

May 12, 1959

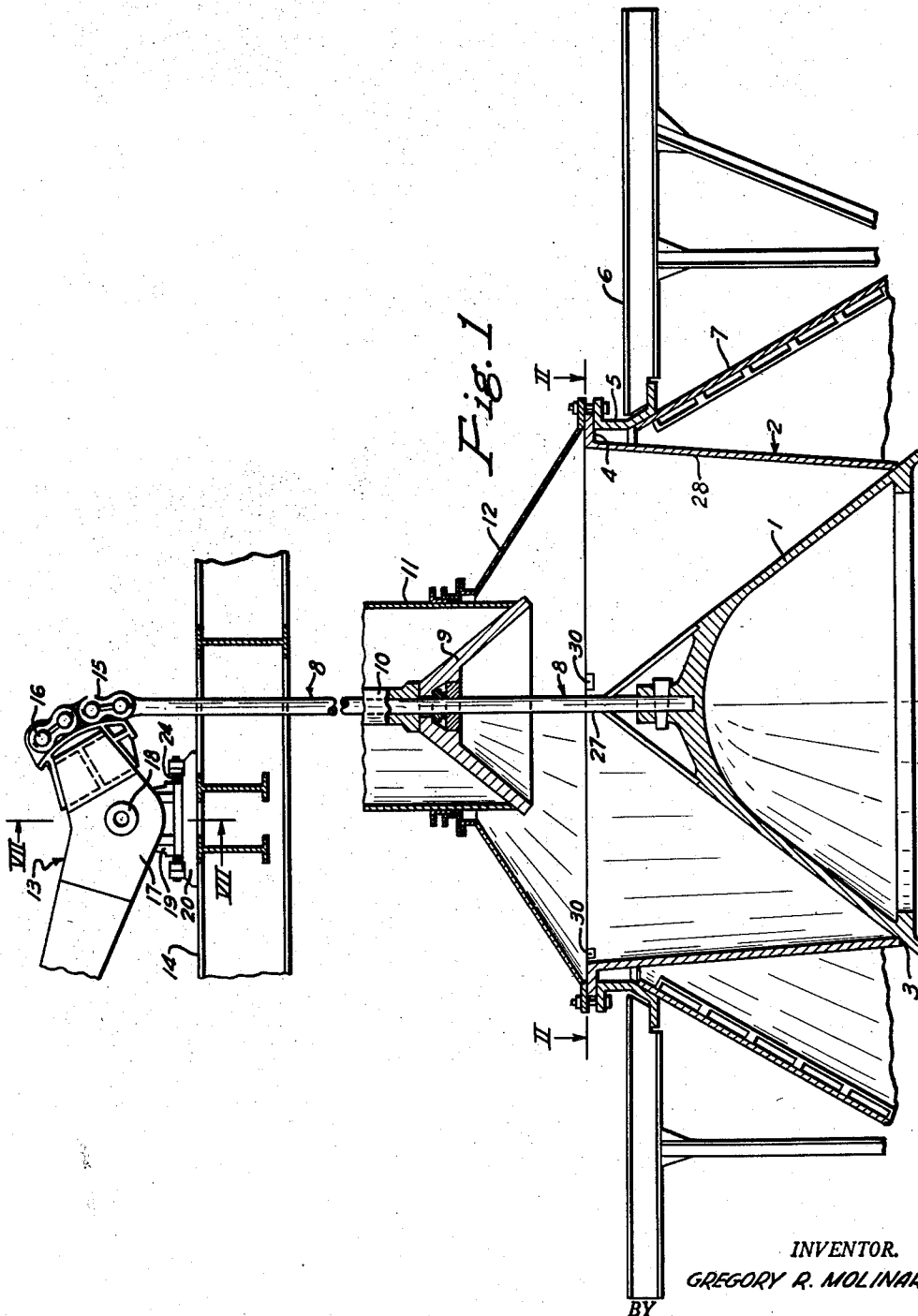
G. R. MOLINARO

2,885,773

METHOD OF CENTERING BLAST FURNACE BELL

Filed Dec. 17, 1956

3 Sheets-Sheet 1



INVENTOR.

GREGORY R. MOLINARO

BY

Donald G. Dalton

HIS ATTORNEY

May 12, 1959

G. R. MOLINARO

2,885,773

METHOD OF CENTERING BLAST FURNACE BELL

Filed Dec. 17, 1956

3 Sheets-Sheet 2

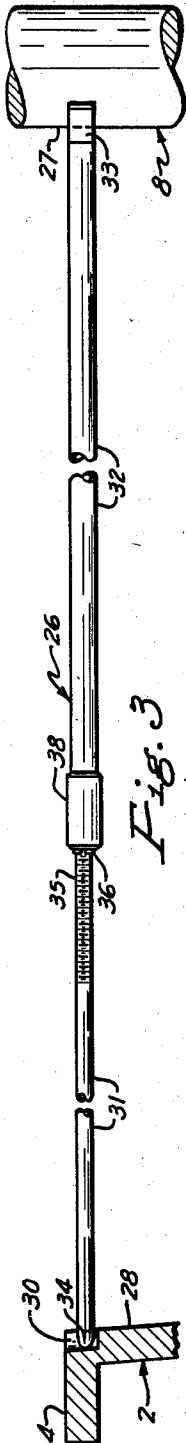


Fig. 3

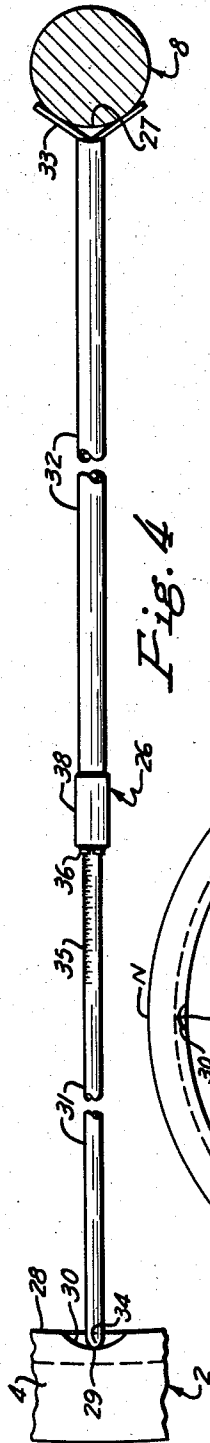


Fig. 4

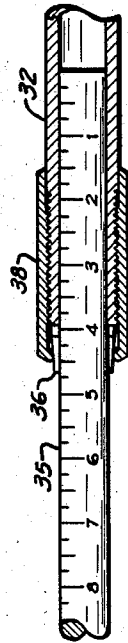


Fig. 5

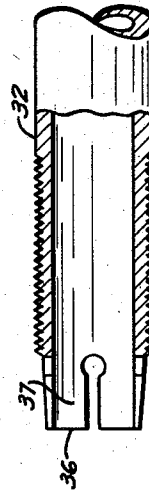


Fig. 6

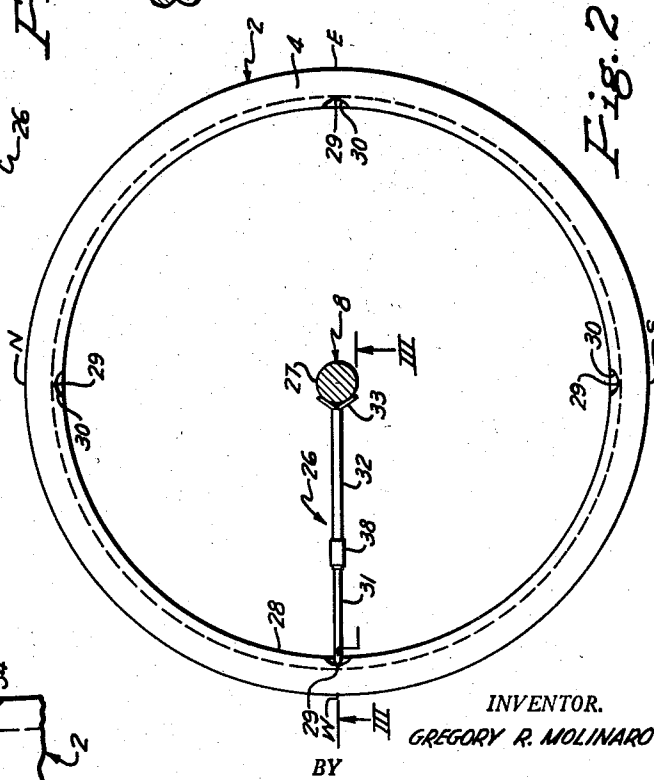


Fig. 2

INVENTOR.
GREGORY R. MOLINARO
BY
Donald G. Salton
HIS ATTORNEY

May 12, 1959

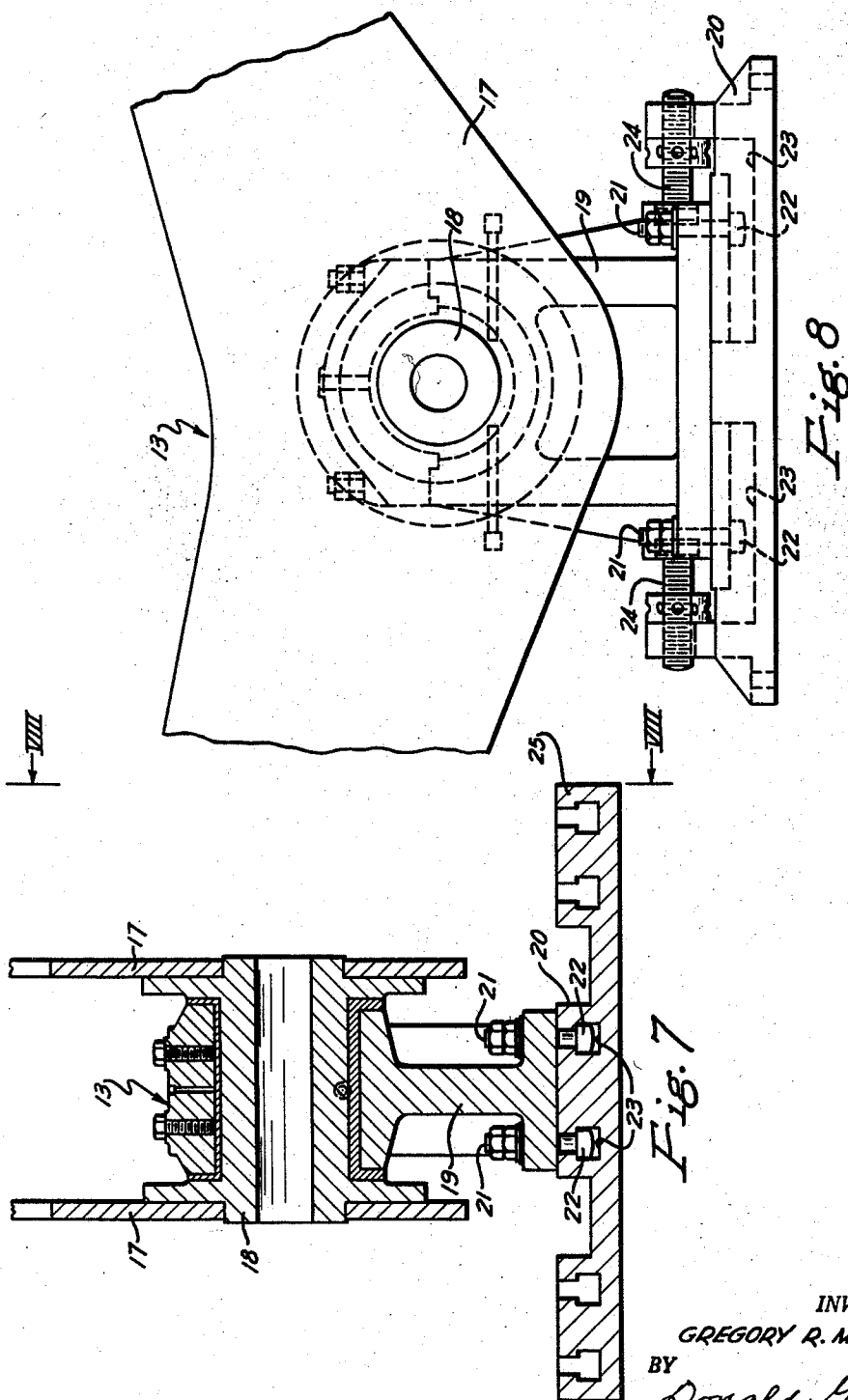
G. R. MOLINARO

2,885,773

METHOD OF CENTERING BLAST FURNACE BELL

Filed Dec. 17, 1956

3 Sheets-Sheet 3



INVENTOR.
GREGORY R. MOLINARO
BY *Donald G. Dalton*
HIS ATTORNEY

1

2,885,773

METHOD OF CENTERING BLAST FURNACE BELL

Gregory R. Molinaro, Gary, Ind., assignor to United States Steel Corporation, a corporation of New Jersey

Application December 17, 1956, Serial No. 628,789

3 Claims. (Cl. 29—407)

This invention relates to the erection and repair of blast furnaces and, more particularly, to the installation therein of the large bell and hopper. As indicated, it is directed to an improved method for centering the large bell with respect to the hopper.

The large bell and hopper are located at the top of the stack of a blast furnace and function as a valve-closure which in closed position seals the top of the furnace stack against the escape of gases and in open position provides for charging the furnace burden of ore, coke, limestone and other materials. Its operation is of course synchronized with the operation of a smaller but similar valve-closure in the form of a small bell and distributing hopper which receives the furnace burden materials from the skip hoist and controls their admission into the large hopper. The operation of the small bell and distributing hopper is synchronized with that of the large bell and hopper to control the admission of the burden materials while preventing the escape of gas from the furnace.

The seal against escape of gas from the top of the furnace stack is provided by seating surfaces which are machined on the large bell and hopper prior to their installation in a blast furnace. In order that these machined surfaces will have proper seating engagement with each other, an accurate concentric mounting of the large bell and hopper is required. Conventional assembly practice for this purpose involves a tedious trial and error procedure which requires as much as three days' time after the large bell and hopper have been installed in their operating positions.

Several successive operations are required to install the large bell and hopper either during erection or repair of a blast furnace. The large bell is first suspended temporarily in the stack by cables from a ring at the top of the furnace and on which the large hopper is then mounted in a centered position with respect to a furnace vertical centerline established by engineering methods. Mounting of the large bell is thereafter completed by attaching it to a bell rod suspended by operating mechanism for effecting vertical opening and closing movements of the large bell with respect to the large hopper. Such operating mechanism includes a bell lever and its pivotal support on a bell lever platform which may be located as much as fifty feet or more above the large bell. Upon completion of these operations, the position of the large bell must be centered with respect to the hopper so that the seating surfaces thereon will have uniform seating and gas sealing engagement around the periphery thereof.

Because the large bell must be concentric to the hopper in order to provide a satisfactory gas seal, conventional centering procedures have required considerable painstaking effort to obtain the desired concentricity. According to such procedures, bell centering is effected mainly by a trial and error method which involves listening to the sound made by engagement of the bell lip with the hopper seat as the large bell moves to its closed position. If a scraping sound is heard, the bell is adjusted to one side

2

or the other by adjusting the position of the support for the bell beam and this operation is repeated until the sound indicates that a tight seat has been obtained. While experience has shown that accurate centering of the bell is not possible by a trial and error operation of this character, the practice has continued. In addition, such practice is time-consuming and, as indicated above, frequently requires as much as three days to obtain a reasonably satisfactory seal.

One of the principal objects of this invention is to provide an improved method of centering the large bell of a blast furnace according to which more accurate centering is obtained and which will reduce the time required for this operation to a matter of hours, compared to the time previously taken. The method of this invention and other advantages and objects thereof will become apparent from the following description and the accompanying drawings. In the drawings:

Figure 1 is a fragmentary elevational view of a conventional blast furnace, parts thereof being broken away and shown in vertical section, to which the method of this invention is applied;

Figure 2 is a view taken substantially along the line II—II of Figure 1 which shows the operative position of a tool for measuring the distance between the bell rod and the large hopper;

Figure 3 is an enlarged elevational and vertical sectional view taken along the line III—III of Figure 2;

Figure 4 is a plan and horizontal sectional view of the parts shown in Figure 3;

Figure 5 is an enlarged fragmentary sectional view illustrating the telescopic construction of the measuring tool shown in Figures 3 and 4;

Figure 6 is a fragmentary sectional view of a part of the tool shown in Figure 5;

Figure 7 is a fragmentary sectional view of the bell lever and its support taken along the line VII—VII of Figure 1; and

Figure 8 is an elevational view taken along the line VIII—VIII of Figure 7.

Figure 1 of the drawings shows the large bell 1 and hopper 2 of a blast furnace with the bell in its upper or closed position relative to the hopper. In this position, annular surfaces at the bottom of the hopper and on the lip 3 of the bell have seating engagement with each other. Since these surfaces are machined prior to installation of the bell and hopper, accurate centering of the bell relative to the hopper is required after installation in order that they will be concentric and provide a gas-tight seal about the bottom of the hopper when the bell is moved to the closed position shown in the drawings. The method of this invention, as indicated above, is directed to an improved procedure for centering the bell.

At its upper end, the hopper 2 has an outwardly turned flange 4 which is bolted to the furnace top ring 5. The top ring 5 is mounted on a platform 6 which extends around the furnace shell 7 at the upper end of the furnace stack. The bell 1 is secured to the lower end of a bell rod 8 which controls the raising and lowering movements of the bell relative to the hopper. The bell rod 8 extends vertically through aligned openings in a small bell 9 and a hollow actuating bell rod 10 therefor. A revolving distributing hopper 11 and cover 12 cooperate with the small bell 9 to provide a gas seal about the upper end of the large hopper 2.

Vertical movement of the bell rod 8 for imparting opening and closing movements of the bell 1 is effected by an actuating mechanism 13 on the bell lever platform 14. It includes a flexible link chain 15 having one end connected to the upper end of the rod 8 and its other end connected at 16 to the outer end of a bell lever 17. The lever 17 has a pivot support at 18 on a pillow block

19 for rocking movement relative thereto to impart vertical raising and lowering movement to the bell rod 8. The pillow block 19, as best shown in Figures 7 and 8, is supported on a base plate 20 which in turn is secured to the bell lever platform 14.

The mounting of the pillow block 19 on the base plate 20 provides for sliding adjustment of its position relative thereto and thereby adjustment of the axial position of the bell rod 8 and bell 1 relative to the hopper 2. For this purpose, the pillow block 19 is secured to base plate 20 by T-bolts 21 the heads 22 of which are received in slots 23 in the base plate 20 so the position of the block 19 may be adjusted by sliding along the length of the slots 23. Threaded jack posts 24 at opposite ends of the pillow block 19 are provided to facilitate its sliding adjustment in this manner. The openings (not shown) in the block 19 through which the bolts 21 extend are elongated in a direction transversely of the slots 23 for adjustment of the position of the block 19 on the base plate 20 in a transverse direction. A similar mounting is provided on side portions 25 of the base plate 20 for the small bell levers (not shown) which actuate the hollow rod 10 for the small bell 9.

In the conventional operation of the bells 1 and 9, the small bell 9 is lowered to discharge furnace burden materials into the large hopper 2 only when the large bell 1 is in its upper closed position as shown in Figure 1. Thereafter, the small bell 9 elevated to its closed position and the large bell 1 is lowered so that materials in the hopper 2 may gravitate into the furnace. The large bell 1 is then returned to its closed position as shown in Figure 1 preparatory to the discharge of additional material from the hopper 11 into the large hopper 2 upon a subsequent lowering of the small bell 9. In this manner, the bells 1 and 2 operate to charge the blast furnace while preventing the escape of gas from the furnace stack through the hopper 2.

As distinguished from the conventional procedure of moving the bell to closed position and centering it according to information obtained by ear from the sound produced by the bell closing operation, the bell is centered in accordance with the principles of this invention while in a stationary and partially open position with its lip 3 out of seating engagement with the lower edge of the hopper 2. For this purpose, the information required for the adjustment of the pillow block 19 is obtained by the use of a tool designated as a whole by the numeral 26 in Figure 2 of the drawings. In a manner to be described, the tool 26 is used to determine the eccentricity of a portion 27 of the external surface of the bell rod 8 which is machined prior to installation and is located opposite the upper end of the hopper 2 with respect to accurately centered reference points formed in a manner to be described on the hopper 2 at its upper end. The bell 1 is thus centered relative to the hopper by centering the position of the bell rod 8 with respect to accurately centered reference points on the upper end of the hopper.

Prior to installation of the hopper 2, its inner face 28 is provided with a plurality of reference points 29, preferably four in number located respectively at the four points of the compass as shown in Figure 2 and adjacent the flange 4 at the top of the hopper 2 as shown in Figures 1 and 3, which are accurately and concentrically arranged with respect to the annular seating surface at the bottom edge of the hopper. As shown in Figure 2, the reference points 29 are surfaces at the bottom of cylindrical recesses 30 which are preferably formed by grinding when the seating surfaces on the bell lip 3 and bottom edge of the hopper 2 are machined. The formation of the recesses 30 in the machine shop prior to installation of the hopper 2 enables accurate concentric location of the reference points 29 relative to the bell and hopper seating surfaces. The method of this invention is practiced by centering the portion 27 of the bell rod

8 with respect to the points or surfaces 29 through information obtained from the tool 26 in a manner to be described.

As best shown in Figures 3 through 6, the tool 26 is comprised of telescopic parts 31 and 32. The part 32 is a hollow rod having a fork 33 at its outer end for engaging the external surface 27 of the bell rod 8. The part 31 is a rod which has a rounded outer end 34 for bottoming engagement in the recesses 30 against the reference points or surfaces 29. The inner end 35 of the rod 31 has indicia for indicating the distance between the bell rod surface 27 and the reference points 29. In this respect, the inner edge 36 of the tube 32 acts as an indicating pointer with respect to the indicia on the inner end of the rod 35. The inner end 37 of the tube 32 is tapered and split so that it may be clamped in holding engagement with the rod 32. A sleeve 38 is threaded on the tube 32 for clamping its split and tapered end 37 into holding engagement with the rod 32 to enable a reading to be taken of the spacing of the points 29 with respect to the bell rod surface 27.

In operation, the hopper 2 and bell rod 1 are installed in a blast furnace according to conventional practice as indicated above. Prior to centering the bell 1 according to the procedure of this invention, the bell lever 17 is pivoted to move the bell 1 to a position in which the seating surfaces on the lower edge of the hopper 2 and the bell lip 3 are spaced axially apart a distance of approximately one inch. The tool 26 is then used to determine the spacing of the bell rod surface 27 with respect to each of the reference points or surfaces 29 on the hopper 2. With this information, the pillow block 19 is adjusted to center the position of the rod 8 with respect to the points 29 and to thereby center the seating surface on the bell lip 3 with respect to the seating surface on the lower end of the hopper 2. After centering of the bell rod 8 in this manner, the tool 26 is used to check the spacing of the rod 8 with respect to the reference points 29 and a second adjustment of the position of the bell rod 8 may be made if required. Usually a single adjustment will be sufficient for obtaining the desired concentricity of the bell rod 8 and the bell 1 with respect to the hopper 2. After a uniform spacing of the rod 8 is obtained with respect to the points 29, the bolts 21 are operated to secure the bell lever pillow block 19 against movement with respect to the base plate 20.

From the foregoing, it will be apparent that the bell centering method of this invention eliminates the trial and error operations required by conventional practice and the inaccuracies resulting from such practice due to centering according to information obtained by ear. Attention is particularly directed to the fact that the centering method of this invention is performed with the bell 1 in a stationary position and with the seating surfaces on the bell lip 3 and hopper 2 out of engagement with each other. Attention is further directed to the fact that the improved bell centering method of this invention requires the provision of concentric reference points 29 adjacent the upper edge of the hopper 2 and spaced axially from the seating surface on its lower edge and the use of a tool 26 for measuring the relative position of the external surface 27 on the bell rod 8 with respect to such reference points. In this respect, it will be understood that other forms of measuring tools 26 and locations of the reference points 29 may be used and are contemplated. For example, an annular surface may be machined concentrically about the upper edge of the hopper 2 instead of grinding recesses 30.

The method of this invention has been found to enable centering of the bell 1 with respect to the hopper 2 in the matter of a few hours compared to a period of from one to three days as previously required in accordance with conventional centering procedures. In addition, it will be apparent that the method of this invention provides for more accurate centering and seating of the bell

5

1 with respect to the hopper 2 compared to previous practices in which the accuracy is dependent upon the skill of the operator and will thus vary considerably with different operators.

While one embodiment of my invention has been shown and described it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. A method of installing the large bell and hopper in a blast furnace which comprises machining annular seating surfaces on the lip of the bell and on the lower edge of the hopper, machining reference points on the hopper at points spaced axially from its lower edge and concentric to the annular seating surface thereon, mounting said hopper on the furnace top ring, attaching said bell to a bell rod having an adjustable support on the bell lever platform by which its position may be adjusted relative thereto, measuring the respective radial spacing of said reference points relative to said bell rod, and then adjusting the position of said bell rod support on said platform to obtain a uniform spacing of said points relative to said bell rod and to thereby obtain a concentric arrangement of said seating surfaces relative to each other.

2. A method of installing the large bell and hopper in a blast furnace which comprises machining annular seating surfaces on the lip of the bell and on the lower edge of the hopper, machining reference points on the hopper at points spaced axially from its lower edge and concentric to the annular seating surface thereon, mounting said hopper on the furnace top ring, attaching said bell to a bell rod having an adjustable support on the bell lever platform by which its position may be adjusted relative thereto, actuating said bell rod to move said bell to a position in which said seating surfaces are spaced

6

axially a small distance apart, taking measurements of the radial spacing of said reference points relative to said bell, and then using the information obtained from said measurements to adjust the position of said bell rod support on said platform to one in which said bell rod is uniformly spaced with respect to each of said reference points and to thereby obtain a concentric arrangement of said seating surfaces relative to each other.

3. A method of installing a large bell and hopper in a blast furnace which comprises machining annular seating surfaces on the lip of the bell and on the lower edge of the hopper, providing reference points on the hopper that are spaced axially from its lower edge and arranged concentrically about the annular seating surface thereon, mounting said hopper on the furnace top ring, providing a reference surface on the large bell supporting rod that is spaced axially from and arranged concentrically about the annular seating surface on the bell lip when the bell is attached thereto, attaching said bell to the bell rod, suspending said bell rod from an adjustable support on the bell lever platform by which its position may be adjusted relative thereto, measuring the respective radial spacing of said reference points relative to said bell rod reference surface, and then adjusting the position of said bell rod support on said platform to obtain a uniform spacing of said points relative to said bell rod reference surface and to thereby obtain a concentric arrangement of said annular seating surfaces relative to each other.

References Cited in the file of this patent

UNITED STATES PATENTS

2,016,883	Barnes	Oct. 8, 1935
2,506,082	Hartman	May 2, 1950
2,594,810	Schaub	Apr. 29, 1952