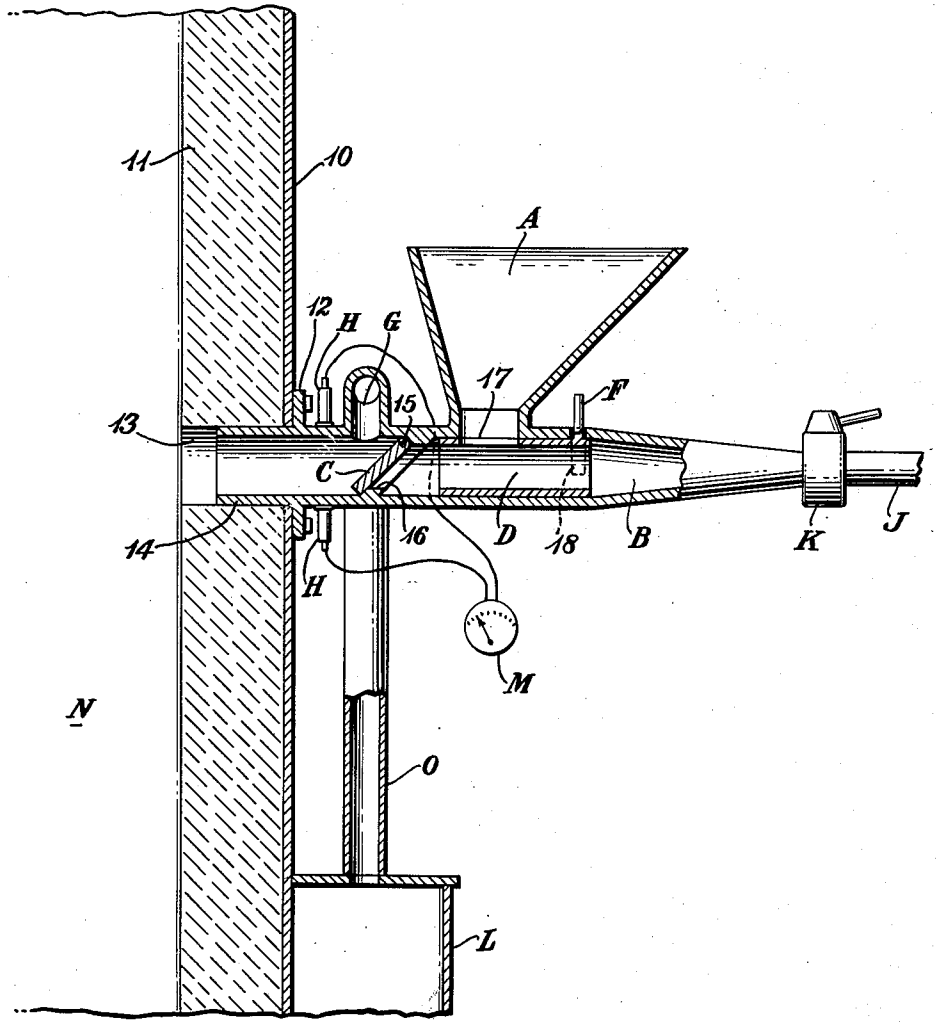
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APPARATUS FOR SHOOTING MATERIAL INTO CUPOLAS

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INVENTOR

Alfred Rexroth

BY Burns, Doane, Benedict & Irons

ATTORNEYS

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APPARATUS FOR SHOOTING MATERIAL INTO CUPOLAS

Alfred Rexroth, Eisenwerk, Lohr (Main), Germany

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This invention relates to an apparatus for injecting metal shavings, borings and the like into the melting zone of cupolas.

More particularly it relates to a pneumatically operated charging device for injecting scrap metal and/or other materials commonly used in foundry work, such as silica, calcium silicate, manganese, lime, etc. into the melting zone of a cupola or blast furnace.

Two types of injecting devices have been used heretofore. One type comprises a screw conveyor or a reciprocating piston for mechanically forcing or pushing the metal shavings or the like into the melting zone. This type of mechanism is subject to the disadvantage that the moving or sliding parts develop friction, and hence are subject to considerable wear, requiring frequent replacement. Furthermore, such apparatus is inclined to develop undesirable obstructions due to the mechanical pressure on the material being fed, thereby causing interruptions in the operation. This results in undesirable non-uniformity of results. Attempts have been made to press the scrap metal into briquettes before injection by this method but the results have not been satisfactory. The briquettes can be formed only under high pressure requiring heavy and expensive briquetting machinery so that any advantages realized in the injection operation, are more than offset.

A second type of charging device does away with some of the disadvantages attendant the use of mechanically moving parts, by using compressed air to force the material into the melting zone. The force imparted to the material in this way, however, is not sufficient to obtain good distribution of the material in the melting zone, or to prevent the formation of obstructions in the canal leading into the cupola. Another disadvantage arises from the chilling effect arising from blowing of cold air into the melting zone.

Both methods have the additional disadvantage that the melting of the injected material takes place in a very limited space adjacent the mouth of the lead-in canal. Slag on the furnace wall and the dripping of slag and iron at the inner end of the lead-in canal bring about disturbance of the injected charge, thus destroying the necessary evenness or uniformity of melting. For these reasons, only relatively small proportions of shavings, borings, etc. can be employed compared to the melting capacity of the cupola.

It is an object of the present invention to provide a pneumatically operated charging device which is economical of power, provides better distribution of the injected material in the melting zone and at the same time eliminates choking or slagging of the lead-in canal.

The accompanying drawing illustrates one embodiment of the present invention in side elevation, partly in section.

N represents the melting zone of the interior of a conventional cupola or blast furnace. The furnace has the usual metal shell **10** and lining **11**. The device of this invention is mounted by any suitable means on the shell **10**, for example, by flanges **12**. The cupola is equipped

with the usual tuyeres for introducing air, and with means for introducing the various materials to be charged, including coke. A passageway **13** is provided in the lining **11** to accommodate the lead-in pipe or canal **14** which may be of suitable heat resistant metal. The pipe **14** extends only part way through the brick work lining. The opening **13** comprises the remaining part of the canal through which material is injected into the melting zone. A check-valve C, hinged at **15**, is provided in the canal **14**. Valve C, which is inclined from top to bottom in the direction of the cupola may be spring loaded by suitable means, not shown, so that it is biased in normally closed position as shown, and rests against a seat **16**. According to the embodiment shown, valve C is biased to closed position by air pressure applied through the pipe G. The air is supplied under pressure from the duct L and the pipe O. The duct L may be the manifold for supplying air to the tuyeres at the base of the cupola. This air may be at the pressure at which the air supplied to the tuyeres of the cupola for effecting burning of the coke to furnish the heat for melting of the cupola charge. The pressure of the air being somewhat above that in the burning zone of the cupola opposite the lead-in canal, holds the valve C in normally closed position. The cold air also tends to cool inlet sleeve **14** and to prevent flame from entering the mouth of the lead-in canal. Cold air from any source may be employed provided the pressure is greater than that in the interior of the cupola. The quantity of air passing through the lead-in canal is comparatively small so that it has negligible adverse chilling effect upon the operation of the cupola. The charging chamber B is an extension of the lead-in pipe **14**. It is provided with a hopper A for intermittently filling the chamber B with the shavings, borings, or other suitable scrap metal of suitable size, which is to be injected into the cupola.

A rotatable sleeve D is provided with a slot or opening **17** which, when in loading position, is in register with the outlet of hopper A. The sleeve D is provided with a lever F which can be rotated around the axis of the pipe B so as to bring the opening **17** into or out of register with the outlet of hopper A. A slot **18** is cut part way around the wall of chamber B to permit the lever arm F to be rotated from the open position shown, to the closed position. A quick acting valve K is provided in the end of tube B remote from the cupola. This in turn is connected with a supply of compressed gas such as air, entering through pipe J. The valve K is designed for intermittent operation and may be manually or automatically controlled, as may the lever F. The compressed air is supplied at a substantially higher pressure than the air entering through pipe G, so that when it is turned on, the greater pressure will force the charge of scrap against valve C, and force it open.

A magnet H is interposed between the flange **12** and the valve C externally of the canal **14**. The poles of the magnet are attached to an electrical indicating device M. This may be a ring magnet, or two oppositely disposed magnetic devices. A magnetic field is set up across the lead-in canal **14**.

At the start of the operation, the valve C is held closed by the air pressure from the pipe G or by mechanical means such as a spring when this is used. The valve K is closed and the handle F of sleeve D is rotated to the position shown to bring the opening **17** into register with the outlet of feed hopper A. This causes the chamber B to be filled from the hopper with the turnings or other scrap metal or materials it is desired to inject. The handle F is then rotated so that the slot **17** is no longer in register with the hopper outlet and the chamber B are sealed from the hopper. Valve K is opened and the blast of compressed air striking the base of the material

in the chamber B forces it violently up against the valve C. Due to the sudden application of force, and the momentary resistance of valve C, the materials are compacted to a certain extent to form a cylindrically shaped slug before it swings open to permit the charge to pass into the cupola. Thus the metal strikes the melting zone as a more or less compact mass rather than as more or less individual pieces as in previous practice. In effect it is "shot" through the lead-in pipe 14 and the corresponding opening 13 in the brickwork wall, and thence into the melting zone of the cupola. Small pieces of coke, slag or the like which might lie in the mouth of the shooting canal are demolished and larger pieces are pushed aside by the rapidly moving slug so that the injected material penetrates deep into the interior of the cupola. Upon striking the bed of material in the melting zone, the slug breaks up into lumps or pieces which penetrate deep into the glowing coke bed. As they penetrate into the coke an immediate slagging of the individual pieces occurs, followed quickly by melting after two to five seconds. As a consequence, the injected charge is well distributed through the melting zone which results in even melting and a remarkable saving of coke.

Because of the good distribution and of the intermittent shooting, the material in a following shot never contacts partly melted material from a previous shot which would interrupt the continuity of the melting process.

As previously mentioned, other modifying materials commonly employed in cupola melting may be injected in the form of grains or shot, etc. with the scrap metal being charged. This furnishes a means for controlling the composition and quality of the melt. These include silica, calcium silicate, manganese, lime, etc. It may include coke-sand or metal shavings or borings mixed with oil, the latter being a preservative against iron-mould.

By equipping the cupola with several of these devices distributed around the melting zone, the entire metal charge may comprise the shavings, borings and the like, to be melted. The result is a new kind of work for cupolas.

When the slug of material passes through the magnetic field set up in canal 14 by the magnet H there is a change in the strength of the field which can be detected by the indicating device M. From the change in the magnetic field and the duration of the change, the approximate quantity of material introduced per shot can be determined. The indicating device M may also be a counter so that the number of charges introduced can be determined. It can also be determined whether material is being passed through the shooting pipe. This is useful in determining whether the supply from the hopper has failed, or an obstruction has developed in the shooting canal. A mechanically operated counting device actuated by the movement of the valve C may be provided.

Instead of using compressed air to force the charge into the cupola a charge of explosive material may be introduced into chamber B behind the material to be charged. When the propellant is exploded by appropriate means,

the resulting gases propel the slug of material into the cupola in a manner similar to shooting it from a gun. This has the advantage that no cold air reaches the melting zone when the charge is shot into it. Suitable propellants and means for introducing them into the chamber B will be apparent to one skilled in the art.

I claim as my invention:

1. An apparatus for injecting a material to be melted, such as metal shavings, borings and the like, into the melting zone of a cupola, blast furnace and the like, comprising a pipe forming a lead-in canal, a charging chamber, a check valve between said canal and said chamber, means biasing said valve into normally closed position; a hopper mounted on said charging chamber, valve means for intermittently opening and closing the hopper outlet whereby a charge of material to be melted can be introduced from said hopper into said charging chamber, means for intermittently supplying a propellant gas to apply sudden pressure to the end of said charge remote from said check valve, said pressure being substantially in excess of the closing forces exerted thereon, whereby said charge is compacted and propelled into said melting zone as a slug, and means for mounting said device with said pipe extending through the wall of said cupola or blast furnace in communication with the interior thereof.

2. The apparatus of claim 1 wherein said propelling means comprises means for intermittently supplying compressed gas to said chamber.

3. The apparatus of claim 1 wherein said check valve is maintained in closed position pneumatically.

4. The apparatus of claim 1 wherein the check valve is maintained in closed position by air pressure exerted on the face remote from the charging chamber, and the propelling means comprises means for intermittently supplying gas to said chamber at a pressure greater than valve-closing air pressure.

5. The apparatus of claim 1 wherein the propelling force on said charge is supplied by an explosive material.

6. The apparatus of claim 1 wherein the valving means between said chamber and said hopper comprises a rotatable sleeve provided with an opening in its wall, and with means to rotate said sleeve for bringing said opening into and out of register with the hopper outlet, thereby opening or closing said outlet.

7. The apparatus of claim 1 further characterized by means for setting up a magnetic field across said canal between said valve and the mounting means, and means for detecting the extent and duration of changes in the magnetic field due to the passage therethrough of a charge of material to be melted.

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