Sept. 22, 1970 F. ALSBACH ET AL 3,529,783

ROTARY BREAKER DRUM

Filed Feb. 26, 1968 3 Sheets-Sheet 1

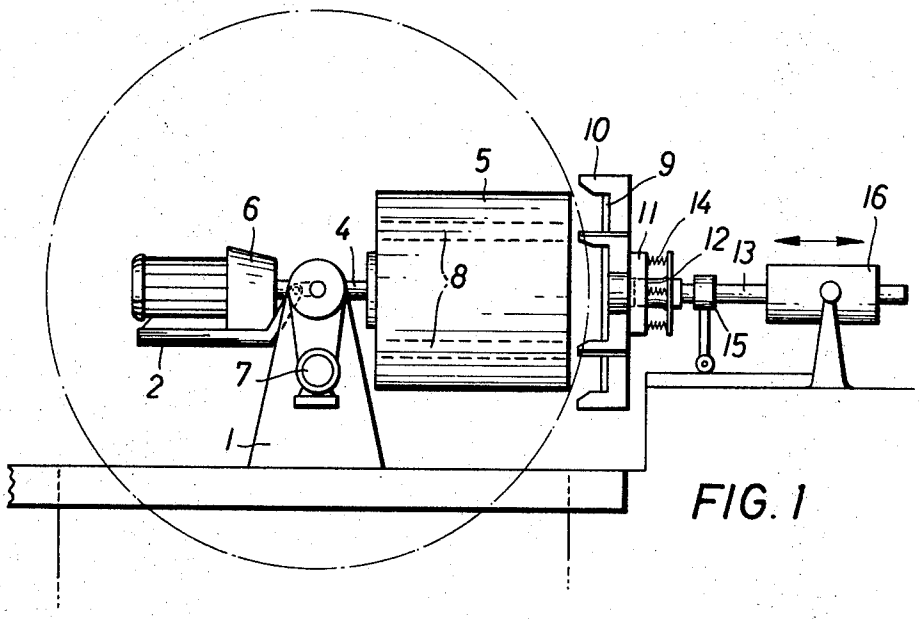


FIG. 1

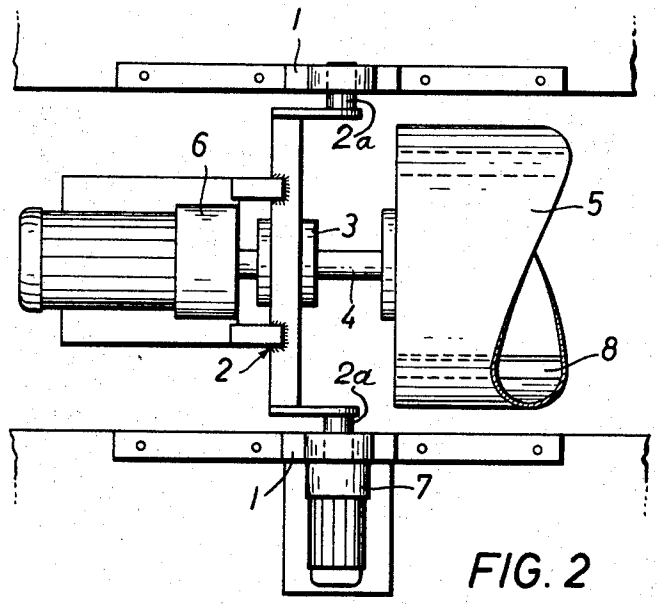


FIG. 2

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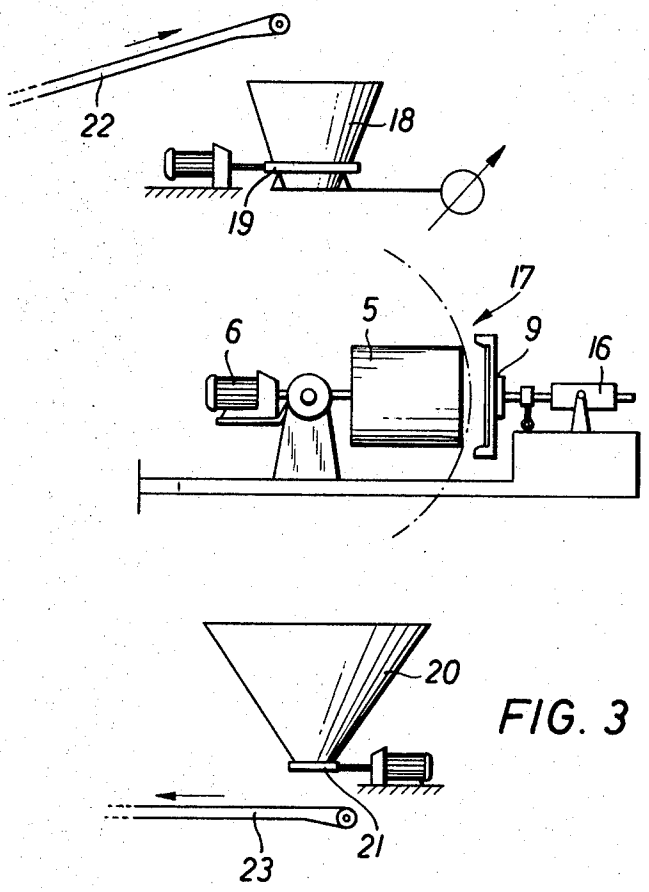


FIG. 3

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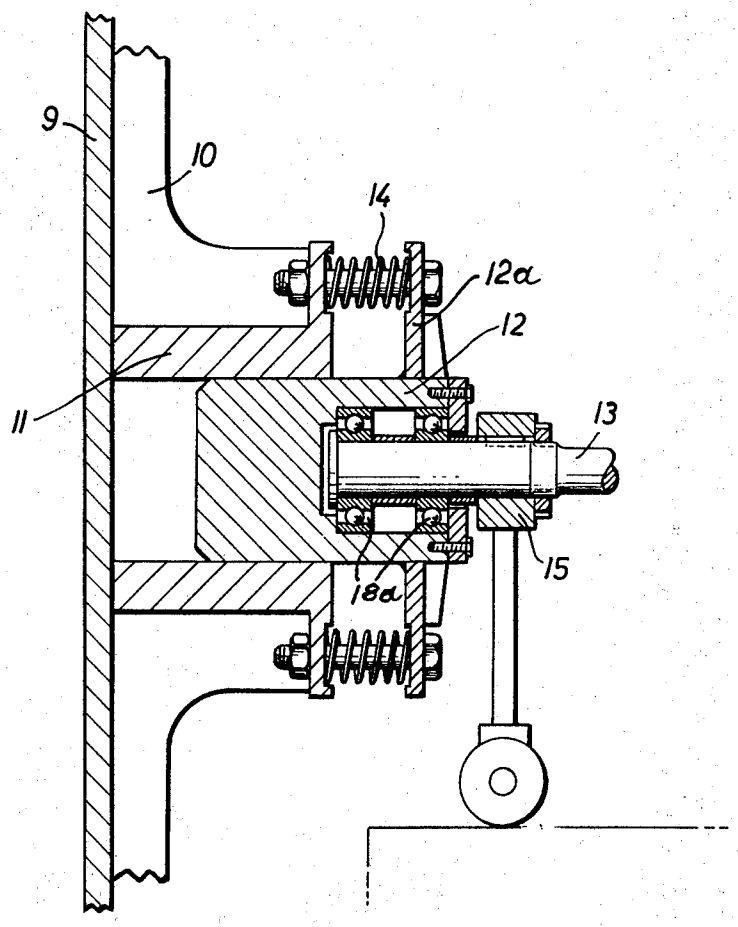


FIG.4

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ROTARY BREAKER DRUM

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Int. Cl. B02c 17/04, 17/18
U.S. Cl. 241—284 3 Claims

ABSTRACT OF THE DISCLOSURE

A rotary drum used in an arrangement for testing the breaking strength and abrasion resistance of comminuted material, such as blast furnace coke, ore pellets and other granulated matter. The drum is permanently closed at one end and open at its other end which is closable, however, by a removable cover shiftable along the axis of rotation of the drum and rotatable with the drum when closing the open end of the drum. A drive shaft is attached to the permanently closed end of the drum for rotating the latter when its axis of rotation is horizontally disposed. The drive shaft is rotatably mounted in a frame which itself is rotatably adjustable about an axis etxending at right angles to the axis of rotation of the drive shaft and drum so that upon rotation of the frame the drum is either tilted vertically with its open end facing upwardly to receive the material to be tested or is tilted vertically into the other direction with its open end facing downwardly for discharging the material from the drum which only is rotated about its axis when the latter is in a horizontal position.

The invention relates to a rotary drum for testing the breaking strength and abrasion resistance of comminuted materials, particularly blast furnace coke, ore pellets, granules and the like.

Knowing the strength and granular structure of the coke is of great importance for the effective operation of a blast furnace. Coke of insufficient strength and poor grain structure is capable of considerably impairing the working of the furnace, whereas small differences in strength and grain structure of the coke may be compensated for by a properly adjusted operation of the furnace. Prerequisite for this, however, is that the grain structure and firmness of the coke to be fed to the blast furnace is known, especially when coke of different origin is used.

The granulometric analysis is carried out in known manner by a screening apparatus containing screens of graduated mesh. The firmness of the coke is tested, as a rule, in a rotating drum consisting of a hollow cylinder having an inner length of 1000 mm., an inner diameter of 1000 mm. and smooth end walls. In the interior of the hollow cylinder, i.e. to the inner cylindrical surface and along the entire length of the cylinder are attached four angular iron bars which serve as lifting or throw bars and which are arranged parallel to the cylinder axis and spaced 90° from each other so that the inner suface of the cylinder is divided into four equal sections. The angular bars project about 100 mm. into the cylinder, measured from the cylindrical wall.

Heretofore, the rotary drum for the purpose of its charging and discharging was provided with an opening in its cylindrical wall, which opening had to be closed by a cover plate curved in accordance with the diameter of the drum. Considerable difficulties were encountered in

charging and discharging of the drum because the position of the charging and discharging opening in the cylindrical wall of the drum in prior constructions made a complete and automatic discharge impossible. The remnants remaining in each end space and on the lifting bars of the drum had to be removed by hand. This, however, due to the high labor expenditure made a continuous checking of the strength of the coke uneconomical. Consequently, this testing device so cumbersome in its manipulation led to just making a few random tests per shift. The disadvantages entailed with such procedure are, however, obvious: The furnace cannot be adjusted with certainty to its optimal operation; the plant is restricted to coke from one source which is able to give certain quality guaranties since the plant is not able to actually check the quality of the coke; otherwise great expense is incurred by regularly checking the coke used. Furthermore, with prior constructions it is not possible to incorporate the firmness test of blast furnace coke into an automatically operating test and analysis assembly.

It is the object of the invention to overcome the aforementioned disadvantages of conventional rotary drums. According to the invention, the opening for charging and discharging the drum is provided at one end of the cylindrical drum and this end is so constructed as to be closed by a removal closure plate. It is advantageous to make the outer edge of the opening of the rotary drum wholly or partly identical with the inner edge of the cylindrical wall, and to arrange the rotary drum for the purpose of charging and discharging so as to be pivotable about a horizontal axis positioned at 90° to the axis of rotation of the drum.

The rotary drum according to the invention is capable of being completely emptied in a simple manner. Also the lifting or throw bars will no longer retain any remnants of the charge because the bars are now longitudinally oriented toward the opening at one of the ends of the drum.

In a preferred embodiment of the invention, the rotary drum is disposed in an overhung position so that the entire opposite end of the drum can be used as a charging and discharging opening, respectively. The diameter of this opening is equal to the inner diameter of the cylindrical drum. In this embodiment the closure plate for the opening is mounted on a horizontally displaceable carriage that can be locked in position so that in the horizontal position of the axis of rotation of the drum the closure plate is urged against the drum opening. It is advantageous if the closure plate itself is rotatably mounted with respect to the carriage so that it may rotate with the rotary drum during the tesing procedure. In order to simplify the displacement mechanism for the closure plate and to protect the edge of the opening of the drum from being damaged by the closing action, it has been found advantageous to yieldably support the closure plate in axial direction of the displacement of the carriage.

These and other objects of the invention will further be described in detail with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic view of the rotary drum according to the invention, with the axis of rotation of the drum arranged in a horizontal position and with the end cover in open position;

FIG. 2 is a top view of the assembly in an enlarged scale;

FIG. 3 is a simplified schematic view of the rotary drum assembly between an upper weighing and filling device which may be connected with an automatic sampler, and a lower sample collecting container, and

FIG. 4 is a detailed view of the mounting of the cover plate.

Referring to FIGS. 1 and 2, the drum assembly consists of two spaced bearing brackets **1** between which a frame structure **2** having two opposed and axially aligned bearing pins **2***a* is pivotally mounted. The center of the frame structure **2** carries a bearing structure **3** for rotatably supporting a shaft **4** on two axially spaced points about an axis extending at right angles to the pivot axis of the frame structure **2**. One end of the shaft **4** is flanged and has attached thereto one end, namely the permanently closed end, of the rotary drum **5** in an overhung position. The rotary drum **5** is rotated by a drive motor **6** which is mounted on the frame structure **2** and is connected to the other end of the shaft **4** by a coupling. Attached to one side of one of the bearing brackets **1** is a swivel drive **7** by means of which the frame structure **2** together with the drum **5** and its drive motor **6** are swivelled about the axis of rotation of the frame structure **2** so that the drum **5** is swung vertically upward or downward. In the sectional view of the drum **5** illustrated in FIG. 2 one of the customary four lifting or throw bars **8** is visible.

FIG. 1 shows an exemplary embodiment of a removable closure member for the right hand end of the drum **5** which, as already stated, is arranged in an overhung position. The closure member comprises a smooth cover plate **9** having a diameter which is about equal to the outer diameter of the drum **5**, and to this plate **9** are welded on edge six hook-shaped sheet-metal pieces **10**, the ends of which facing the drum extend in the closed position of the closure member over the right hand end of the drum **5**. These sheet-metal pieces **10** extend radially along the back of the cover plate **9** toward a flange **11** on the plate **9**. The flange **11** is so constructed that the cover structure as a whole has a certain amount of axial play with respect to the hub **12**. By means of helical springs or other resilient elements **14**, the flange **11** and the cover plate **9** connected thereto are elastically supported against a circular flange **12***a* secured to the hub **12** (FIG. 4). Thereby the blow of the closure member against the front edge of the cylinder wall of the drum during the closing movement is resiliently absorbed and a destruction of the edge or of a sealing placed therebetween is avoided. The closure member **9** by way of the hub **12** is rotatably mounted on a connecting rod **13** by means of ball bearings **18***a* so that the closure member is rotated jointly with the closed drum. The axial displacement of the closure member **9** for the purpose of closing or opening the drum **5** is effected hydraulically or by an electric displacement device **16** which axially displaces the connecting rod **13**. The connecting rod **13** together with the closure member **9** is supported by a carriage **15** provided with rollers on a horizontal base structure which assures a straight-line movement.

The operation of the rotary drum will now be described with reference to FIG. 3. The drum assembly **17** is so arranged that it is spaced with its base plane below a contained balance **18** having a motor operated slide plate **19**, while placed below the drum assembly is a collecting container or bin **20**, also having a motor-operated slide plate **21**. The loading of the container balance **18** is effected by a sampler (not illustrated) by way of a conveyor **22**, such as for instance a conveyor belt. The transfer of the tumbled samples from the container **20** to a screening apparatus takes place by a suitable conveyor means **23**, such as a conveyor belt.

The testing procedure is as follows: At any desired time interval the sampler takes samples from the flow of material conveyed, for instance, toward a blast furnace. The samples taken from the conveyed material are, first, screened so that the sample to be tested contains only pieces from a certian granular size on upward, and the thus screened material is conveyed to the container balance **18**. The amount of one drum charge is, as a rule, 50 kilograms. The cover plate **9** of the drum **5** is opened

and the drum with its open end is pivoted upward, with its axis of rotation in a vertical position. When now the slide plate **19** is moved to its open position, the coke sample is discharged from the balance **18** into the drum **5** by means of a suitable slide arrangement. The employment of a slide, a chute or the like is necessary because otherwise the lumps of coke might break apart when dropped into the drum and, thus, the results of the test would be falsified. The axis of rotation of the drum is now brought again into a horizontal position and the cover plate **9** is axially pressed by the displacement device **16** against the drum opening. By turning the drive motor **6** on the drum with the coke sample therein starts rotating and is kept rotating for four minutes at a speed of 25 r.p.m. After turning the drive motor **6** off, the cover plate **9** is opened and the contents of the drum **5** are discharged into the sample bin **20** by pivoting the drum **5** clockwise so that its opening faces downward. Also during this discharge of the material care must be taken to prevent a further breakage of individual pieces of the coke sample. The sample just tumbled in the drum is then conveyed to the screening apparatus for a granulometric analysis.

From the above description it is apparent to what essential degree the testing of coke samples is simplified when the rotary drum according to the invention is used. Only by dispensing with the manual charging and discharging of the rotary drum it is made possible, and also useful, to equip the rotary drum assembly with control elements known per se and, coupled with an automatically operating sampler, thus completely automatize its operation.

The rotary drum according to the invention is not only suitable for testing the breaking strength and abrasion resistance of blast furnace coke, but it may also be used for the testing of ore pellets, granulated matter, compacted matter, and the like, if the properties just mentioned are of significance for the further processing or quality of such goods.

What we claim is:

1. In a device for testing the breaking strength and abrasion resistance of comminuted material, particularly blast furnace coke, ore pellets and granules, a rotary drum closed permanently at one end and open at the other end, a drive shaft attached with one of its ends to said closed end and in axial alignment with the axis of rotation of said rotary drum, a removable closure member for the open end of said drum, said closure member comprising a cover plate having a diameter substantially equal to the outer diameter of said drum, a horizontally displaceable carriage, a horizontal member supported by said carriage, means for rotatably supporting said closure member on said horizontal member, said horizontal member also moving said closure member in axial direction to and from the open end of said drum, said closure member being adapted to rotate when moved to a position in which it closes the open end of said rotary drum, said closure member rotating with said drum when the latter is rotated.

2. A device according to claim **1**, including means for axially resiliently mounting said closure member relatively to said carriage for cushioning any resulting stresses when said closure member is moved to closing position against the open end of said drum.

3. A device according to claim **1**, including frame means for rotatably supporting said drive shaft between its ends in said frame, a drive motor mounted on said frame means in axial alignment with said drive shaft and drivingly connected to the other end of said drive shaft, means for rotatably supporting said frame means about an axis of rotation extending at right angles to the axis of rotation of said drive shaft and disposed between said drum and said motor, and means for rotating said frame means so that said drum may be pivoted about the axis of rotation of said frame means into a position with its open end facing upwardly for receiving comminuted material and may also be pivoted into a position with its open

end facing downwardly for discharging said comminuted material.

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73—12; 241—171; 259—3