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CHARGING SYSTEM OF BLAST FURNACES

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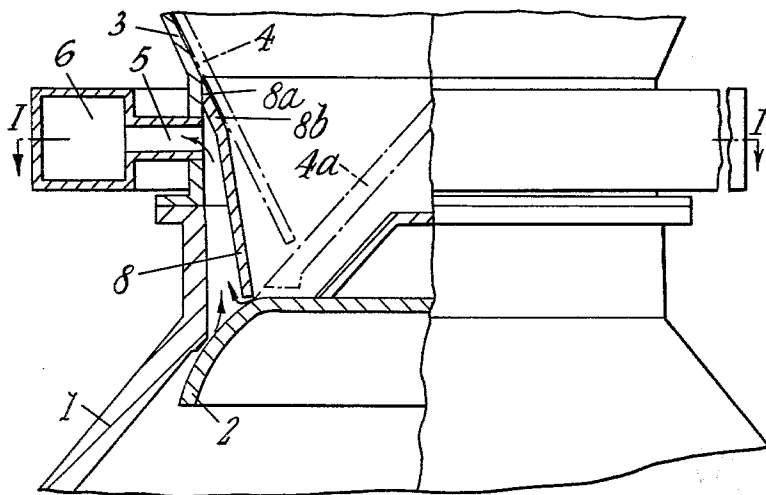


Fig. 1.

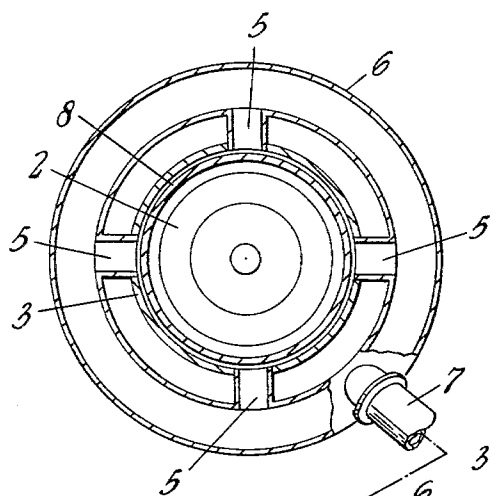


Fig. 2.

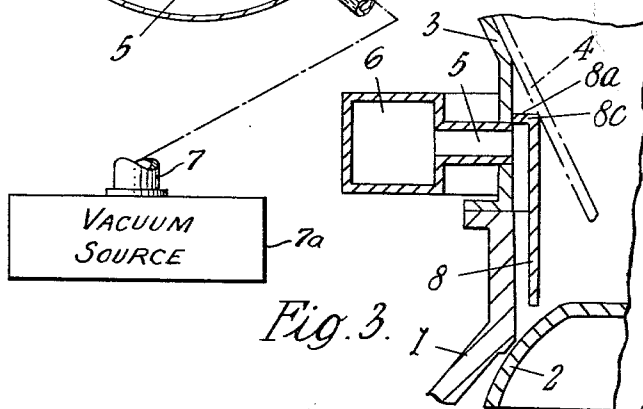


Fig. 3.

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3,180,502

## CHARGING SYSTEM OF BLAST FURNACES

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8 Claims. (Cl. 214—36)

This invention relates to the charging of blast-furnaces and relates more particularly to an improved ventilating arrangement for a bell and hopper system of blast-furnace charging.

In, for example, the double bell and hopper system the top of a blast-furnace is constituted by a hopper with a top and bottom opening and which has an upwardly tapering "bell" lying within each opening. If either bell is moved upwards the corresponding hopper opening is closed and vice versa. The two bells may be moved upwards or downwards independently of each other. To charge the furnace,

(a) With the lower bell closing the lower opening, the upper bell is lowered and the charge can thus fill the hopper from above;

(b) The upper bell is raised again;

(c) The lower bell is lowered, thus allowing the charge to fall into the furnace; it will be seen from (b) that the furnace top is still closed;

(d) The lower bell is raised, thus allowing for repetition of the cycle.

It is known both to have a further hopper above the upper bell, in order that there shall be a supply of the blast furnace charge to the bell-controlled hopper, and to have the upper part of the bell-controlled hopper arrangement so formed as to seat a removable bucket the bottom of which can open in synchronism with lowering of the upper bell. The present invention has special application to this second type of arrangement.

The purpose of a double bell and hopper system is to prevent too much dust and gas entering the atmosphere. However, small amounts of dust and gas still escape, and with some types of blast-furnace even these small amounts are harmful to health. This is especially true of a blast-furnace treating zinc-lead ores.

The invention consists in an arrangement for ventilating a bell and hopper blast-furnace charging device, e.g. of the type using a removable bucket comprising a suction outlet leading out of a substantially annular enclosed space lying around and above the opening in the hopper to be closed by the bell and communicating with any gap formed between the hopper and the upper surface of the upper bell.

In this context, the phrase "annular enclosed space" should be taken to mean any circumferential enclosed space, e.g. it may be an elliptical or even a square "annulus."

By this means, if it should happen that the bell should not completely seal its opening when a charging bucket is removed, any vapours escaping from the hopper are drawn away.

Preferably, the enclosed annular space is that defined between an upstanding wall extending around the edge of the upper opening, in which wall the suction outlet is formed, and a downwardly tapering frusto-conical or frusto-pyramidal shell extending from the wall above the level of the suction outlet to, or to just above, the upper surface of the bell when this closes the opening.

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In a preferred embodiment, the frusto-conical or frusto-pyramidal shell has an upper portion of greater semi-vertical angle (i.e. less steep slope) and forms part of the seat upon which the bucket rests when in position.

Alternatively, the annular enclosed space may be that defined between an upstanding wall extending around the edge of the upper opening, in which wall the suction outlet is formed, and a shell extending inwards from the wall above the level of the suction outlet and thence downwards parallel to the wall to, or to just above, the upper surface of the bell when this closes the opening.

It will of course be an advantage to have a number of suction outlets connected to a convenient common surrounding conduit.

Such a gap might be between half an inch and one inch in width and avoids any possibility of fouling between the frusto-conical shell and the upper surface of the upper bell, when the latter seats against the hopper, while remaining small enough to ensure that any gas escaping from the hopper is captured by air drawn through the gap. A reasonable gap however avoids any possible chance of the frusto-conical shell fouling the bell as it seats against the hopper and thus preventing as good a seal being made as is possible with the condition of the seating faces at any time.

The invention will be further described with reference to the accompanying drawings, in which:

FIGURE 1 is a part-sectional and somewhat diagrammatic view of the upper part of a double bell and hopper according to the invention, and

FIGURE 2 is a section along line I—I of FIGURE 1.

FIGURE 3 is a fragmentary part-section of an alternative embodiment.

In these drawings, 1 is a charge hopper of a blast-furnace. Only the upper part of this hopper is shown. The lower part may be of well-known design. 2 is the upper bell, lying within the upper opening of the hopper. An inclined seat 3 is provided to hold a bucket 4, which bucket has a bottom 4a capable of opening. The bucket is removable and is accordingly shown in dotted lines. This upper bell 2 and bucket 4 can be of well-known type and will accordingly not be discussed in detail. Between the seat 3 and the top of hopper 1 there are four outlets 5 leading to a surrounding suction conduit 6 from which gasses and air are drawn by offtake 7 (FIGURE 2) connecting vacuum source 7a. A downwardly tapering frusto-conical shell 8 extends from the wall above outlets 5 to the vicinity of, or touching the upper bell 2 in its raised position.

It should be mentioned that in FIGURE 2 the bucket is to be considered as removed.

During the charging operation of the furnace, the bell 2 drops downwards and the bucket 4 opens at 4a to discharge the contents into the hopper. The contents of the bucket cause a good deal of dust as they discharge into the hopper 1 and this dust, together with any furnace gases originally present in hopper 1, will tend to pass into the bucket and thus to atmosphere.

This tendency is prevented to a certain extent by suction outlets 5, conduit 6 and offtake 7.

However, suction outlets 5 are ineffective in that when the bell 2 is raised again and bucket 4 is removed they would be open to atmosphere and thus any gas seeping through spaces caused by wear or accumulated material at the contact between bell 2 and hopper 1 would not be effectively drawn away.

Accordingly, downwardly tapering frusto-conical shell 8 is provided, and welded to the wall at 8a above suction outlets 5. Even when bucket 4 is removed, dust and gas escaping is now sucked up into the annular space defined between shell 8 and hopper 1. Normally even if there

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is a small clearance (e.g.  $\frac{1}{2}$ " to 1") between bell 2 and shell 3, the suction created will be sufficient to cause an inward flow of air through this clearance, so that no gas or dust can escape and gas or dust trapped behind the bucket on the top of the bell will also be evacuated.

A preferred but not essential feature of shell 3 is shown at 3b, where the slope of shell 3 is altered so that it can constitute an extension of the bucket seat.

Various modifications may be made within the scope of the invention. Thus, the shell 3 need not taper inwards but could, for instance, proceed inwards at right angles and then downwards parallel to the vertical portion of the hopper wall provided that the angle so formed did not interfere with the seating of the bucket. This is shown in FIGURE 3, in which the reference numerals have the same meaning as in FIGURE 2, and 3c is the angle between horizontal and vertical portions of shell 3. Moreover, if necessary the hopper opening need not be circular, although this is the most usual shape. In other cases from the circular, the shell might be, e.g. the frustum of a pyramid or an elliptical cone.

It will be observed that the provision of the frusto-conical, or similar, shell 3 does not detract from the general usefulness of the suction system in dealing with the hot gases and dust arising when charging the furnace while considerably improving its effectiveness when the bucket is removed.

I claim:

1. In a bell and hopper blast-furnace charging device, the improvement which comprises the combination therewith of a ventilating arrangement, said ventilating arrangement including a hopper having an upper opening; a bell vertically movable to open or close the opening; an upwardly extending wall around the opening having at least one suction outlet therein; a shell extending inwardly and downwardly from above the suction outlet to the upper surface of the bell when said bell closes the opening and thus defining with the wall substantially annular space which communicates with any gap between the bell and the hopper.

2. In a bell and hopper blast-furnace charging device, the improvement which comprises the combination therewith of a ventilating arrangement said ventilating arrangement including a hopper having an upper opening; a bell vertically movable to open or close the opening; an upwardly extending wall around the opening having at least one suction outlet therein; a shell extending inwardly and downwardly from above the suction outlet to just above the upper surface of the bell when said bell closes the opening and thus defining with the wall, a substantially annular space which communicates with any gap between the bell and the hopper.

3. In a bell and hopper blast-furnace charging device, according to claim 2 in which the shell extends to between half an inch and one inch above the bell when said bell closes the opening.

4. In a bell and hopper blast-furnace charging device, the improvement which comprises the combination therewith of a ventilating arrangement said ventilating arrangement including a hopper having an upper opening; a bell vertically movable to open or close the opening; an upwardly extending wall around an opening having at least one suction outlet therein; a tapering shell extending inwardly and downwardly from above the suction outlet to not more than one inch above the upper surface

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of said bell defining with the wall a substantially annular space which communicates with any gap between the bell and the hopper; said tapering shell having an upper portion of relatively greater semi-vertical angle capable of forming a seat for a removable bucket.

5. In a bell and hopper blast-furnace charging device, the improvement which comprises the combination therewith of a ventilating arrangement, said ventilating arrangement including a hopper having an upper opening; a bell vertically movable to open or close the opening; an upwardly extending wall around the opening having at least two branch suction outlets connected to a main suction outlet; a frusto-conical shell extending inwardly and downwardly from above the suction outlet to not more than one inch above the upper surface of the bell when said bell closes the opening defining with the wall a substantially annular space which communicates with any gap between the bell and the hopper; said frusto-conical shell having an upper portion of relatively greater semi-vertical angle capable of forming a seat for a removable bucket.

6. In a bell and hopper blast-furnace charging device, the improvement which comprises the combination therewith of a ventilating arrangement, said ventilating arrangement including a hopper having an upper opening; a bell vertically movable to open or close the opening; an upwardly extending wall around the opening having at least two suction outlets therein; a common surrounding suction conduit connected to each suction outlet; a shell extending inwardly and downwardly from above the suction outlet defining with the wall, a substantially annular space which communicates with any gap between the bell and the hopper.

7. In a bell and hopper blast-furnace charging device, the improvement which comprises the combination therewith of a said ventilating arrangement said ventilating arrangement including a hopper having an upper opening; a bell vertically movable to open or close the opening; an upwardly extending wall around the opening having at least one suction outlet therein; a shell extending inwardly from and thence downwardly parallel to the wall, from above the suction outlet defining with the wall, a substantially annular space which communicates with any gap between the bell and the hopper.

8. In a bell and hopper blast-furnace charging device, the improvement which comprises the combination therewith of a ventilating arrangement for removing dust and gases from the vicinity of the hopper; said ventilating arrangement including a hopper having an upper opening, a bell vertically movable to open or close this opening, an upwardly extending wall above and around the opening, having at least one suction outlet therein; a shell extending inwardly and downwardly from the wall, above such suction outlet defining with the wall an annular space which can be maintained under suction and which communicates with any gap between the bell and hopper and with any gap between the said shell and the upper surface of the bell.

#### References Cited by the Examiner

#### UNITED STATES PATENTS

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HUGO O. SCHULZ, *Primary Examiner*.

**UNITED STATES PATENT OFFICE**  
**CERTIFICATE OF CORRECTION**

Patent No. 3,180,502

April 27, 1965

Alan Andrew Clark

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 38, for "setat" read -- seat --; column 3, line 38, after "wall" insert -- a --; line 43, after "with" insert -- of --; line 59, after "arrangement" insert a comma; same column 3, line 62, for "an", second occurrence, read -- the --; column 4, line 36, strike out "said", first occurrence; same line 36, after "arrangement" insert a comma.

Signed and sealed this 21st day of September 1965.

(SEAL)

Attest:

ERNEST W. SWIDER  
Attesting Officer

EDWARD J. BRENNER  
Commissioner of Patents