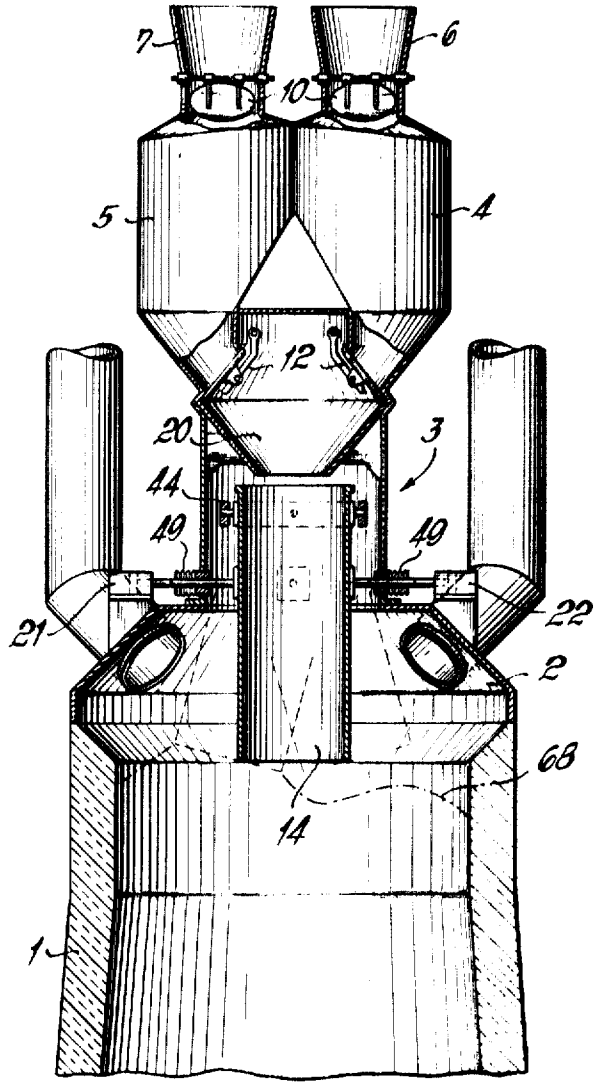
FIG. 6



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DEVICE FOR DISTRIBUTING MATERIAL INTO A FURNACE

SUMMARY OF THE INVENTION

The present invention is directed to a device for changing material into shaft furnaces, such as blast furnaces and the like, at which the throat or mouth opening operates under high gas pressures, and, more particularly, the invention is concerned with a distributing member which can be swiveled about its vertical axis for effecting a uniform distribution into the furnace. Additionally, the invention concerns an advantageous method for supplying the material into the furnace.

In the past, attempts to increase the output of blast furnaces have lead to the addition of oil or natural gas at the tuyeres, to an increase of the blast temperature, to the use of pelletized charge material, and to increased gas pressure at the throat of the furnace. The basic concept for increasing the output is directed at attaining better gasification of the furnace charge. This requirement has become more and more imperative as the furnaces have increased in size. However, better gasification can be achieved only if the distribution of the charged materials is considered as "uniform" in accordance with metallurgical concepts. The uniformity of the charge material within the furnace is based essentially on the distributing device employed.

Distributing devices presently in use can be classified into two types, one where the material is "distributed" outside the furnace zone and then is simply delivered into the furnace by a distributing bell or cone, and the other where the distribution takes place directly into the furnace zone by means of devices such as baffle aprons.

A distributing device which has been in use for many years includes a pair of bells of unequal diameter, one superposed above the other. However, such a device no longer stands up under the increased requirements of present day operation due to the higher gas pressures involved and also because of the wear which occurs. Another difficulty in such a device involves the replacement of a bell, which problem has long presented difficulties which have not been overcome because the furnace cannot be operated during replacement nor can it be closed down since this would result in even greater production losses. Another disadvantage of this arrangement is that the distributing effect obtained with the use of the bells is insufficient where large charge areas are involved. While the material may be deposited more or less exactly from the bell, there is considerable doubt that the material distribution on the bell itself will be uniform and, as a result, a favorable distribution is unlikely. Another consideration in the use of such devices concerns the granular size of the material being distributed, since the size of the material in addition to its particular properties, such as physical form, surface, and the like, imparts a different motion which affects the distribution. For all substances of the charge materials, however, the paths of the free fall are the same and are of the same length. For example, the amplitude of the discharge per hour is determined according to the attained velocity on the conical surface of the distributor bell. At fixed material properties and fixed distributor dimensions, the distributing effect cannot exceed an optimum value which is basic to the device. Therefore, it follows that efforts to increase the output of blast furnaces must be preceded by the solution of the problem of providing suitable distribution devices for larger charge areas presently used in the furnaces.

In the course of technical developments in furnaces, drastic changes have occurred in the properties of the materials charged. For example, ore, in a lump state, has been replaced by classified sinter and finally by pellets, that is, ore carriers which approach a spherical form. However, the distributing devices are not changed in their basic concept, although entirely new requirements have been presented because of the change in the form of the charge materials. One attempt that has been made to overcome the problem has been the use of

displaceable baffle aprons suspended in the furnace zone, and which contribute to the distribution of the material. The action of such baffle aprons is limited to their ability to deflect the material dropping from the distributor bell based on a set angle of incidence, though it is also possible to adjust the baffle plates obliquely and/or to vary their size. Material arriving at the baffle plates at different velocities must therefore follow a different distribution pattern which may not be appropriate for the desired furnace operation. While double bells and baffle aprons constitute acceleration members or deflection means, respectively, there is a lack of suitable means for introducing the material in a particular direction independently of the material properties without the intervention of variables which are difficult to control, such as velocity, acceleration, the angle of incidence, and the like. In particular, there is a lack of adequate means for meeting the needs of larger furnaces.

Accordingly, the primary object of the present invention is to improve the existing distributing devices or to provide replacements for them so that the disadvantages which have been experienced in the past can be overcome. Further, the invention has as its primary object to provide a device for effecting distribution of the charge material in consideration of the problems experienced with increasing furnaces sizes. Another consideration to which the invention is directed is to afford independence from the properties of the charge materials, which in the past have affected its distribution and which can be determined only imperfectly in practice.

Therefore, in accordance with the present invention, the problems experienced in the past can be overcome by employing a distributor pipe mounted pivotally about its outer circumference so that the lower end of the pipe can be swiveled about its normally vertical central axis for effecting the desired distribution. By means of this distributor pipe, the charged material can be delivered into the furnace in a more uniform pattern than has been possible in the past. Unlike the distributor used in the past, the angle of discharge of the charged material is not rigid fixed but can be varied as required. This variability affords specific adjustment based on the properties of the charged material. If the material is distributed before it enters the furnace zone, that is, if certain distribution cross sections have, in the past, rendered distribution difficult, the ability to select an angular position for the distributor pipe with the required velocity of movement now permits optimum charging to be carried out. By means of the present invention, it is possible to take into account, to a considerable extent, the differences of the materials involved in the metallurgical operation of blast furnaces and the like.

In a preferred embodiment of the present invention, the distributor or filling pipe is suspended at its upper end within a ring which is pivotally supported by a pair of diametrically disposed pins secured within an outwardly disposed support shaft. The pipe is similarly pivotally suspended by another pair of pins extending outwardly from the distributor pipe into the ring. The axis of the second pair of pins is disposed perpendicularly to the axis of the first pair of pins. Such a suspension resembles a cardan suspension, and it has the advantage of being rugged which is of special importance in rough metallurgical operations. The number of pivotal suspensions is limited and, as a result, the suspension arrangement is simple and inexpensive. Normally, articulated parts contained in the furnace zone are exposed to special loads. However, in the present invention, the number of such parts is kept at a minimum, and the articulated parts are located at a position protected from the application of high loads and, as a result, a correspondingly longer life is obtainable.

In laterally displacing the distributor pipe about its normal vertical axis, drive assemblies are used, located below the pivotal suspension of the pipe, and having their axis of movement disposed normally to the axis of the pivot pins about which they effect the displacement of the pipe. For distributing the charge material onto a cone-shaped distributor bell only two pairs of the assemblies are needed to effect the

desired movement of the pipe. Further, by arranging the assemblies in pairs the pipe can be guided reliably in its swiveling action even where heavy distributor pipes are used.

When the present invention is employed, it is possible to omit the use of one of the distributor bells, where previously two bells has been used, so that the distributor bell, as known in the past, then delivers the charged material into the furnace zone. Based on the prior art, the function of the bell was to seal the throat from the furnace zone and to form a lock chamber, and the combination of the two bells, one superposed on the other, effected the predistribution of the material onto the lower bell. As mentioned above, this arrangement afforded a uniform distribution of the charged material which was something less then optimum, and its ability to achieve uniform distribution decreased as the size of the furnaces increased. Accordingly, with the present invention, a single distributor bell is required from which the material can flow uniformly into the furnace zone.

While the present invention is directed to use in shaft furnaces generally, and in particular in blast furnaces operating under normal pressure conditions its use is particularly advantageous in such furnaces operating at above normal pressure conditions. In furnaces operating under high pressure conditions, the invention is particularly useful because the shaft supporting the outer pair of pivot pins for the suspension ring is connected in pressure tight relationship with a lock chamber above the distributor pipe and at its lower end is similarly sealed to the furnace head. The drive elements which effect the lateral displacement of the distributor pipe are enclosed within sealed members as they pass through the shaft to maintain the pressure tight conditions. As a result, the suspension of the filling pipe which affords it ability to swivel is located in a shaft at the throat of the furnace which is without any major leakage points. Accordingly, any problems of packing openings through the shaft are easily solved by means of presently available packing material. With the drive assemblies located outside the shaft, they are accessible for maintenance and repair, and are also protected from the adverse affects of heat and dirt so that only the extension of the assemblies which effect the lateral rectilinear displacement of the pipe within the shaft are exposed to such conditions. However, since the drive assemblies involve only rectilinear movements their passages through the shaft can be easily sealed.

The sealing problem involved with the drive assemblies is easily solved by employing a ram disposed within a pressure tight enclosure at its point of passage through the shaft and with the inner end of the ram contacting a special sliding surface on the outer circumference of the filling pipe for effecting the desirable displacement without difficulty.

Moreover, the use of the sealing enclosure about the rams assures a total sealing for the opening for the ram through the shaft. The sealing enclosure employs a metal bellows extending between a flange mounted on the outer end of the ram and a second flange forming the closure for the shaft. By means of the metal bellows the necessary rectilinear motion of the ram perpendicular to the axis of the shaft can be easily accommodated without permitting any gas losses to exist in the overall device.

Another advantageous feature of the invention is the use of hydraulic piston drive mechanisms for the drive assemblies disposed in diametrically opposed positions on the exterior of the shaft and interconnected by a common control device for effecting the displacement of the distributor pipe. The piston drive mechanisms are double acting so that pressure variations on the opposite sides of the pistons can be maintained in corresponding assemblies so that a reliable guide for the movement of the distributor pipe is achieved. Where two pairs of the drive assemblies are disposed in a common transverse plane about the shaft a ringlike movement can be given to the lower or outlet end of the distributor pipe. By operating the drive assemblies in sequence about the circumference of the filling pipe the desired swiveling action in an annular path is easily achieved. As the pressure variation within the control devices is continued, the sequence of operation can be varied so that the diameter of the swivel action of the pipe can be changed in accordance with operating conditions. Further, the circumferential speed of the distributor pipe can be regulated by controlling the delay of the pressure build up or decrease within the hydraulic piston assemblies.

While up to this point the distributor pipe has been described in combination with a lower distributor bell, it is also possible to employ the distributor pipe for charging material into the furnace without the corresponding use of a distributor bell. In such an alternate embodiment, the distributor pipe is of a sufficient length so that it extends to the charging surface within the furnace zone. In this arrangement, it is possible to feed the charged material without difficulty under either normal or high pressure operation, since the extent of the fall of the material is small or negligible because the material is supplied directly to the charge surface.

The distributor pipe can be designed to improve the load conditions and also to achieve improved operating conditions within the furnace. Accordingly, the distributor pipe is formed either cylindrically or conically and it is possible that it can be provided with eccentric outlet apertures. Further, in view of the nature of the materials being passed through the distributor pipe, it is equipped with a replaceable wear lining.

The wear lining of the distributor pipe is advantageously formed by a plurality of axially extending segment plates which are supported within a corresponding sleeve by means of their own weight. The segment plates are supported at their upper end by flanges and, due to their formation and the relative dimensions, the plates cannot be displaced radially which avoids any problems resulting from misalignment of the lining members.

Another desirable characteristic of the invention is the method for operating the distributing pipe due to its support arrangement. Under normal operating conditions the distributor pipe can be moved in a desired pattern to effect the preferred charging arrangement. However, by regulation of the drive means for the distributor pipe the pipe can be moved continuously along a specified path with interruptions of such movement so that individual steps of the furnace operation can be taken into consideration. In the past it has not been possible to deposit the charged material on different diameters of the charged surface or to charge selectively areas within the furnace which operate under different conditions.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view through a portion of a blast furnace head and throat closure embodying the present invention;

FIG. 2 is an enlarged vertical sectional view of a portion of the furnace shown in FIG. 1;

FIG. 3 is a horizontal sectional view taken along line III—III in FIG. 2;

FIG. 4 is a horizontal sectional view taken along line IV—IV in FIG. 2;

FIG. 5 is a horizontal sectional view generally similar to the arrangement shown in FIG. 4, however, including a hydraulic fluid supply system and control means for operating the hydraulic piston drive mechanisms; and

FIG. 6 is a vertical sectional view, similar to FIG. 1 illustrating another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 1 a blast furnace 1 is shown as having a furnace head 2 arranged to form a closure into the furnace and to which is connected a distributor assembly 3 for charging materials into the furnace. The charged material, which consists, for example, of ore in lump, sintered or pelletized form, lime and coke, is fed from storage bunkers 4 and 5 located above the distributor assembly 3. Positioned above the bunkers 4 and 5, are hoppers 6 and 7 for delivering the charged material into the bunkers, the hoppers receiving the material by skip charging and the like.

The blast furnace illustrated in FIG. 1 is operable by the high-pressure method, in which a pressure higher than atmospheric prevails in the throat 8 within the furnace head through which charge materials are supplied into the furnace. Accordingly, due to the higher pressure conditions within the throat, the storage bunkers 4 and 5 form lock chambers provided with a sealing valve 10 at each of their inlets 9 and a similar sealing valve 12 at each of their outlets 11. By constituting the storage bunkers 4 and 5 as lock chambers the material delivered by skip charging 13 into the bunkers can be eventually supplied into the furnace without any loss of pressure at the furnace throat.

The distributing assembly 3 is composed of a distributor pipe 14 located above and in axial alignment with a distributor bell 15 having a conically shaped upper surface with its apex rounded off. It is the purpose of the distributor pipe to supply the charged material uniformly between the conical surface of the distributor bell and the oppositely disposed surface of the charge vessel 16. The distributor pipe 14 is cylindrical in shape, but, it may be frustoconical and may be provided with eccentric openings. The distributor pipe 14 supplies the charged material 17 in a symmetrical distribution onto the distributor bell. In the position shown in FIG. 1, the distributor bell is sealed against the lower end of the charge vessel 16 retaining the material on its surface. When the distributor bell 15 is lowered into the position 18 indicated in dotted lines the charged material 17 flows off its conical surface 19 about the entire circumference of the distributor bell in a uniform pattern of a type which would not be possible if a superposed distributor bell were employed in place of the filling or distributor pipe 14.

To effect uniform distribution of the material passing through the distributor pipe, a swiveling suspension is provided for the pipe adjacent its upper end. In FIG. 2, it will be noted that the pipe 14 is shown in a normal vertical position in full lines and in a laterally displaced position in dot-dash lines. In the normal position, the distributor pipe 14 is located concentrically about the vertical axis 38. However, when the pipe is displaced laterally, it adopts the position shown in dotted lines and is concentrically disposed about the axis 39 which intersects the axis 38 in the plane of its suspension at its upper end and is angularly spaced from the axis 38 for the remainder of its extent. It will be understood that the position of axis 39 is shown only by way of example and this axis can be swiveled or rotated about the axis 38 through a full 360° to orient the distributor pipe as required for uniform distribution of the material into the furnace. During operation the material flows from the hopper 20 into the distributor pipe 14 and the distributor pipe can be swiveled or rotated as required during the flow of material into the pipe to provide the necessary distribution. For displacing the distributor pipe 14 about the vertical axis 38 two pairs of hydraulic piston drive assemblies 21 and 22 are angularly spaced about the exterior of a shaft 40 which laterally encloses the distributor pipe 14. The piston drive assemblies 21, 22 have double acting pistons 23, 24, respectively, whereby the interior of the piston chambers are divided into pressure zones or chambers on each side of the pistons 23, 24. In the piston assembly 21 the chamber is divided into the zones 27 and 28 while in piston assembly 22, the chamber is divided into pressure zones 25, 26. In the arrangement shown in the drawing, the pressure zones 26, 27 of the different piston assemblies are spaced closer to the distributor pipe while the zones 25 and 28 are more remote. The corresponding inner and outer pressure zones within the piston assemblies are interconnected as will be explained later in the description of FIG. 5.

As indicated in FIG. 2, pressure lines 29, 30, 31 and 32 serve to supply and to remove hydraulic fluid from the respective pressure zones. Each of the pistons 23 and 24 has a piston rod 33, 34, respectively, directed inwardly toward the shaft which encloses the distributor pipe, and the axes of the piston rods are arranged in pairs extending through the axis 38 of the distributor pipe in its normal vertical position. Moreover, the axes of the angularly spaced piston assemblies intersect one another substantially at right angles. Since the outer ends of the piston rods 33, 34 terminate outwardly from the shaft 40, rams 35, 36, respectively, extend inwardly from the ends of the piston rods into contact with sliding faces 14*a* on the outer circumference 37 of the pipe 14. The drive movement supplies by the piston assembly is transmitted through the piston rods 33, 34 to the rams 35, 36 which move in the same direction along the axes of the piston assemblies.

In providing the swiveling action for the lower end of the distributor pipe 14 a carrier ring 44 is provided concentrically about the upper end of the distributor pipe and is supported by means of the pair of diametrically disposed pivot pins 41 extending between the shaft 40 and the ring 44. The distributor pipe 14 is comprised of an outer sleeve 46 and a plurality of inner segment plates 53 which extend axially along the inner surface of the sleeve 46. At the upper end of the sleeve 46, in the same transverse plane with the ring 44, a pair of diametrically disposed pivot pins 45, spaced approximately 90° away from the pivot pins 41, 41, extend between the sleeve 46 and the ring 44. The pivot pins 41, 45 have slots 47 at the ends of the pins which are clamped within the sleeve 46 and the shaft 40, respectively. Accordingly, each of the pivot pins has its end opposite the slot 47 disposed within a pivot suspension 48 located within the ring 44. As the piston assemblies 21, 22, shown horizontally in FIG. 4, are operated, the distributor pipe 14, by means of the suspension arrangement at its upper end, pivots about the pins 41, and when the other pair of piston assemblies, arranged vertically in FIG. 4, are operated the distributor pipe correspondingly pivots about the pins 45.

It can be noted in FIG. 2 that the rams 35, 36 extend through the shaft 40 into the throat portion of the furnace which is operating under pressurized conditions. Accordingly, it is necessary to seal the passage of the rams through the shaft to prevent loss of pressure at these locations. To effect the sealing action a flexible metal bellows 49 is disposed concentrically about each of the rams 35, 36. At its outer end the bellows is connected to a first attachment flange 50 which rests against a shoulder on the ram and a second attachment flange 51 encircles the ram in the plane of the shaft 40 and provides a seal with the shaft. Due to the flexible character of the metal bellows 49 the inward and outward movements of the rams 35, 36 are accommodated by the bellows and an effective seal is provided for the interior of the shaft 40.

As indicated in FIGS. 2 to 5 the filling pipe is lined with individual segment wear plates 53 in contact about their outer surfaces with the inner surface of the sleeve 46. As shown in a somewhat exaggerated manner in the drawing the axially extending edges of the plates 53 are spaced apart by a gap 54. However, the spacing is so narrow that only axial movement of the plates can take place and it is not possible for the plates to move radially inwardly into the passageway for the material through the pipe 14. At their upper ends, as indicated in FIG. 2, each of the plates is provided with a flange 55 which rests on the corresponding upper end of the sleeve 46 for supporting the plates in position. Since the distributor pipe 14 is in an upright position even when displaced from its normally vertical position, the support for the plates provided by the flanges 55 and the narrow spacing afforded by the gaps 54, it is not possible for the plates to be displaced from their lining position even when the lower end of the pipe is being swiveled about a circular path.

In FIG. 5, the manner in which the hydraulic piston assemblies 21, 22 are operated is illustrated. Each pair of piston assemblies 21, 22 are connected to one of the control devices 56, 57. Each of the control devices 56 and 57 has a double acting piston 58 located within a piston chamber and which divides the chamber into a pair of pressure zones 59, 61. From the pressure zone 59 on the side of the piston 58 adjacent the control device, 56, 57, a line 60 extends to an inner pressure zone 26 in each of the different pairs of piston assemblies. Similarly pressure lines 62 extend from the pressure zone 61 to the inner pressure zones 27 of the two different pairs of piston assemblies. In other words, the pressure zones 59 and 61 are connected to adjacent inner zones of the piston assemblies 21, 22 and are not connected into piston zones in the same pair of oppositely disposed pistons. Accordingly, when one of the piston devices 56, 57 is operated displacing piston 58 through its enclosed chamber in the direction of the arrows 65 and 66, then the diametrically disposed pistons within a pair of piston assemblies will be displaced in the same direction with one of the rams 35, 36 being urged into the shaft while the other ram is displaced outwardly from the shaft. Since the plane of the piston assembly is spaced below the suspension plane of the distributor pipe the lateral or rectilinear movement imparted by the piston assemblies and the rams will cause the distributor pipe 14 to swivel or pivot about its upper suspension with its axis adapting an angular relationship to the normal vertical position of its axis as indicated in dot-dash lines in FIG. 2 by the axes 38, 39. It is possible to operate both of the control devices 56 and 57 so that their movements combine and the distributor pipe is imparted with a circular or elliptical movement as its axis 39 swivels about the normal vertical position of the axis 38.

Further, all of the outer pressure zones 25 and 28 of the hydraulic piston assemblies 21 and 22 are connected together by means of a pressure line 63. A pressure relief valve 64 is provided in pressure line 63 to avoid any excessive rise of pressure in the hydraulic fluid system.

In FIG. 5, the movement of the control devices 56 and 57 is indicated by the arrow 65, 66, respectively, and it is clear based on such movement that an additional distance transmitter could be employed to coordinate the movements of the control devices and regulate the path of movement of the distributor pipe within the furnace shaft. The amplitude of the movement executed by the distributor pipe 14 can be read on each of the control devices 56 and 57 by means of a scale 67 and an indicator mounted on the end of a rod extending axially from the piston 58. The measure of the movement indicated on the scale 67 affords a measure of the movement of the distributor pipe within the shaft 40.

In FIG. 6, an alternate embodiment of the invention is shown which is also employable in a blast furnace operating under high pressure conditions. It will be noted that the distributor pipe 14 supplies the material directly into the furnace and does not employ the intermediate medium of a distributor bell or cone as indicated in FIG. 1. Above the distributor pipe 14 a pair of bunkers 4 and 5 are arranged equipped with sealing valves 10 at its inlets and sealing valves 12 at its outlets to prevent any loss of pressure from the furnace when materials are being fed from the bunkers 4 and 5 into the distributing pipe 14. Since the distributor bell 15 is dispensed with the distributor pipe 14 extends downwardly into the furnace to the charge surface 68 so that, practically, the charge material is deposited on the charge surface without any free fall. Since the sealing valves 10 and 12 and the bunkers form a lock chamber there is no need for a further sealing action as was provided by the distributor bell, see FIG. 1. The suspension of the filling pipe 14 and the means for laterally displacing the pipe are the same as previously indicated so that the pipe can be used in the same manner as described above. Moreover, due to the increased length of the distributor pipe its movement from its normal vertical position can be executed with a greater amplitude.

What is claimed is:

1. A distributing device, for supplying material into a shaft furnace, comprising an upright shaft arranged to interconnect a furnace casing and a superposed hopper and to form a passageway therebetween, an upright distributing pipe positioned within said shaft and having its central axis disposed in a first upright position, means for supporting the upper end of said distributing pipe so that its central axis near its upper end in a transverse plane through the central axis is maintained in the first upright position while below the transverse plane the central axis can be swiveled about the first upright position, and means for displacing said distributing pipe so that its central axis swivels about the first upright position, said means for supporting the upper end of said distributing pipe comprising an inner annular member disposed about and supporting said distributing pipe within said shaft, an outer annular member disposed about said inner annular member within said shaft, pivot means interconnecting said inner annular member and said outer annular member, and pivot means interconnecting said outer annular member and said shaft.

2. A distributing device, as set forth in claim 1, wherein said inner annular member comprising a longitudinally extending sleeve enclosing and forming the exterior support of said distributor pipe.

3. A distributing device, as set forth in claim 2, wherein the inner part of said distributing pipe comprising a plurality of axially extending segment plates disposed within and supported by said inner annular member, a flange being formed on the upper end of each of said segment plates, and said flange being supported by the upper end of said inner annular member, the axially extending edges of said segment plates being closely spaced apart whereby said segment plates can be moved axially through said inner annular member and are retained in position against displacement radially inwardly into the passageway for the material through said distributor pipe.

4. A distributing device, as set forth in claim 2, wherein said outer annular member comprising a ring concentrically disposed about the upper end of said sleeve and being spaced outwardly from said sleeve and inwardly from said shaft.

5. A distributing device, as set forth in claim 4, wherein said pivot means interconnecting said inner annular member and said outer annular member comprising a first pair of pins in diametrically opposed relationship across said distributor pipe and said pivot means interconnecting said outer annular member and said shaft comprising a second pair of pins diametrically disposed across said distributor pipe and spaced approximately 90° apart from said first pair of pins.

6. A distributing device, as set forth in claim 5, wherein said ring comprising a plurality of pivot suspension openings, said first pair of pins being clamped within said shaft and extending into oppositely disposed suspension openings in said ring, and said second pair of pins being clamped within said sleeve and extending into oppositely arranged suspension openings in said ring.

7. A distributing device, for supplying material into a shaft furnace, comprising an upright shaft arranged to interconnect a furnace casing and a superposed hopper and to form a passageway therebetween, an upright distributing pipe positioned within said shaft and having its central axis disposed in a first upright position, means for supporting the upper end of said distributing pipe so that its central axis near its upper end in a transverse plane through the central axis is maintained in the first upright position while below the transverse plane the central axis can be swiveled about the first upright position, and means for displacing said distributing pipe so that its central axis swivels about the first upright position, said means for displacing said distributor pipe comprising a plurality of devices capable of rectilinear movement in a plane transverse to the central axis of said distributor pipe and located at a distance spaced below said means for supporting the upper end of said distributor pipe, said devices comprising at least one pair of angularly spaced piston assemblies, said piston assemblies being located outwardly from said shaft and each comprising a piston chamber, a double acting piston located

within said chamber, a piston rod secured to said piston and extending therefrom and having its end opposite said piston spaced outwardly from said shaft, and means extending between the end of said piston rod and said distributor pipe for displacing said distributor pipe laterally within said shaft so that the axis of the distributor pipe is displaced from its first upright position at its lower end.

8. A distributing device, as set forth in claim 7, wherein said means extending between said rod and said distributor pipe comprising an elongated ram member extending through said shaft and in contact with the end of said piston rod at its outer end and with a sliding surface on the exterior of said sleeve about said distributor pipe at its inner end, a flexible bellows member enclosing said ram at its point of passage through said shaft on the outer face of said shaft and extending outwardly therefrom and arranged to contract and expand as said ram moves inwardly and outwardly as actuated by said piston rod for maintaining the opening through said shaft for said ram in a substantially pressure tight condition.

9. A distributing device, as set forth in claim 7, wherein control means interconnecting said piston chambers for selectively displacing said piston rods and said rams for swiveling said distributor pipe about its first upright position.

10. A distributing device, for supplying material into a shaft furnace, comprising an upright shaft arranged to interconnect a furnace casing and a superposed hopper and to form a passageway therebetween, an upright distributing pipe positioned within said shaft and having its central axis disposed in a first upright position, means for supporting the upper end of said distributing pipe so that its central axis near its upper end in a transverse plane through the central axis is maintained in the first upright position while below the transverse plane the central axis can be swiveled about the first upright position, and means for displacing said distributing pipe so that its central axis swivels about the first upright position, said means for displacing said distributor pipe comprising a plurality of devices capable of rectilinear movement in a plane transverse to the central axis of said distributor pipe and located at a distance spaced below said means for supporting the upper end of said distributor pipe, said devices comprising a first pair and a second pair of diametrically disposed piston assemblies with said first pair of piston assemblies being angularly spaced from said second pair piston assemblies by approximately 90°, said first and second pair of piston assemblies being disposed in a common plane arranged perpendicularly to the first upright position of said distributor pipe, each of said piston assemblies comprising a piston chamber spaced outwardly from said shaft, a double acting piston located within each of said chambers, a piston rod secured to said piston within said chamber and the axes of oppositely disposed piston rods being aligned and passing through said central axis of said distributor pipe in its first upright position, and an elongated ram supported in said shaft and extending between the end of said piston rod opposite said piston and a sliding surface on the exterior of said sleeve forming the outer surface of said distributor pipe, and means for sealing the opening for said ram through said shaft for preventing loss of pressure therethrough.

11. A distributing device, for supplying material into a shaft furnace operating under high pressures and temperatures, comprising, in combination, an upright shaft forming a sealed connection between a furnace casing and a superposed hopper, and defining a sealed passageway therebetween, an upright substantially rectilinear distributing pipe positioned within said shaft and sealed from the exterior by said shaft, said distributing pipe having its central axis normally disposed in an upright position, mounting means supporting said distributing pipe at its upper end for swinging about a pair of mutually perpendicular, substantially horizontal axes, and means engageable with said distributing pipe at a distance below said mounting means and operable to swing said distributing pipe about its mounting means to displace its central axis angularly from said upright position, said last-named means comprising a plurality of devices capable of rectilinear movement in a plane transverse to the central axis of said distributor pipe and located at a distance below said mounting means.

12. A distributing device, for supplying material into a shaft furnace operating under high pressures and temperatures, comprising, in combination, an upright shaft forming a sealed connection between a furnace casing and a superposed hopper, and defining a sealed passageway therebetween, an upright substantially rectilinear distributing pipe positioned within said shaft and sealed from the exterior by said shaft, said distributing pipe having its central axis normally disposed in an upright position, mounting means supporting said distributing pipe at its upper end for swinging about a pair of mutually perpendicular, substantially horizontal axes, means engageable with said distributing pipe at a distance below said mounting means and operable to swing said distributing pipe about its mounting means to displace its central axis angularly from said upright position, and at least one storage bunker positioned above and in communication with the upper end of said distributor pipe, said storage bunker having an inlet for receiving material therein and an outlet for dispensing material into said distributor pipe, a pressure sealing valve at each of the inlet and the outlet of said storage bunker for forming a lock chamber within said storage chamber whereby with said sealing valve at the inlet to said bunker closed and the sealing valve at the outlet from said bunker open material can be dispensed into said distributor pipe without any appreciable loss of pressure in the portion of the furnace containing said distributor pipe.

13. A distributing device, as set forth in claim 12, wherein a loading hopper is located above each of said storage bunkers for supplying material into said storage bunkers.

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