An elongated screeb bar, the end of which is secured to the concrete support columns for a basic oxygen furnace vessel, and positioned to scrape the skull from the vessel mouth as the vessel is tilted to dump the slag therefrom.
SCREED FOR CLEARING NOSE OF TILTING VESSEL

BACKGROUND OF THE INVENTION

The manufacture of steel in the basic oxygen furnace involves blowing oxygen gas into molten iron to burn the impurities therefrom. The reaction is at times violent enough to cause considerable slopping or turbulence in the bath whereby drops of metal and slag are thrown from the molten bath and out of the vessel. This frequently causes metal and slag called a “skull,” to form on the cooler lip or mouth outside of the steel-making vessel. In order to continue efficient operation of the furnace, the skull must not be allowed to grow appreciably. That is, excessive accumulation of metal and slag around the furnace mouth will cause several operating difficulties, such as interference with hot metal and scrap charging, metal spillage when tapping, increased gas velocities through the mouth and therefore enhanced slopping, reduction in lining life, damage to vessel drives, and extensive delays in removing the accumulated skull as well as possible damage to the vessel shell during skull removal.

Since the industry is well aware of the above problems, many devices have been developed to remove the skull before there is substantial accumulation. Most of these devices comprise a portable device having an arcuate row of steel teeth spaced along a support member and so positioned such that when the vessel is tilted to tap the charge, the mouth thereof will pass adjacent to the steel teeth which scrape the skull accumulation therefrom. Although such devices have met with some degree of success, there are still many problems associated therewith. For example, fragments of the skull frequently become lodged between the steel teeth and thus interfere with vessel clearance adjacent to the teeth. In many installations the scraping teeth and supporting structure are fixed to the charging floor structure which is independent of the vessel supporting structure. The downward thrust of the vessel against such devices will eventually damage the floor structure. The portable nature of some devices does not provide sufficient rigidity to be completely effective. Because of slight relative movement between the two supporting structures, proper clearance between vessel and scraping teeth is difficult to maintain. Still other problems are encountered when a skull or a portion thereof is so firmly “welded” to the vessel mouth that it is not readily dislodged. Forcing such a welded skull against the scraper teeth will often damage the vessel itself or the vessel tilting mechanism or break the vessel scraping teeth. Indeed, mechanical scrapers have been developed which incorporate automatic release mechanisms which will disengage the scraper teeth when the scraping forces thereagainst exceed a predetermined maximum value. Although such mechanisms have been successful in preventing damage to the scraper mechanism and more importantly in preventing damage to the vessel and vessel tilting mechanism, these scraping devices are complex and expensive, and indeed are not effective in removing such skulls or portions thereof which are firmly welded to the vessel mouth.

SUMMARY OF THE INVENTION

This invention is predicated upon our conception and development of a simplified but yet more effective means for scraping the mouth of a basic oxygen furnace to remove the skull therefrom.

An object of this invention is to provide a simplified and improved means for removing the skull and skull fragments from the mouth of a basic oxygen furnace which substantially overcomes the above disadvantages.

Another object of this invention is to provide an inexpensive means for removing the skull from a basic oxygen furnace which is secured to the furnace support columns to assure a positive interference to the skull without damage to the charging floor structure, and which lacks sufficient rigidity to damage the vessel or vessel tilting mechanism in the event a “welded” skull is encountered.

A further object of this invention is to provide a means for removing the skull from a basic oxygen furnace which can be utilized in a matter of seconds after each heat without loss of operating time and thereby preventing a build-up or accumulation of skulls that could become damaging when ultimately removed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational front view of a basic oxygen furnace incorporating the skull removing apparatus of this invention. The furnace vessel is shown in a semitilted position.

FIG. 2 is a sectional side view of the furnace and apparatus shown in FIG. 1.

FIG. 3 is an elevational side view of the screed bar retaining means taken along the line III—III of FIG. 2, and

FIG. 4 is a perspective view of the screed bar.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the drawings, particularly FIGS. 1 and 2, a conventional basic oxygen furnace is employed having a vessel 10 rotatably mounted at trunnions 12 between a pair of concrete support columns 14. Since basic oxygen furnaces are well known in the art, further details thereof are not necessary here.

The skull removing apparatus of this invention simply comprises an elongated steel screed bar 20 rigidly secured in a horizontal position to the concrete support columns 14. The screed bar 20 is positioned such that the opening or mouth of vessel 10 will just clear the bar 20 as vessel 10 is sufficiently rotated about trunnions 14 to dump the slag therein. The center part of screed bar 20 is bent arcuately away from vessel 10 to provide an arcuate contact surface so that a uniform clearance is maintained around the full circumference of the mouth on vessel 10 as vessel 10 is rotated past screed bar 20.

With reference to FIG. 3, screed bar 20 is rigidly held in place against the forward edge of concrete support columns 14 by a pair of U-brackets 22. In order to provide suitable adjustment of screed bar 20 relative to vessel 10, brackets 22 are substantially wider than necessary for retaining screed bar 20 alone. Accordingly, a plurality of plate shims 24 are inserted on both sides of screed bar 20 to fill the space between screed bar 20 and brackets 22. Screed bar 20 can therefore be ad-
justed towards or away from vessel 10 by merely re-
moving a suitable number of shims 24 from one side of
screed bar 20 and reinserting them on the other side of
bar 20. Shim pack cover plate (not shown) may be
employed to keep the shims in place.

In operation, vessel 10 is in the upright position while
the heat therein is being blown. When the heat is fin-
ished, the vessel 10 is first tilted in one direction to
draw the molten metal through a tap hole (not shown)
in the upper side thereof. After the metal has been
tapped, the vessel 10 is tilted in the opposite direction
to drain the slag therefrom through the mouth of vessel
10 and into a slag pot 26. It is during this slag draining
operation that the vessel mouth is cleaned by screed
bar 20.

At first glance, the skull removing apparatus of this
invention does not appear to differ significantly from
other prior art skull removing devices. Specifically, in
our apparatus as well as many other prior art devices,
skull removal is effected merely by rotating the vessel
to a point where the mouth thereof passes adjacent to
a screed member which scrapes or knocks the skull
therefrom. As noted previously, however, the prior art
has experienced considerable difficulty with such skull
removers, in that damage thereto, to the charging floor,
or to the vessel or vessel tilting mechanism, may result
if a skull is encountered which is not readily loosened
from the vessel. In view thereof, the prior art has di-
rected its attention to more complicated devices incor-
porating hydraulic or other automatic release systems
which when engaged the skull remover when the forces
thereagainst exceed predetermined limits. The fixed
skull removing apparatus of this invention provides the
same advantages without the complicated automatic
release mechanisms.

Specifically, the screed bar 20 of our invention is not
secured to the charging floor or floor structure, or to
any other relatively light structure which can be dam-
egaged. Rather, our screed bar 20 is secured to the con-
crete vessel support columns 14, which are quite mas-
sive and rigid and cannot therefore be damaged. Since
basic oxygen vessels are extremely heavy and rotatable,
the concrete support columns are necessarily massive
and rigid. Therefore, screed bar 20, which is rigidly
secured to such massive support columns will provide a
positive interference to any skull material on the mouth
of vessel 10.

In addition, the screed bar 20 of our apparatus is
rather long, and is rigidly supported only at the extreme
ends thereof. Therefore, screed bar 20 is somewhat
flexible to forces applied midway between the supports.
Therefore, should screed bar 20 encounter a skull or
skull fragment which is firmly welded to the mouth of
vessel 10, the screened bar 20 will be deflected away thus
avoiding damage to the vessel 10 or vessel tilting mech-
anism. Such a skull may be eventually loosened by re-
peated contact with screed bar 20. If not, then other
means must be employed to remove the skull. Never-
theless, since the skull build-up will most likely be
rather small, since the only accumulation will be that
resulting from one heat, any deflection of screed bar 20
will likely be within the elastic limits of the bar 20.
Therefore, if screed bar 20 is deflected by a "welded" 
skull, it will spring back to its original position once the
skull has passed. Even if the screed bar 20 is perma-
nently bent out of shape, it is easily repaired and re-
placed in comparison with damage repairs resulting
from prior art skull removing devices. Of most impor-
tance, however, is the fact that damage to the vessel 10
of vessel tilting mechanism is avoided, since the dam-
age, if any, is limited to the inexpensive screed bar 20.

Another advantage enjoyed by our inventive skull re-
moiver is that it is utilized after every heat without any
positive effort by the furnace personnel. That is to say,
the prior art skull removing devices have all been port-
table in nature requiring activation, i.e., swinging,pi-
voting or rolling it into operating position. Because of
this effort, the usual practice is to use the device only
after an appreciable amount of skull has been allowed
to accumulate. With our device, however, no effort is
required by the furnace personnel and it is necessarily
utilized after every single heat. This provides the addi-
tional advantage that the skull is not allowed to accu-
mulate, and hence only a small amount of skull mate-
rial is removed at a time. This serves to minimize the
possibility of damage to the screed bar 20.

To exemplify more specific details of this invention,
we have successfully employed the above described
embodiment on a 220 ton basic oxygen vessel using a
screed bar 20 measuring about 28 feet in length and
having a cross-section of 15 inches by 8 inches. The
centers of the bar supports, i.e., U-brackets 22, were 26
feet apart, and positioned to provide about 2 inches
clearance between the vessel mouth and bar 20. The
above dimensions do provide a good combination of
rigidity and flexibility. That is, the bar is sufficiently
rigid to remove ordinary skull accumulation without
difficulty, and yet sufficiently flexible that the bar will
be deflected, if a particularly tough skull is encoun-
tered, without damage to the vessel 10 or vessel tilting
mechanism.

For shims, we have provided four shim packs each
being 6 inches thick. The combination we have pre-
ferred is one 2 inch plate, two 1 inch plates, two ½ inch
plates and four ¼ inch plates. U-brackets 22 are there-
fore wide enough to accommodate two 6 inch shim
packs and the screed bar 20.

We claim:

1. In a basic oxygen furnace for making steel having
a vessel mounted to rotate on a horizontal axis between
a pair of concrete support columns, apparatus for
removing skulls from the mouth of said vessel comprising
an elongated screed bar mounted horizontally between
said concrete support columns and positioned close to
the path of the mouth of said vessel as said vessel is ro-
tated for deslagging after each heat, said screed bar
being supported only at the extreme ends thereof and
having a cross-section sufficient to provide flexibility so
that the screed bar is deflected without damage to the
vessel in the event a skull is not dislodged upon initial
contact.

2. An apparatus according to claim 1 in which the
center portion of said screed bar is bent arcuately away
from said vessel to provide an arcuate contact surface
so that a uniform clearance is maintained around the
full circumference of the vessel mouth.

3. An apparatus according to claim 1 in which the
ends of said screed bar are held in place by a pair of U-
brackets, said U-brackets being sufficiently oversized
to accommodate a plurality of shim plates in addition
to the screed bar 20 to provide adjustment for posi-
tioning said screed bar relative to said vessel.