Sept. 9, 1941. J. F. CRAWFORD 2,255,379

FURNACE CHARGING MEANS

Filed Oct. 22, 1938 2 Sheets-Sheet 1

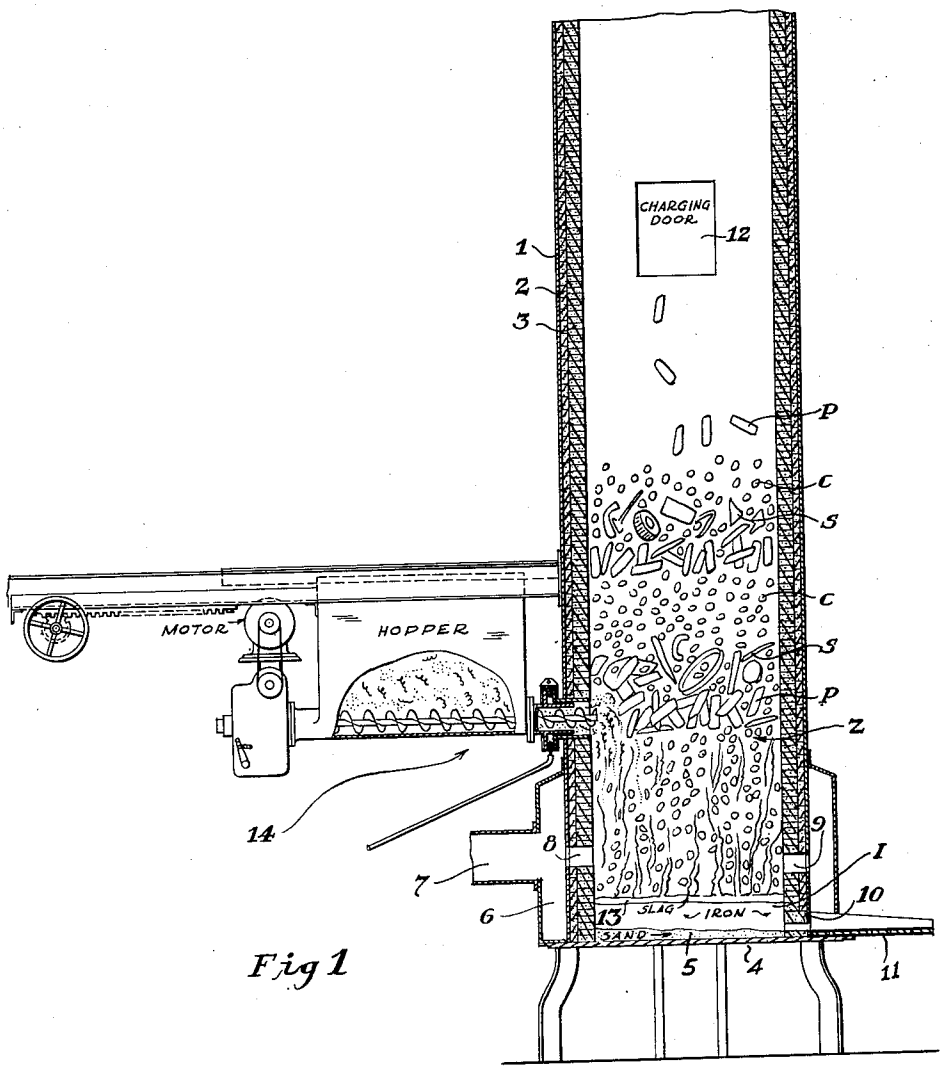


Fig 1

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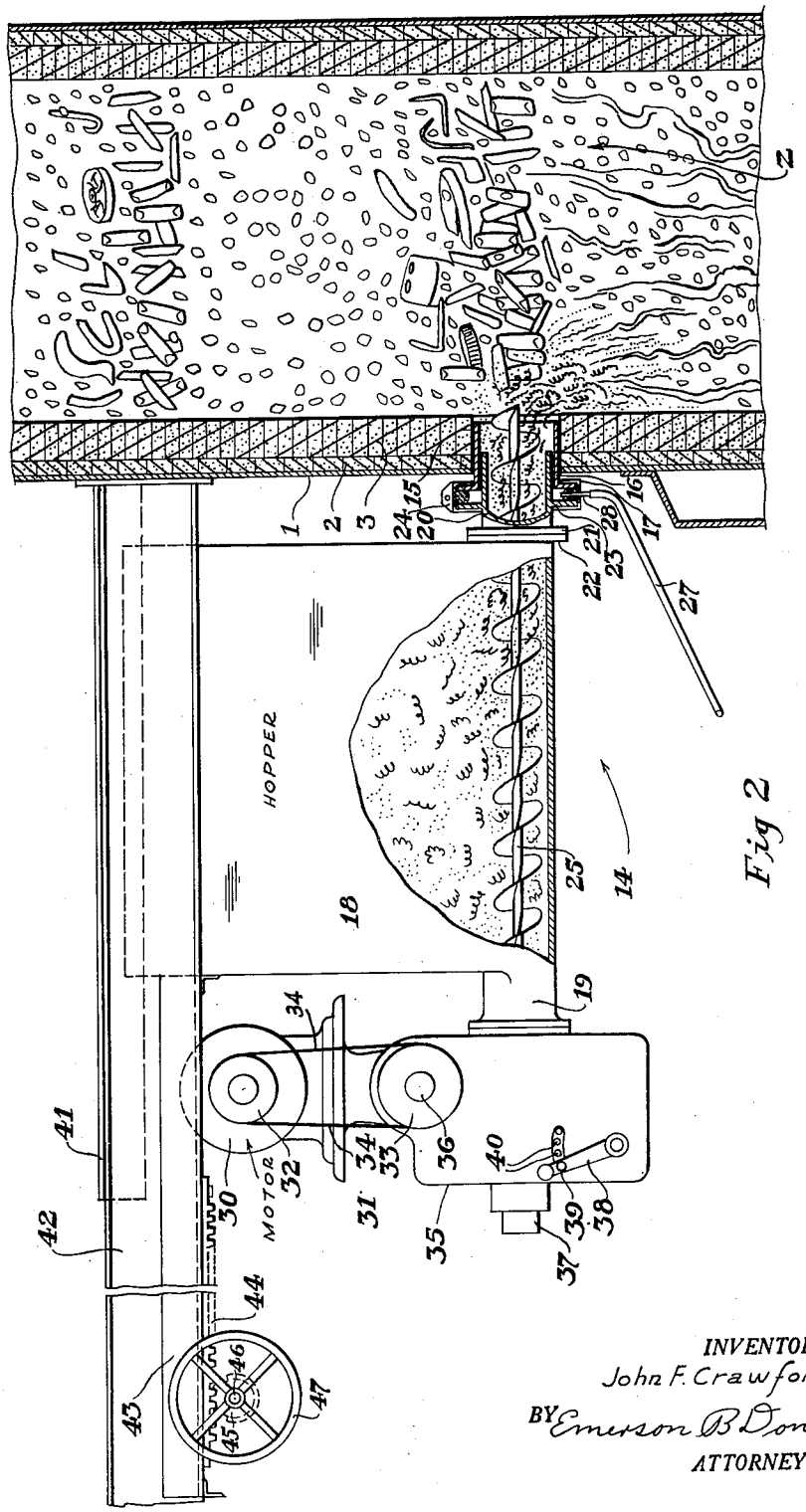


Fig 2

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FURNACE CHARGING MEANS

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21 Claims. (Cl. 266—27)

The present invention relates to cupolas, and an object of the invention is to generally improve the construction and operation thereof.

A further object is to provide novel mechanism for utilizing metal chips, shavings, fragments, etc., in a cupola whereby to avoid excessive loss of material by burning or oxidation.

A further object is to provide novel mechanism for quickly modifying the properties of the metal being discharged from the cupola.

Further objects and advantages of the invention will be apparent from the following description and accompanying drawings, in which:

Figure 1 is a vertical axial sectional view, with parts broken away, of a cupola embodying the invention, and operating according to the method.

Fig. 2 is a similar view, enlarged, of certain portions of the device indicated in Fig. 1.

In the operation of cupolas it has long been desirable to be able to utilize metal chips, turnings, fragments and the like as part of the charge to be melted, both for the purpose of utilizing the metal involved and also for modifying the properties of the metal discharged from the cupola. In the ordinary operation of the cupola however wherein alternate charges of coke and metal are introduced through a charging door high up in the furnace, the introduction of chips with the other metal is generally unsuccessful because the relatively small particles, when they reach the melting zone, are exposed to an oxidizing atmosphere and consequently they are to a large extent, if not entirely consumed. Furthermore such of the chips as are not consumed, being relatively much smaller than the other or ordinary contents of the cupola have a tendency to adhere together and arch or bridge across the furnace body and arrest the normal downward movement of the charge. In the present instance these difficulties are avoided by introducing the chips at a point remote from the charging door where conditions are normally favorable for the rapid melting of the chips and unfavorable for combustion thereof.

The novel method of operating the cupola accordingly comprises introducing the chips at a point well down in the body of incandescent coke, for example at about the point where the usual pig iron and scrap material is thoroughly heated and about to liquefy or possibly already partially liquefied. While it is not known exactly what the action may be at this point it appears that the partially liquefied metal may tend to take the chips and fragments into suspension and protect them from the oxygen in the combustion zone, heating them and melting them substantially instantly. On the other hand it is possible that the preponderance of carbon at a high temperature in this zone may have such an affinity for oxygen as to protect the chips therefrom, the effects being what might be expected if the chips were introduced into a reducing zone in the furnace.

In any event it appears that chips introduced at such a zone are substantially all melted and appear promptly in the accumulation of melted metal in the base of the furnace. This results in further possibilities in the operation of the cupola, particularly in the prompt and accurate control of the quality of the output. For example the composition of the metal in the chips is generally known and can be very accurately controlled, whereas the composition of the melted metal accumulating in the bottom of the cupola is apt to vary in accordance with the amount of carbon picked up from the coke in its descent through the furnace. If the composition of the metal discharging from the furnace is important and a test shows an excess of carbon, for example, according to prior practice more steel scrap low in carbon would be introduced through the charging door in the usual manner. A considerable time would then elapse before this change in proportion would make itself felt in the composition of the output. Then if it turned out that too much low carbon metal had been introduced, a similar delay would ensue before further correction could be accomplished.

In the practice of the present invention such a correction can be effected in a matter of a few minutes by simply increasing the rate of introduction of the chips, assuming a similar situation and that the chips are of low carbon material. This appears to be so because the chips melt immediately and promptly find their way to the accumulation of metal in the base. Of course if a test shows that the change in the chip feeding rate has been too small or too great, correction of this error can be made just as promptly. As a result it is a simple matter to hold the quality of the output metal very close to that desired, whereas in the past much greater fluctuations in the proportions of iron, steel, carbon, etc. have been necessarily tolerated.

As seen in Fig. 1 a typical arrangement for practicing the above disclosed method includes a furnace tube, body or casing 1 of the usual or suitable type having an insulating or other lining 2 and a refractory or heat resisting lining 3, the

casing having a floor 4 covered with a layer of sand or the like 5, a blast chamber 6 surrounding the casing at the lower end, the blast being supplied from a suitable source not shown through a duct 7 and passing into the furnace through openings or tuyères 8 and 9. An opening 10 is provided for drawing off the melted metal into a trough 11 and an opening or charging door 12 is provided relatively high up in the casing through which the fuel and metal are introduced.

In operation pig iron P, coke C and scrap S are introduced through the charging door 12 so as to produce alternate layers of metal and coke as shown, the material settling gradually as the coke is consumed and the metal melted, the metal reaching a temperature approximately at zone Z such that it becomes plastic and begins to melt and trickle down through the body of incandescent coke and accumulate at I on the sand floor 5, the fused ash from the coke, and other impurities, floating on the iron as a layer of slag 13.

The desirable point for introduction of the chips appears to be in the neighborhood of zone Z and accordingly injecting mechanism generally designated as 14 is arranged substantially at this point for introducing the chips.

As seen in Fig. 2 an opening 15 is provided through the casing 1 and linings 2 and 3 in which is fixed, in the present instance, a fitting 16, in the form of a sleeve which may have a flange 17 for a purpose to appear, the injecting mechanism operating through the sleeve.

Said injecting mechanism may be of any suitable or well known type capable of forcing granular or powdered material through sleeve 16, and it is to be understood that the invention is not to be taken as limited by the particular disclosed mechanism 14, or in fact in any manner except as defined by the claims. Mechanism 14 comprises a hopper or reservoir 18 having a trough or auger chamber 19 in the lower part thereof, and a delivery sleeve 20 arranged to be introduced into above mentioned sleeve 16, sleeve 20 for convenience having a flange 21 engaged with a flange 22 on the hopper whereby sleeve 20 may be readily removed and replaced. A flange 23 also on sleeve 20 approaches flange 17 on sleeve 16 when sleeves 16 and 20 are fitted together and a sealing ring, clamp or the like 24 is fitted about the flanges to make a fluid-tight connection. This is desirable because the pressure in the furnace due to the blast is considerably above atmospheric at this point and would otherwise cause leakage of objectionable amounts of gas and smoke into the building.

An auger 25 of suitable or well known form occupies auger chamber 19 and may advantageously extend through sleeve 20 into sleeve 16, substantially or entirely through the wall of the furnace. Rotation of the auger will accordingly feed chips from hopper 18 through the sleeves and into the furnace, the end of the auger being protected by the flow of relatively cool chips thereover from the heat of the charge in the cupola.

Difficulty may be experienced with gas and smoke backing up through the body of chips and sleeve 20 into the hopper 18, objectionable amounts issuing from the hopper. This is avoided by introducing, as for example by a hose 27, air or other unobjectionable fluid at a pressure higher than that obtaining in the furnace, through sealing ring 24, a spud 28 or the like extending through the wall of the ring, the fluid finding its way through a clearance space 29 to a point spaced materially back from the mouth of sleeve 16. The introduction of sufficient amounts of air, for example, at this point produces a flow of clean air in both directions from the mouth of sleeve 20, part of the air passing into the furnace and part of it passing backwardly into the hopper, the result being to completely prevent any flow of smoke backwardly along the auger.

Auger 25 may be driven in any suitable or well known manner, in the present instance, a motor 30 being carried on bracket 31 and driving, through pulleys 32 and 33 and a belt 34, a speed reducer generally designated as 35. Such reducers being well known and the particular type used being immaterial insofar as the operation of the rest of the device is concerned, it is not necessary to describe it further than to say that it has a shaft 36 driven by pulley 33 and which through internal mechanism drives an output shaft 37 at a reduced speed. Shaft 37 may be directly connected with auger 25 and operates at a large reduction in speed from shaft 36. The speed of shaft 37 may be variable if desired as by a lever 38 although this is not essential since other means is contemplated for controlling the amount of material fed. The lever may be locked in various positions by engagement of a detent 39 with one or another of sockets as 40. Other means is contemplated for locking the lever, or for varying the speed of the auger within the scope of the invention.

Since the cupola requires some time to reach operating temperature it is usually fired up with the injecting mechanism 14 retracted and sleeve 16 plugged with clay or the like. For convenience in so retracting the mechanism, hopper 18 is carried by means of a sliding member or trolley 41 engaged on a beam, track or the like 42 suitably supported as from casing 1 and for example part of the enclosing building in any well-known manner, member 41 being movable on beam 42 whereby hopper 18 and its attached parts may be readily moved away from casing 1.

Suitable means may be used for so moving hopper 18, in the present instance a bar 43 extending from the hopper in a direction away from the cupola. A rack 44 fixed with the bar engages a gear 45 on the shaft 46 suitably journaled in relation to the rack to provide proper interengagement between it and the gear, a hand wheel or other suitable means 47 being fixed with the shaft for rotating it and gear 45. By the use of hand wheel 47 mechanism 14 is readily moved toward or away from the cupola as desired.

The operation of the mechanism is thought to be clear from the above description, the cupola operating in the usual manner except that the chips or other fine material are introduced well below the surface of the charge in the zone Z where melting of the larger pieces of metal has already commenced, or where the chips will melt substantially as fast as they are introduced. This obviates any resistance on the part of the charge already in the furnace to the introduction of the chips and avoids the building up of pressure at the mouth of sleeve 16. The rate of introduction of the chips may be changed by controlling the speed of auger 25, as by lever 38, although other means are contemplated as equivalent. The injecting mechanism may be readily applied to or removed from the injecting opening by means of the gearing 44—45, and smoke and

objectionable gas are prevented from backing up through the body of chips by means of air pressure introduced through clearance space 29.

The above being a full and complete description of the novel method of operation of a cupola and typical mechanism for the practice of such method, what is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a cupola a body portion having side walls, a bottom for collecting melted metal, a blast opening above the bottom, a charging door above the blast opening, and means including an auger conveyor projecting into and beyond the wall of the body portion between the blast opening and the charging door arranged for injecting granular material into the body portion at a point where the charge is partly melted, whereby to melt the granular material before it can be destroyed by oxidation, means for supplying granular material to the auger, and power driven mechanism for driving the auger.

2. In a cupola a body portion having side walls, a bottom for collecting melted metal, a blast opening above the bottom, a charging door above the blast opening, said side walls providing an opening above the blast opening and below the charging door, and injecting mechanism including a hopper, an auger conveyor in the hopper including an enclosing sleeve projecting from the hopper, supporting means for the mechanism, and said mechanism being movably mounted on the supporting means said enclosing sleeve being adapted to be inserted in said opening between the blast opening and the charging door, and means for moving said mechanism on said supporting means for applying or removing said inclosing sleeve from said opening.

3. In a chip feeding means for a cupola means providing an opening through the wall of the cupola and injecting mechanism adapted to be applied to the opening for propelling chips through the opening into the cupola, and supporting means for the mechanism including a track and a trolley movable on the track and connected to support the mechanism.

4. In a cupola having a body portion including side walls, a bottom for collecting melted metal, a blast opening above the bottom, a charging door above the blast opening, said side walls providing an opening above the blast opening and below the charging door, an injecting mechanism including a hopper, an auger conveyor in the hopper including an auger and an enclosing sleeve projecting from the hopper and said auger projecting into and beyond the opening provided in the wall of the cupola.

5. In a cupola a body portion having side walls, a bottom for collecting melted metal, a blast opening above the bottom, a charging door above the blast opening, said side walls providing an opening above the blast opening and below the charging door, an injecting mechanism including an auger conveyor having an enclosing sleeve projecting into said opening and partly through said side walls, said auger extending into the opening substantially beyond the end of the sleeve.

6. In a cupola a body portion including side walls, a charging door high up in the body portion, and a blast opening near the bottom of said body portion, said body portion providing a passageway leading through the side walls between the charging door and blast opening, injecting means for introducing granulated material through the passageway into the contents of the body portion and including a delivery sleeve, and means for introducing a fluid under pressure into the body of granulated material in said delivery sleeve peripherally thereof at a point removed from that at which said passageway opens into the interior of the body portion of the cupola whereby to prevent seepage of gas from the cupola backwardly through the granulated material into the injecting means.

7. In a chip injecting means for a cupola a sleeve fixed in the side wall of the cupola and defining an opening through the wall, injecting mechanism adapted to introduce granular material into the opening for passage into the body of material in the cupola, and means for introducing fluid under pressure peripherally into the body of granular material between the inner and outer ends of the sleeve for preventing seepage of gas from the cupola backwardly through the body of granular material.

8. In a chip injecting means for a cupola a sleeve fixed in the side wall of the cupola and defining an opening therethrough, injecting mechanism for introducing granular material through the opening and including a sleeve extending into and partly through the first mentioned sleeve, there being clearance between said sleeves, and means for introducing fluid under pressure into the clearance space to prevent seepage of gas from the cupola backwardly through the body of granular material being introduced through the sleeves.

9. In a chip injecting means for a cupola a sleeve fixed in the side wall of the cupola and having an outer flange, mechanism for introducing granular material through the sleeve including a conveyor having a flange adapted to approach the first mentioned flange when the feeding means is in position at the opening, a sealing band engaging the margins of said flanges to prevent the escape of fluid therebetween, and a pipe arranged to introduce fluid between the flanges for preventing seepage of objectionable gases from the cupola backwardly into the body of granular material being introduced by the feeding means.

10. In a chip injecting means for a cupola a sleeve fixed in the side wall of the cupola and opening into the interior thereof, an auger conveyor included in the injecting mechanism and having an enclosing sleeve, said enclosing sleeve being inserted in the first mentioned sleeve with clearance and projecting partially therethrough to provide an annular passageway leading into the body of chips issuing from said auger conveyor, and means for introducing air under pressure into the clearance space between the sleeves for penetrating the body of chips beyond the enclosing sleeve for preventing filtration of objectionable gases from the cupola through the body of chips in the conveyor.

11. In a chip injecting means for a cupola a sleeve fixed in the side wall of the cupola and having an outer flange, an auger conveyor having an enclosing sleeve, said inclosing sleeve being adapted to be inserted in the first mentioned sleeve with clearance to provide a passageway extending longitudinally of the first mentioned sleeve and into the cupola, a flange on said enclosing sleeve adapted to approach the first mentioned flange but to be spaced therefrom when said sleeves are placed together, a sealing band engaging the margins of said flanges to prevent the escape of fluid therebetween, and means for

introducing a fluid under pressure into the space between said flanges.

12. In a cupola a body portion having side walls, a charging door high up in the side walls, a blast opening near the bottom of the body portion, said side walls providing an opening between the charging door and the blast opening, and means for injecting granular material through the opening including a conveyor projecting into the cupola beyond the side walls, means for driving the conveyor including power actuated mechanism, and means for selectively changing the rate at which the conveyor introduces material through the opening.

13. In a chip feeding means for a cupola, means providing an opening through the wall of the cupola and injecting mechanism adapted to be applied to the opening for propelling chips therethrough, and into the cupola, and means for supporting the mechanism for movement toward and away from the opening whereby said injecting mechanism may be applied to the opening when desired, and readily removed from the cupola when not in use.

14. In a cupola a body portion having side walls, a bottom for collecting melted metal, a blast opening above the bottom, a charging door above the blast opening, said side walls providing an opening above the blast opening and below the charging door, and injecting mechanism including an auger conveyor, an enclosing sleeve for the conveyor and supporting means for the mechanism, and said mechanism being movably mounted on the supporting means, said enclosing sleeve being adapted to be inserted in said opening between the blast opening and the charging door, and means for moving said mechanism on said supporting means for applying or removing said enclosing sleeve from said opening.

15. In a cupola a body portion having side walls, a bottom for collecting melted metal, a blast opening above the bottom, a charging door above the blast opening, said side walls providing an opening above the blast opening and below the charging door, injecting mechanism including a hopper, a conveyor in the hopper including an enclosing sleeve projecting from the hopper, supporting means for the mechanism and said mechanism being movably mounted on the supporting means, said enclosing sleeve being adapted to be inserted in said opening between the blast opening and the charging door, and means for moving said mechanism on said supporting means for applying or removing said enclosing sleeve from said opening.

16. In a cupola, a body portion having side walls, a bottom for collecting melted metal, a blast opening above the bottom, a charging door above the blast opening, said side walls providing an opening above the blast opening and below the charging door, and injecting mechanism including a hopper, an auger conveyor in the hopper, supporting means for the mechanism and said mechanism being movably mounted on the supporting means, said conveyor being adapted to be inserted in said opening between the blast opening and the charging door, and means for moving said mechanism on said supporting means for applying or removing said conveyor from said opening.

17. In cupola, a body portion having side walls, a bottom for collecting melted metal, a blast opening above the bottom, a charging door above the blast opening, said side walls providing an opening above the blast opening and below the charging door, and injecting mechanism including a hopper, an auger conveyor in the hopper including an auger having an enclosing sleeve and projecting from the hopper, supporting means for the mechanism and said mechanism being movably mounted on the supporting means, said conveyor being adapted to be inserted in said opening between the blast opening and the charging door, and means for moving said mechanism on said supporting means for applying or removing said conveyor from said opening.

18. In a cupola, a body portion having side walls, a bottom for collecting melted metal, a blast opening above the bottom, a charging door above the blast opening, said side walls providing an opening above the blast opening and below the charging door, and injecting mechanism including a hopper, an auger conveyor in the hopper including an enclosing sleeve projecting from the hopper, supporting means for the mechanism, and said mechanism being movably mounted on the supporting means, said conveyor being adapted to be inserted in said opening between the blast opening and the charging door, and means for moving said mechanism on said supporting means for applying or removing said conveyor from said opening.

19. In a cupola, a body portion having side walls, a bottom for collecting melted metal, a blast opening above the bottom, a charging door above the blast opening, said side walls providing an opening above the blast opening and below the charging door, and injecting mechanism including a hopper, an auger conveyor in the hopper including an enclosing sleeve projecting from the hopper, supporting means for the mechanism and said mechanism being movably mounted on the supporting means, and said enclosing sleeve being adapted to be inserted in said opening between the blast opening and the charging door.

20. In a cupola, a body portion having side walls, a bottom for collecting melted metal, a blast opening above the bottom, a charging door above the blast opening, said side walls providing an opening above the blast opening and below the charging door, and located substantially at a level where the usual metal charge is partly melted, an injecting mechanism including a conveyor having an enclosing sleeve projecting into said opening and partly through said side walls, and said conveyor extending into the opening substantially beyond the end of the sleeve for acting on material being injected at a region beyond the end of the enclosing sleeve.

21. In a cupola a body portion having side walls, a bottom for collecting melted metal, a blast opening above the bottom, a charging door above the blast opening, said side walls providing an opening above the blast opening and below the charging door, an injecting mechanism including auger conveyor means having an enclosing sleeve projecting into said opening and partly through said side walls, said auger conveyor means extending into the opening substantially beyond the end of the sleeve, and supporting means for the mechanism including a track and a trolley movable on the track and connected to support the mechanism.

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