United States Patent

Knappstein

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[54] **FREE FALL CHARGING APPARATUS FOR A COKING FURNACE**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**.....**C10b 31/04**

[58] **Field of Search**..214/18 PH, 18.2, 35 R; 222/58, 222/59; 202/262

[56] **References Cited**

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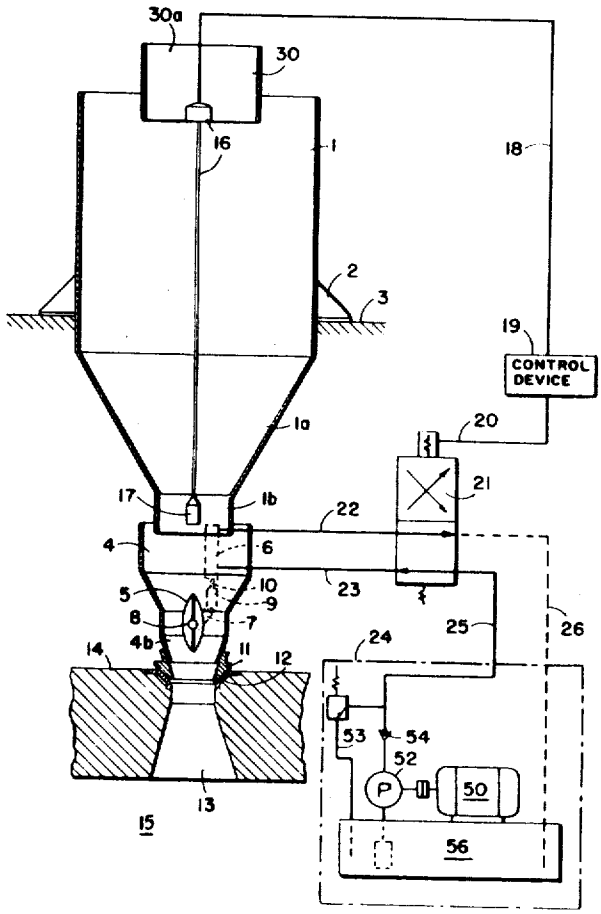
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[57] **ABSTRACT**

A coking furnace charging hopper includes a lower discharge which is connected to a transfer funnel leading to the furnace head, and a valve member is pivotally mounted in the funnel for movement between an axially extending fully opened position to a transversely extending closed position. The hopper includes a coal inflow gauge or device for measuring the inflow rate of the charging coal which is connected to a control for regulating the valve between its fully opened and fully closed position in order to maintain the volume or weight reduction of the coal in the hopper constant per unit of time.

10 Claims, 2 Drawing Figures



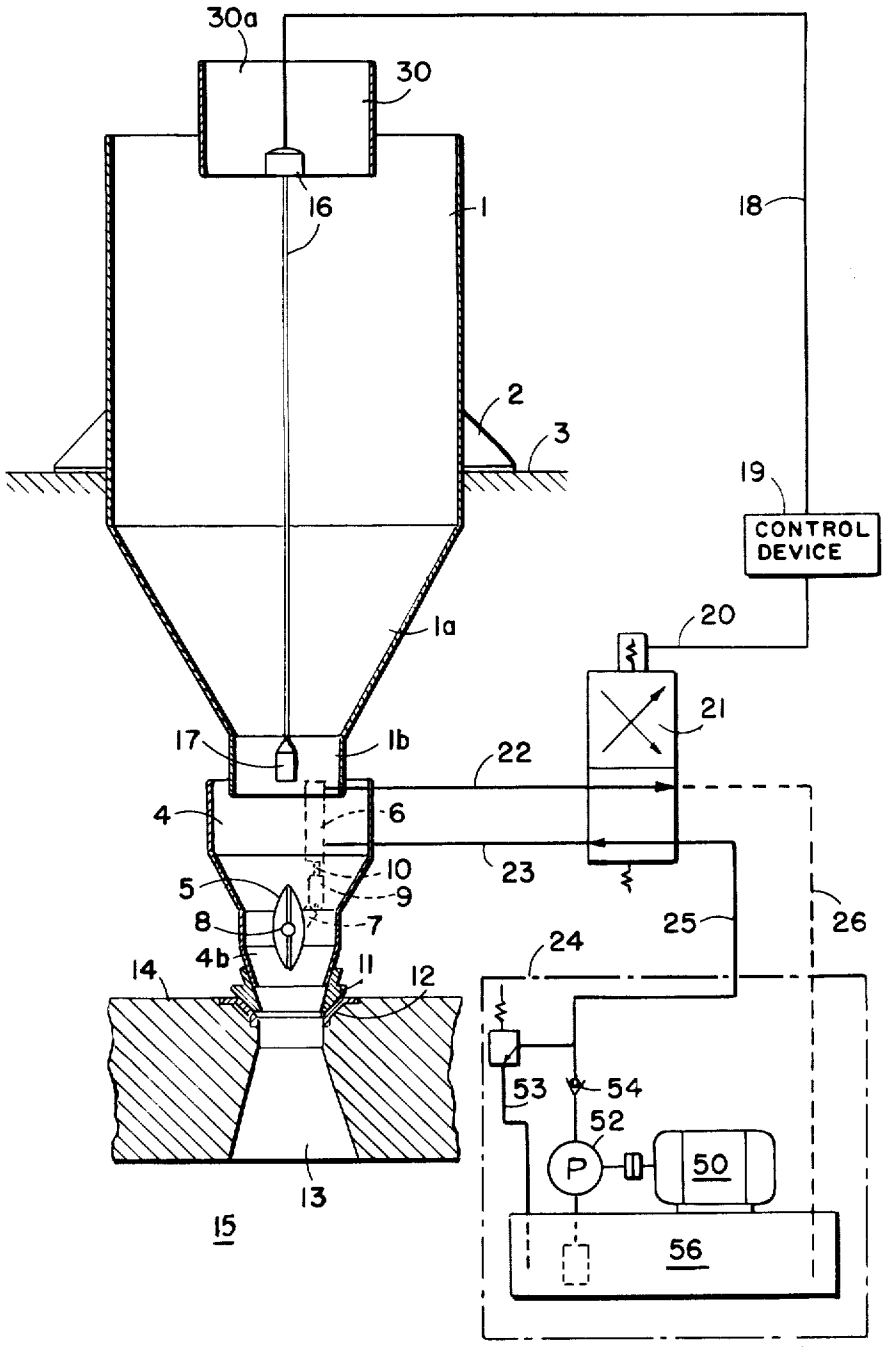


FIG. 1

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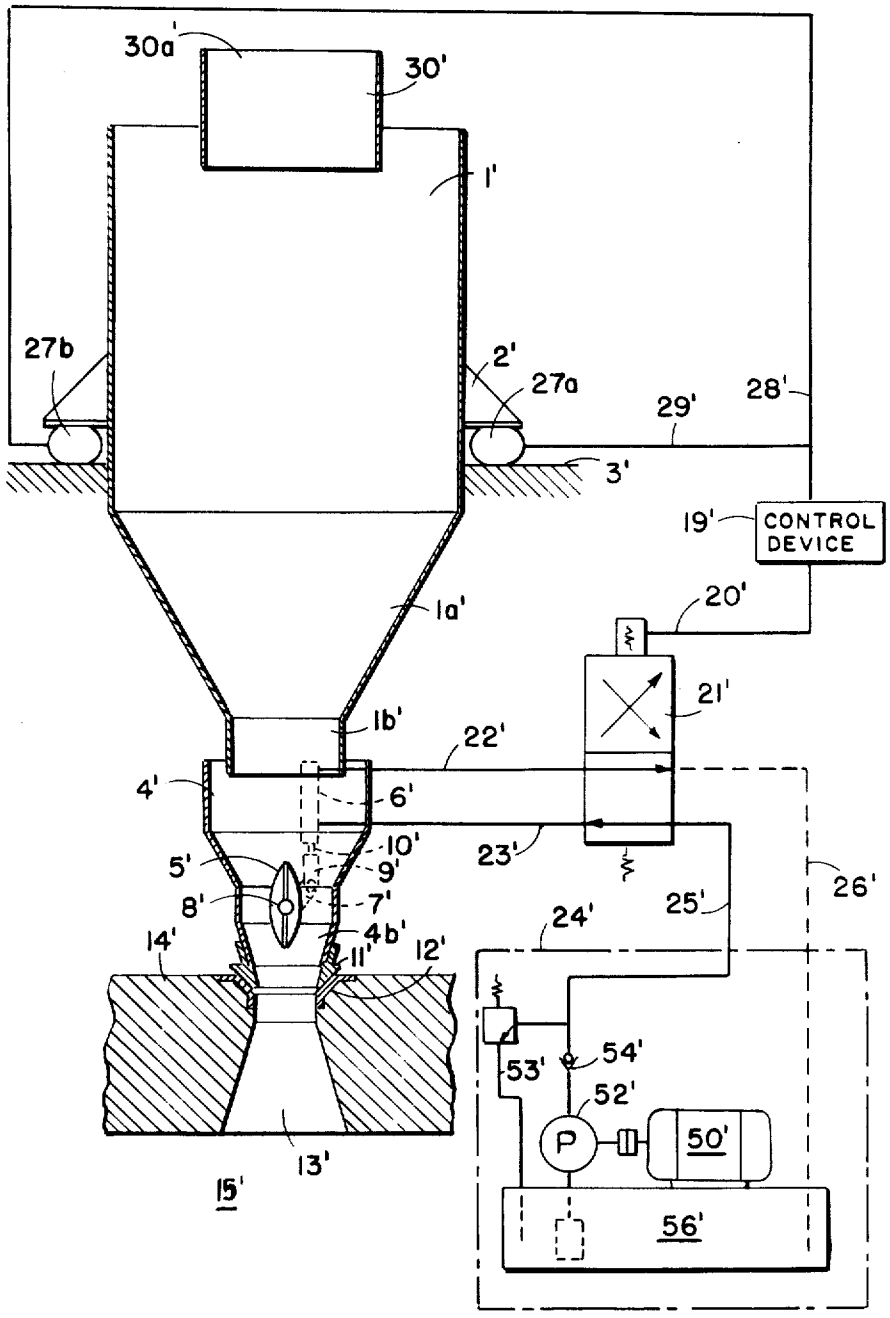


FIG. 2

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FREE FALL CHARGING APPARATUS FOR A COKING FURNACE

SUMMARY OF THE INVENTION

This invention relates in general to the construction of coking furnaces and in particular, to a new and useful free fall charging device for maintaining the free fall flow of coking material in a charging hopper substantially constant during the charging of a coking furnace.

Charging devices for coking furnaces are known which include arrangements for dosing the coking coal into the furnace chambers by using rotary plates or screw conveyors, for example, to ensure uniformity and regularity of the coal supply from the individual hoppers. Apart from the highly technical expenditure which is required for such devices, the coal supply through the rotary plates and the screw conveyors is frequently too slow for todays output requirements of modern coking furnace batteries so that the substantially simpler and fastest supply in the free fall hopper charging construction is preferred. This is particularly true since means and ways are known to prevent the discharging difficulties of the coking coal, for example, by the attachment of vibrators to the hoppers or by oscillating the closing elements. The rapid charging of the coking coal into the furnace chamber is also desired because of the resulting higher bulk density in the furnace chamber and the reduced separation of the coking coal during the charging. A disadvantage in the charging of coking chambers with the so-called "free fall hopper cars" is that the charging rate, that is, the amount of coal flowing into the furnace chamber per unit of time, is practically uncontrolled and cannot be regulated and will vary with different hoppers. The originally low velocity increases under the influence of different factors such as granulation and moisture of the coal and also the quality of the surface of the hopper walls. This increase, up to a maximum velocity, depends on coincidence and it can vary from hopper to hopper and either rise or decrease frequently. This is particularly disadvantageous in view of the legal requirement for reducing air pollution to a minimum during the charging of coking furnaces.

According to the state of technology the charging gases are either exhausted through the outer casings of the furnace chambers or they are burnt and/or washed and discharged into the open atmosphere or they are sucked into the receiver through the interior of the coking chamber and the uptake while the underpressure is produced by a steam nozzle. In any case the lay out of the suction elements presents difficulties if they must be so designed that different amounts of charging gas are formed in the unit of time per volume displacement and spontaneous evolution of gas. This is more true if a charging process itself takes only about from 90 to 150 seconds and up to 35 tons of coking coal flow into the modern coking furnaces in such a period. The flow of the charging gases would be much easier to exhaust if the volume of the displaced air in the furnace chamber caused by the movement of the coking coal, and also the evolution of gases as a result, could be increased from the start of the charging operation up to a predetermined maximum value and could stay at this maximum value until the end of the charging operation.

In accordance with the invention, a free fall charging hopper arrangement includes a discharge of the hopper

which is connected into a charging funnel, arranged at the furnace head, and which carries a closing element which is arranged in the freely moving discharge from the hopper. The closing device is opened or closed in order to keep the volume or weight reduction of the coal level in the hopper after the initial opening of the closure for charging purposes at a constant value per unit of time. ($dv/dt=0$) The closing element advantageously comprises a mushroom valve, a rotary slide valve, or an ordinary plate valve, and is preferably an ordinary hinged valve member. The coal gauge can be of a mechanical nature for example, a feeler suspended inside the hopper on a rope to sense the flow of the coking materials and to provide an indication of the weight of the materials in the hopper. It may also be a radial active indicator arranged outside the hopper. It is possible to provide an electric capacitative feeler in the hopper for similar purposes. The impulse for the control device can be taken from the weight reduction of the individual hoppers. To this end the hoppers are mounted in a known manner, for example, on an electric or hydraulic pressure cells which are in turn connected with the control device. The control device may be a commercial electronic control device. It is advantageously set so that it closes the closing element before the coal has issued completely and a small amount will remain in order to provide a gas seal in the hopper or the discharge funnel. This prevents the break through of the charging gases to the inside and the intake of the outside air into the furnace chambers. The closing element can oscillate in the known manner during the charging operation to facilitate the task of obtaining a constant charging current.

Accordingly, it is an object of the invention to provide an improved device for measuring and controlling the rate of charging coal moving through a charging hopper for charging a coking furnace.

A further object of the invention is to provide a coking furnace charging hopper system which is simple in design, rugged in construction, and economical to manufacture.

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 provided and described preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a schematic or diagrammatic view of a coking charging apparatus constructed in accordance with the invention; and

FIG. 2 is a view similar to FIG. 1 of another embodiment of the invention.

GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in particular, the invention embodied in FIG. 1 comprises a coal charging hopper 1 which is mounted on a carrier 3 by brackets 2 and it includes a lower converging conical end 1*a* which ter-

minates in a small diameter discharge 1*b*. The hopper 1 may be positioned over a transfer funnel or furnace charge chute 4 which may be closed against the interior of a coking furnace 15 by a valve 5 which is rotatably mounted on a pivot 8 across a lower narrow portion 4*b* of the funnel 4. The funnel 4 is sealed to a chamber roof 14 of the furnace 15 above a charging opening 13 by means of a sealing ring 11.

In accordance with a feature of the invention, the charging hopper 1 carries a measuring ring 30 having a top opening 30*a* for the entrance of a charging material. Associated with the measuring ring and the hopper 1 is a capacitative coal gauge 16 which includes a loading weight 17 which is connected through an impulse line to a control device 19. The control device 19, in turn, is connected through an impulse line 20 to a magnetically operated valve 21 which is employed for controlling the operation of the valve 5 to open or close the transfer funnel to the furnace interior 15.

In the embodiment illustrated in FIG. 1, the valve 5 is rotated by a lever 7 which is connected through a forked head 9 to a piston rod 10 which is movable in a fluid cylinder 6. Hydraulic fluid under pressure is supplied to a selected side of the fluid cylinder 6 by a hydraulic apparatus generally designated 24 which is connected through lines 25 and 26 to the magnetically operated valve or solenoid 21. The hydraulic device includes a driving motor 50 for a pump 52 which is arranged to discharge through a check valve 54 into the line 25 and in the position of the valve 21, as indicated in the drawing, through the line 23 to the hydraulic cylinder 6. When the valve 21 is reversed the pressure line 25 connects to the line 22 in the cylinder 6. The return line 26 is indicated in one position of the valve 21 as being connected to the line 22 and it will of course be connected to the line 23 in the reverse position of the valve 21. The fluid is returned to a reservoir 56. An over pressure line 58 leads backwardly from the line 25 to the reservoir 56.

The device of the invention is operated as follows: During the charging of the furnace 15, the hinge valve 5 is at first completely opened or moved to the position indicated in FIG. 1, at which its major axis extends substantially parallel to the direction of the flow of the charging material. During the charging the control device 19 receives impulses (electrical, mechanical or fluid) which provide a regulation of the amount of which the valve 5 is opened, and it is continuously moved toward a greater opening or closing position in accordance with the flow of material through the hopper 1. The signals which are transmitted through the lines 18 and 20 to the control 19 and from the control 19 to the valve 21 depend on the discharge time to which the apparatus is set.

In the embodiment of FIG. 2, similar parts are similarly designated but with a prime added. In this embodiment the brackets 2' on the side of the hopper 1' rests on pneumatic or hydraulic pressure cells 27*a* and 27*b* respectively, which are connected through respective lines 28' and 29' to a control device 19' which in turn is connected through impulse lines 20' to the solenoid valve 21'. The function and the operation of the device of FIG. 2 is substantially identical with that of FIG. 1 with the exception of the pressure cells 27*a* and 27*b* which function in the manner similar to the coal gauge 16 and provide pulse signals which may in accordance with the quantity of coal being fed through the hopper 1'.

What is claimed is:

1. A free fall charging apparatus for coking furnaces comprising a charging hopper having a lower furnace discharge connected through a narrowed lower portion leading to the furnace, a flow valve pivotally mounted in said narrowed lower portion and being pivotable between an axially extending fully open position to a transversely extending closed position, and pressure responsive means associated with said hopper and connected to said valve and being responsible to changes of the amount of coal moving through said hopper to regulate said valve after it has been initially opened between fully and partly opened and closed positions in accordance with the amount of coal moving through said hopper to maintain coal reduction constant.

2. A device, according to claim 1, wherein said pressure responsive means includes a measuring ring at the entrance of said hopper through which the charged material is directed, a coal gauge mounted in said measuring ring and having a weight depending therefrom extending through said hopper, and control means connected to said gauge for regulating said valve.

3. A device, according to claim 2, wherein said control means includes an electrically operated solenoid valve, fluid pressure means connected to said flow valve for shifting said valve between opened and closed positions and fluid pressure supply means associated with said solenoid valve for controlling the operation of said fluid pressure means for controlling said flow valve.

4. A device, according to claim 1, wherein said pressure responsive means includes a fluid pressure member, said hopper being supported on said fluid pressure member and said fluid pressure member being pressurized in accordance with the weight of the hopper bearing thereon.

5. A device, according to claim 1, including a fluid pressure flow valve operating cylinder, a piston slidable in said cylinder and connected to said flow valve to move said flow valve between opened and closed positions, means for supplying fluid under pressure to a selected side of said cylinder for moving said piston, and wherein said pressure responsive means includes an electrical control system responsive to the amount of coal passing through said hopper for regulating said fluid supply to said fluid pressure cylinder.

6. A device, according to claim 5, wherein said control system includes a coal gauge with a weight portion extending through said hopper.

7. A device, according to claim 5, wherein said control system includes a fluid pressure member, said hopper being supported on said fluid pressure member and influencing the pressure therein in accordance with the amount of coal passing therethrough.

8. A device, according to claim 1, wherein said valve comprises a vertical flap.

9. Free-fall charging apparatus for coking furnaces comprising a hopper with a bottom outlet, a closing element adjacent said bottom outlet, secured on said hopper, a capacitative coal gauge arranged in said hopper, which is connected with said closing element, a control device arranged between said closing element

and said coal gauge for opening and closing said closing element to keep the volume or weight reduction of the coal in the hopper constant per unit of time, after opening of the closing element, by influencing the degree of opening of the closing element.

10. Apparatus according to claim 9, characterized in that the closing element is a vertical flap.

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