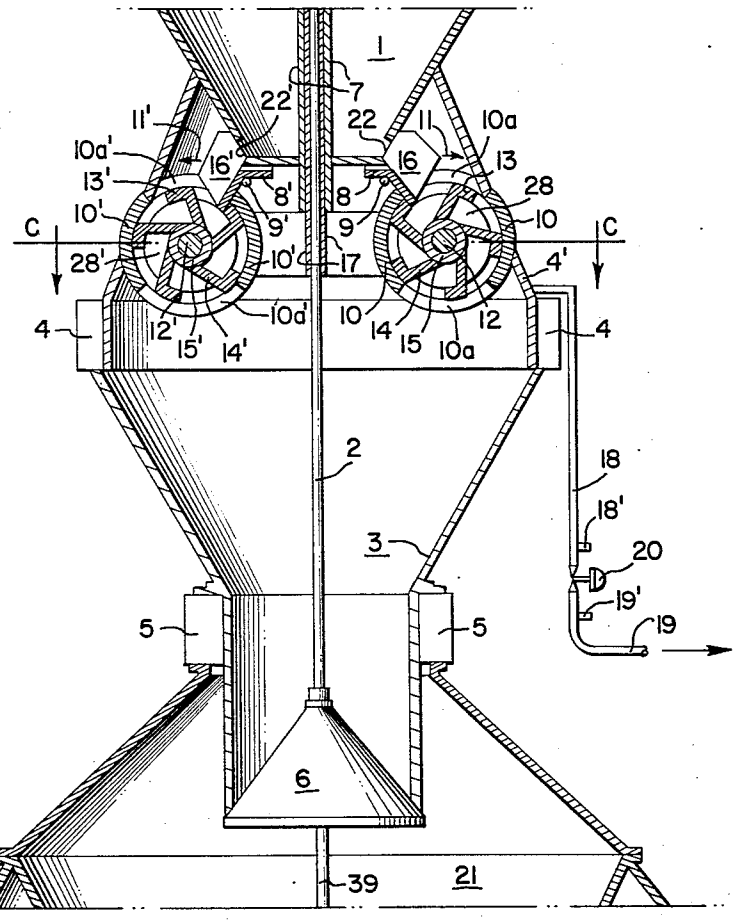
May 5, 1964 KEIJI TSUJIHATA ETAL 3,131,821

RAW MATERIAL CHARGING DEVICE IN THE TOP PART OF A BLAST FURNACE

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Fig 1.



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FIG 2.

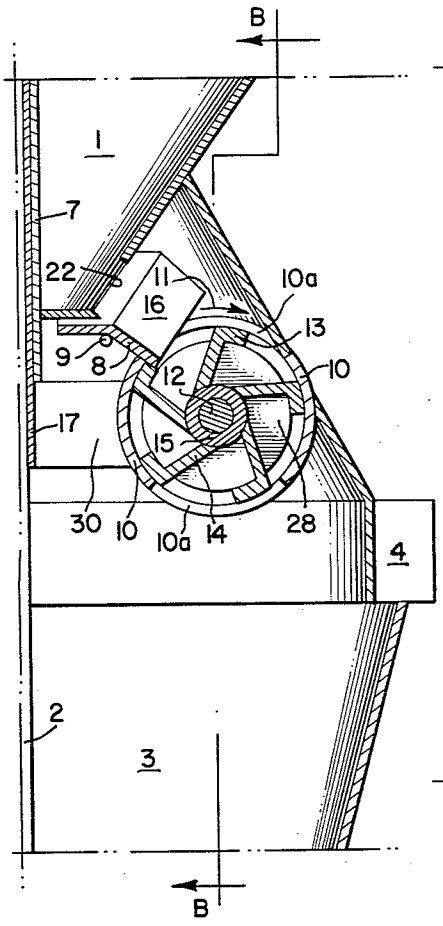
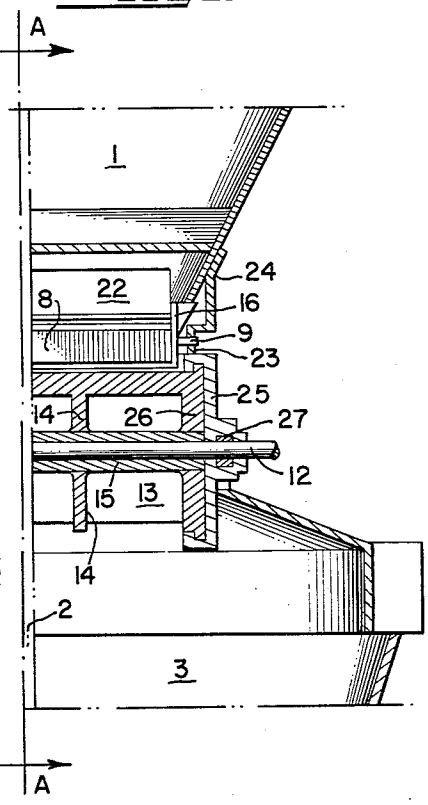


FIG 3.



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FIG 4A.

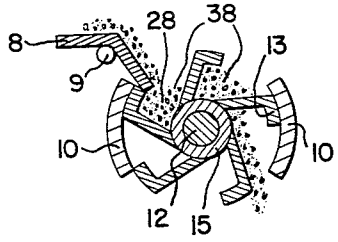
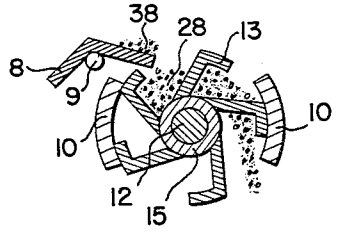


FIG 4B.



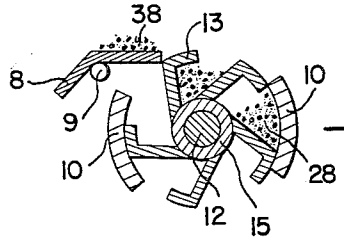
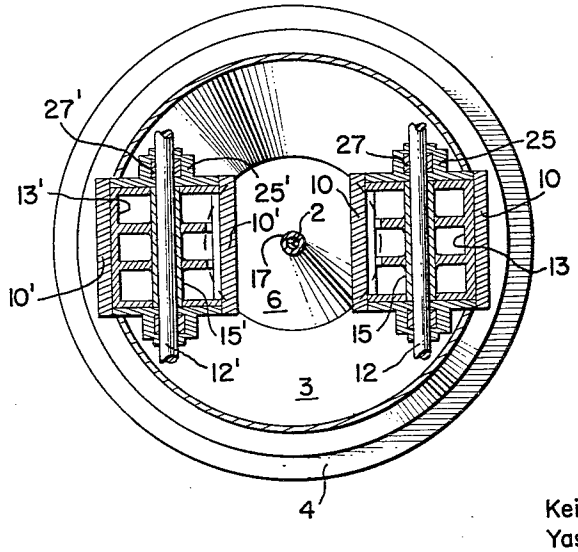


FIG 4C.

FIG 5.



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United States Patent Office

3,131,821

Patented May 5, 1964

3,131,821

RAW MATERIAL CHARGING DEVICE IN THE TOP PART OF A BLAST FURNACE

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Filed Sept. 18, 1962, Ser. No. 224,328
Claims priority, application Japan Sept. 27, 1961
1 Claim. (Cl. 214—35)

This invention relates to raw material charging devices for blast furnaces and more particularly to a raw material charging device adapted to be used with a blast furnace operated at high pressure.

It is well known that, when a blast furnace is operated at high pressure operation, there will be such various advantages as are mentioned below:

(1) As the moving velocity of the gas is reduced, the solution loss will be reduced.

(2) The amount of production will be increased and at the same time the consumption of coke will be decreased.

(3) The amount of furnace top dust which is discharged will be decreased.

As compared with a furnace operated at normal pressure, there occur in the furnace wherein such high pressure operation is carried out various difficulties in the maintenance of the equipment. The greatest one of them is the problem of keeping the furnace top charging device air-tight.

A so-called McKee type raw material charging device comprising large and small charging cones, a rotary hopper and a charging hopper is usually used in a blast furnace for the high pressure operation thereof. However, although the air-tight part between the charging cone and hopper may be made of a special wear-resistant material at the time of manufacture, it is difficult to maintain the air tightness perfect over a long period of time, because the large and small charging cones will be progressively worn by the charge, the high pressure gas will jet out through the worn gaps, the wear will be further accelerated by the dust contained in the blast furnace gas and the air-tightness will be further reduced. It is reported in literature on the high pressure operation of a blast furnace that, when the high pressure operation was carried out at such furnace top pressure as, for example, 1.5 atmospheres, the service period of a charging device such as is mentioned above was about one year.

Many suggestions have been made to keep the air-tightness of the part subjected to wear favorable over a long time. But there has existed nothing which adequately meets the requirement, because the wear of the air-tight part by the charge is unavoidable. In addition, the wear of such air-tight part will be further accelerated by the gas leaking through the said air-tight part.

We have confirmed that, even if the wear of the air-tight part of the cone by the charge is not avoidable, when the leaking gas is prevented from flowing through the said air-tight part, the wear of the said part will be remarkably reduced and therefore the service period of the charging device will be remarkably elongated.

An object of the present invention is to fit a comparatively simple device to a McKee type charging device so that the service period of such type of device may be lengthened and the top part of the blast furnace may be kept air-tight in a positive manner.

Another object of the present invention is to provide a charging device which can be easily repaired or replaced during a short stoppage of the blast without interrupting the operation of the blast furnace in the case of trouble or wear.

The above mentioned objects of the present invention can be attained by an arrangement according to the present invention wherein an additional hopper is provided above the rotary hopper and an air-tight feeding device consisting of sliding parts having raw material inlets and outlets and of rotary feeders provided in the said sliding parts is provided below the raw material outlets of the said additional hopper so that the said feeding device may receive the raw material discharged from the additional hopper and may feed it into the rotary hopper while maintaining the rotary hopper air-tight.

Since the device of the present invention has the structure described above, the top part of the furnace will be kept air-tight in a positive manner. Therefore, it is very easy to keep the pressure within the rotary hopper and the pressure within the blast furnace constant. As a result, there will be substantially no leakage of the blast furnace gas through the air-tight joint between the hopper and cone. Thus the wear of the above mentioned air-tight part by the leakage of the gas can be positively prevented.

Further, a controlling pipe to control the pressure within the rotary hopper can be connected to the said hopper in order that the leakage of the gas from the air-tight part of the cone may be more effectively prevented.

Thereby the pressure within the blast furnace and the pressure within the rotary hopper will always be kept safely and positively in equilibrium, no gas will leak or pass through the air-tight part of the cone and therefore the wear of the said air-tight part will be more positively prevented.

The objects and features of the present invention will be made clearer by the detailed explanation of the embodiment of the present invention illustrated in the accompanying drawings in which:

FIGURE 1 is a vertically sectioned view of a device according to the present invention;

FIGURE 2 is a partial sectional view, on an enlarged scale, of the device taken on a line A—A of FIGURE 3;

FIGURE 3 is a sectional view taken on line B—B of FIGURE 2;

FIGS. 4A–4C are sectional views of a part of the apparatus showing how raw material is led into and out of the rotary air-tight feeding means; and

FIGURE 5 is a sectional plan view taken on line C—C of FIGURE 1.

In the drawings, **1** is an additional hopper provided above a rotary hopper **3** according to the present invention. Below the additional hopper **1** is provided a rotary air-tight feeding device which receives raw material discharged from the said additional hopper and discharges the said raw material into a rotary hopper **3** while keeping the said rotary hopper air-tight. Said feeding device consists of fixed cylindrical drums **10** and **10'** having openings **10***a* and **10***a'* along the top and bottom thereof and rotary vane wheels each provided with a proper number of radially extending vanes **13** or **13'** having the ends slidable along the interior surface of drums **10** and **10'**. The fixed drums **10** and **10'** are rigidly fixed to an enclosing body **4'**. The rotary shaft **12** or **12'** of the rotary vane wheel is borne by bearings **27** provided on the cylinder end walls **25** (see FIGURE 5) and is driven through a suitable power transmitting mechanism. The said enclosing body **4'** is substantially a truncated cone and, is secured at the upper end thereof to the hopper **1** and is provided at the lower end with the air-tight slidably rotatable part **4** of the rotary hopper **3**. A partition wall **30** perpendicular to the axis of the hopper is provided near the rotary shafts **12** and **12'** in order to seal the space within the rotary hopper **3** from the outside air.

The additional hopper **1** has raw material outlets **22**

and 22' in the bottom. Chutes 8 and 8' which can pivot around the shafts 9 and 9', respectively, are provided below the said outlets. The said chutes lead the raw material from the outlets 22 and 22' into pockets 28 and 28' formed by the air-tight rotatable vanes 13 and 13', respectively, and at the same time serve to regulate the charge of the raw material. The said chutes are further provided on both sides with raw material guiding side plates 16 and 16'. The air-tight sliding vanes 13 and 13' are secured to bushings 15 and 15' fixed to the rotary shafts 12 and 12', respectively. The tip of each of the vanes 13 and 13' is bent as illustrated but can be made in any other form if sufficient air-tightness can be maintained as it slides along the interior of the drum 10. 14 is a reinforcing rib for the air-tight vane 13. 17 is an air-tight sleeve for a charging cone hanging rod. 2 is a hanging rod for a small charging cone 6. The charging hopper 3 has the small charging cone 6 as its bottom surface. 5 is a rotating device for rotating the charging hopper. 21 is a charging hopper having a large charging cone (not shown) for its bottom surface. 18 is a blast furnace gas inlet pipe connected to the charging hopper 3. 18' is an outlet for detecting the pressure within the charging hopper 5. 19 is a blast furnace gas outlet pipe connected to the blast furnace. 19' is an outlet for detecting the gas pressure within the blast furnace. 20 is an adjusting valve for adjusting any unbalanced pressure between the gas outlet 18' on the charging hopper 3 side and the gas outlet 19' inside the blast furnace. FIGURE 3 is a partial vertical section taken on line B—B in FIGURE 2. 24 is a holding arm for the shaft 9 or 9' of the pivotable chute. 23 is a holding bearing for the pivotable chute 8. 25 is an end wall provided on each end of the cylindrical drum. 26 is an end wall to which the vanes 13 are secured to form the vane wheel. 27 is a bearing for the rotary vane shaft R.

The operation of the device of the present invention shall now be described. When the additional hopper 1 for charging is charged with a raw material, a known raw material detecting device (not illustrated) will detect the amount of raw material being fed and will automatically start and rotate the rotary air-tight feeding device (which may be normally operated). When the rotation of the said feeding device begins in the direction indicated by the arrow 11 or 11', the tip of the rotary vane 13 or 13' will rotate while pushing the pivotable chute 8 or 8' up, thereby charging the pocket 28 or 28' between the rotary vanes 13 or 13' with a fixed amount of the raw material. For example, as illustrated in FIGS. 4A–4C, at the start of charging the pocket 28 with the raw material 38, the pivotable chute 8 will have completely fallen as seen in FIG. 4A, and thereafter the pocket 28 will be well charged with the raw material 38, the pivotable chute will be pushed up as in FIG. 4B by the rotation of the rotary vane 13 and the charging with the raw material 38 will gradually stop. Then, as seen in FIG. 4C, the charging with the raw material will completely stop and thereafter the raw material in the pocket will be discharged into the hopper 3 through the discharging port. Then the condition of FIG. 4A will occur again and the charging with the raw material 38 will begin. As the raw material is fed in by repeating such actions, no raw material will be poured against the vanes 13 sliding on the inside of drum 10 at all and the charging with the raw material will be carried out while keeping air-tightness at all times. Further, as the pressure within the blast furnace and the pressure within the

rotary hopper 3 are so controlled as to be kept constant by means of the connecting pipes 18 and 19, there will be substantially no gas flowing through the air-tight part of the small charging cone 6 and the large charging cone and no wear will be caused by the gas flowing through the air-tight part of the charging cones. Further, if required, a gas cleaning device can be provided in the connecting pipes so that the gas balancing the pressure within the charging hopper 3 may be cleaned before it is blown in. When the raw material in the additional hopper 1 is thus completely fed into the rotary hopper 3, the rotary vanes 13 for charging will stop and will maintain air-tightness.

The present device is as described above. The number of the rotary vanes 13 or 13' and the capacity of the pockets 28 or 28' should be determined by taking the form of the charge into consideration and are not to be limited to the relative size of the present device. Further, in the present invention, the air-tightness of the rotary feeding device can be improved by blowing steam or high pressure air into the rotary vane arrangement from either side thereof.

What we claim is:

A raw material charging device for use in a blast furnace operating at superatmospheric pressure, comprising a charging hopper having a large bell forming the bottom thereof, a rotary hopper over the charging hopper and having a small bell forming the bottom thereof and opening into said charging hopper, an additional hopper positioned above said rotary hopper having at least one outlet in the bottom thereof, an enclosing body having an upper edge secured to said additional hopper and having a lower edge slidably engaged with and in air-tight relationship with the upper part of said rotary hopper, a rotary air-tight feeding device between said additional hopper and said rotary hopper, said feeding device consisting of at least one fixed horizontal cylindrical drum fixed to said enclosing body and having an opening extending along the top thereof and an opening extending along the bottom thereof, a vane wheel rotatably mounted in said drum and having substantially radially extending vanes with the ends thereof slidable along the interior surface of said drum in air-tight relationship therewith when said vane wheel rotates, and a pivotable chute pivotably mounted adjacent said cylindrical drum at a point no higher than the level of the tops of the vanes on said vane wheel and immediately beneath the outlet to said additional hopper and having the free end of the chute above the opening in said cylindrical drum and engageable by the ends of the vanes on the vane wheel so as to be raised and lowered as successive vanes move past the opening in the top of the cylindrical drum, and said charging device further comprising gas pipes connected to said rotary hopper and adapted to be connected to the interior of a blast furnace, and a valve in said pipes for equalizing the pressure in the rotary hopper with the pressure in the blast furnace.

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