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(71) Applicant: **ROAM 2000 S.r.L.**
74100 Taranto TA (IT)

(72) Inventor: **Chiffi, Cosimo**
74100 Taranto (IT)

(74) Representative: **Ponzellini, Gianmarco et al**
Bugnion S.p.A.
Viale Lancetti 17
20158 Milano (IT)

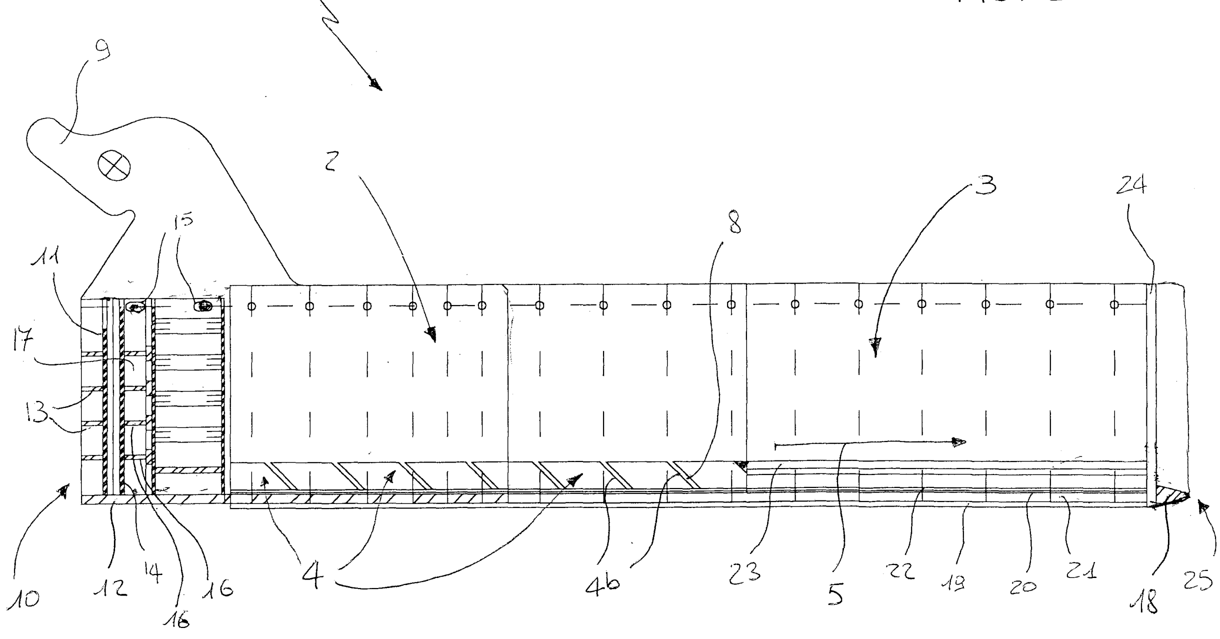
(54) Distributing chute particularly for blast furnaces

(57) It is disclosed a rotating chute for distribution of the charge in blast furnaces in which a first portion (2) defining an impact region of the feed material has a plurality of box-shaped modules (4) to retain part of the feed material and reduce problems connected with wear.

A second portion (3) defining a sliding region for the feed material has a reinforced structure in section consisting of an outer load bearing shell (19), a first reinforcing shell (20) disposed internally of the preceding one, a second reinforcing shell (22) extending longitudinally as far as the impact region and finally a wear-resistant wall secured to the second reinforcing shell (22). The structure appears to be monolithic and cell-like and, due to an engagement system by mechanical fitting with subsequent welding, use of bolting operations can be avoided, the structure appearing mechanically more resistant.

The conceived distributing chute further has a particular rear closing structure (10) and a protection body (18) disposed at the front to shield the chute plates from flames.

FIG. 1



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Description

[0001] The present invention relates to a rotating chute for distribution of the charge, particularly for blast furnaces, to be used in furnaces devoid of a bell and hopper feeding system.

[0002] It is known that presently designed and used are rotating chutes for feeding of blast furnaces which are adapted to enable a suitable wall distribution of the charge in the blast furnace. These types of chutes are susceptible of being supported in a sloping configuration by means of suitable mechanical structures capable of setting in rotation the chute itself through 360°. The chute generally has a semicircular or rectangular structure in section and is defined by a first impact surface receiving the charge falling down from top and by a second sliding surface consecutive to the preceding one, enabling the charge to slide and be directed against the blast furnace wall at a suitable speed.

[0003] In other words, the suspended chute driven in rotation receives the charge consisting of pellets, iron ore and scraps on a surface thereof and directs it at a suitable speed towards the furnace wall so as to conveniently and homogeneously feed said furnace.

[0004] It is well apparent that the problems existing in these rotating chutes are essentially connected with the severe use conditions to which the devices themselves are submitted. In fact, these rotating chutes for blast furnaces work close to the inlet throats of the blast furnace and therefore are first of all subjected to very high temperatures and high thermal shocks systematically damaging the structure of same.

[0005] Due to the scarcity of coke and the great increase in the price of same, the persons in charge for blast furnace processes all over the world have been forced to change the work conditions, which has given rise to an important increase in the operating temperatures (even beyond 1000°C) at the level of the furnace throat.

[0006] This temperature increases greatly condition the "rotating distributing chute" as well, which chute is the structure through which million of tons of ores for pig iron production are distributed in the furnace.

[0007] A constant chute efficiency is of the greatest importance for good operation of the blast furnace. The rotating chutes presently built in the world consist of a series of individual elements (divided into structural elements and wear-resistant elements) connected to each other by a series of bolts. Said bolts, submitted to continuous thermal shocks, tend to break and the individual elements are subjected to deformation giving rise to the following problems:

1. Separation and consequent loss of the whole distributing casing from the hooking/hanging structure, the so-called "hooking ears". This dangerous event that actually stops operation of the furnace, has already occurred in different blast furnaces in the world.
2. Deformation of the distributing casing, which adversely affects the charge distribution in the furnace and therefore also operation of same.
3. Deformation and/or separation of the rear "closing plug" of the casing and, as a result, loss of part of the charge at a region not intended for the purpose;
4. Deformation and burning of the outer coating made of stainless steel which is used to insulate the chute.

[0008] Due to its deformation, said coating can become curved within the chute, thus altering the charge distribution in the furnace in addition to extending the dismantling time of the latter.

[0009] Therefore the charge to be distributed, in particular where it mainly consists of iron ores and agglomerates, heavily affects the chute structure, so that said chute is worn out and damaged rather quickly.

[0010] In order to solve the serious inconveniences highlighted above rotating chutes of rectangular or semicircular sections have been widely spread in which the main shell defining the load bearing structure of the chute has been externally coated with a plurality of sheet metals partly overlapping each other and spaced apart from the main shell so as to reduce the heat amount acting on the inner shell thereby creating a suitable insulating region for the chute.

[0011] Therefore, in order to avoid damages to the impact region receiving the feed material, rotating chutes have been widely used which have suitable emerging transverse metal plates in the material-receiving region, which metal plates are such disposed as to retain part of the material itself; therefore, the subsequent charge impacts on the previously retained material and not directly on the chute structure. In this way, an increase in the strength of this region occurs through exploitation of the "material against material" principle.

[0012] While these types of rotating chutes are presently widespread, they however are unable to reach an operating lifetime exceeding some months, except for some rare and exceptional occasions.

[0013] Accordingly, the present invention aims at substantially obviating the above mentioned drawbacks.

[0014] It is a main object of the invention to increase the operating life of a rotating chute as much as possible, making it more resistant to temperature and thermal shocks, more resistant to wear mainly resulting from the material falling down, and also giving said chute a greater structural stiffness involving less deformations in use as regards the parts constituting the chute itself.

[0015] It is to be pointed out that the above mentioned aims are achieved without an important increase in the amount of the material used in the different components (i.e. while maintaining a weight comparable with that of the chutes in use) and without any radical modification to the geometry and/or structure of the chute to maintain the possibility of using the mechanical structures already present in blast furnaces which are designed to stop and drive in rotation the presently existing chutes.

[0016] It is a further object of the invention to improve the resistance to wear of the impact region of the chute so as to surely prevent the same from being perforated by the charge being distributed.

[0017] Additional aims of the invention consist in improving the chute resistance in particular to temperatures and mechanical shocks at the rear portion of the chute itself, by a new planning of the closing structure; it is also an object of the invention to improve the structural resistance of the whole apparatus by suitably combining protection elements and stiffening elements with each other.

[0018] It is an auxiliary aim of the invention to improve the resistance to temperature and thermal shocks at the delivery throat by in particular preventing the flames from directly entering the gaps between the metal plates thereby avoiding deformation of the latter.

[0019] It is a final aim of the invention to enable the rotating chute to be used in blast furnaces with operating temperatures higher than those adopted in the past.

[0020] To solve all problems caused by the rotating chutes hitherto used, as above described, a new chute has been conceived wherein all components, both structural and wear-resistant components, through an engagement system by "mechanical fittings" further welded together, form a single and monolithic cell-like structure making the whole chute particularly suitable to successfully tackle possible further temperature increases in any type of blast furnace.

[0021] By an innovative solution all bolts that are determinant and indispensable in traditional chutes become quite unnecessary or in any case of secondary importance.

[0022] The foregoing and further objects and aims, that will become more apparent in the course of the present description are substantially achieved by a distributing chute in accordance with the features recited in the appended claims.

[0023] Further features and advantages will be best clarified in the detailed description of a preferred but not exclusive embodiment of a rotating distributing chute in accordance with the present invention. This description will be carried out hereinafter with reference to the accompanying drawings, given by way of non-limiting example, in which:

- Fig. 1 is a sectional side view of the distributing chute in accordance with the invention;
- Fig. 2 is a top view of the chute seen in Fig. 1;
- Fig. 3 is an enlarged view of a box-shaped module used in the chute referred to in Figs. 1 and 2;
- Fig. 4 is a side view of the chute seen in Fig. 1; and
- Fig. 5 shows a rear portion of the chute seen in Fig. 4.

[0024] With reference to the accompanying drawings, a rotating chute for distribution of feed material in particular for blast furnaces has been generally identified by reference numeral 1.

[0025] As already pointed out, the rotating distributing chute for blast furnaces being the object of the invention is intended for use in installations in which a bell and hopper feeding system is not present; in more detail the same is hanging, by grip means 9, from a suitably sized mechanical structure that is able to set the chute itself in rotation through 360° so that the charge necessary for operation of the blast furnace can be distributed within the latter in the most suitable, homogeneous and regular manner.

[0026] In this connection it is to be pointed out that the grip means 9 is defined by tailpieces emerging from the upper part of the chute body and such sized as to be able to support the weight thereof and bear the efforts connected with the operations for the charge distribution and chute movement. In particular these tailpieces shown in Figs. 1, 4 and 5 are defined "ears" in technical jargon.

[0027] In detail, it is to be pointed out that the blast furnace charge, generally consisting of pellets, iron ores and agglomerates and also scraps, is caused to fall close to a first portion 2 of the chute defining an impact region for the feed material; the charge itself must then run therefrom along smooth walls so that it reaches the suitable speed for distribution on the furnace wall.

[0028] To this aim in fact a second portion 3 (consecutive to the preceding one) is present which defines a sliding region for the feed material. In other words, the rotating chute keeps in a hanging condition by means of the mechanical structure with some inclination within the upper region of the blast furnace; the material is caused to fall close to the impact region 2 where there is the presence of a plurality of box-shaped modules 4 which are positioned adjacent to at least part of this region (and in particular the whole region) in order to retain part of the feed material.

[0029] It is in fact apparent that falling of the charge greatly damages the chute and therefore the impact region needs to be protected as much as possible. To this aim in the present invention use of said box-shaped modules 4 diagrammatically shown in Fig. 3 has been adopted.

[0030] First of all it will be appreciated that said modules have a substantially rectangular plan configuration (see Fig. 2) defined by four side walls 4a, 4b transversely emerging from a bottom 7 of the module.

[0031] The box-shaped modules 4 have double side walls 4a and 4b on each side emerging from the bottom (as viewed from Fig. 3) and in particular the innermost wall 6 is generally made of wear-resistant material; obviously, these box-shaped modules can also be made up of a single wall of wear-resistant material for each side.

[0032] From a geometrical point of view and as clearly shown in Fig. 1, at least two of said side walls 4b are inclined to a plane of the impact region 2 and said inclination is directed opposite to a sliding direction 5 of the material being fed to the blast furnace.

[0033] This configuration is justified by the fact that the chute is inclined during the steps of charging the blast furnace and by the fact that these box-shaped modules are set to retain part of the feed material.

[0034] In fact, by operating in this way the material being dropped impacts on pellets, iron ores and scraps retained by the box-shaped modules, thereby greatly reducing damage to the impact region of the chute itself.

[0035] In other words, since the new material falls on the retained material, the wear and mechanical shock effects can be greatly reduced, which will increase the operating life of the chute.

[0036] The side walls 4b are inclined by an angle included between 10 and 80 degrees, preferably included between 30 and 60 degrees and of 45° in the embodiment shown.

[0037] Still from a structural point of view it is possible to see that the box-shaped modules 4 have a bottom 7 generally also made of wear-resistant material and raised with respect to the plane of the impact region 2.

[0038] Use of at least another bottom (actually use of two or more bottoms could be conceived) enables the period of use of the rotating chute to be further increased because the material being dropped could damage and perforate the bottom wall 7, finding however another support consisting of the load bearing structure of the chute itself.

[0039] As compared with the chutes of the known art, the above characteristic enables the strength and operating life of the chute to be increased once again.

[0040] The box-shaped modules 4 are separated and independent of each other; in fact each of them has its own side walls independent of those of the adjacent module.

[0041] In the detail in Fig. 2 it is possible to see that the modules are disposed in a predetermined number of transverse rows preferably orthogonal to the sliding direction 5 of the feed material and in particular the modules of intermediate rows are disposed laterally offset relative to those of the immediately preceding and immediately following rows.

[0042] Obviously, but not necessarily, the box-shaped modules 4 are identical with each other; in addition the same are spaced from the adjacent modules defining collecting/passage routes 8 for the feed material.

[0043] It is to be pointed out that the particular structure and geometry of the box-shaped modules 4 causes the solid space/void space ratio (i.e. the ratio between the regions where the surfaces of the side walls of the box-shaped modules are present - solid spaces - and the "hollow" regions defined between the side walls of the same box-shaped modules - void spaces) to be very balanced and of such a nature that even if the whole impact region 2 and sliding region 3 were defined by the presence of these box-shaped elements it would be possible to obtain a ratio practically identical with that of the chutes in accordance with the known art provided with a pocket impact region and a perfectly smooth sliding region.

[0044] In other words, a chute having box-shaped elements 4 over the whole extension thereof (impact region 2 and sliding region 3) would in any case enable the material to reach the necessary and correct speed at the chute exit, with the advantage of greatly increasing the operating life of the sliding region 3 as well. This means that also part or all of the sliding region 3 can be conceived to have a configuration contemplating box-shaped modules.

[0045] It will be further appreciated that the chute can also optionally comprise an upper conveying pipe 30 (Figs. 4 and 5) useful to convey the furnace charge to the furnace centre, when the chute is in the most sloping positions, for example. It aims at preventing the material from jutting out of the chute sides and can possibly be displaced longitudinally on the chute structure depending on the operating requirements.

[0046] In the rear region of the chute, i.e. the region close to the grip means 9, there is the presence of a closing structure 10 consisting of at least one first wall 11 transverse to the bottom and the side walls of the chute (in detail orthogonal thereto) which is rigidly fastened to the load bearing structure of the chute at a rearward position relative to the end portion of the load bearing body 12 (as shown in Figs. 1 and 2).

[0047] The fixed wall 11 also has a predetermined number of stiffening ribs disposed on and welded to the outer surface thereof so as to help in stiffening the closing structure 10 itself.

[0048] Obviously the number and sizes of these ribs 13 can be established at will depending on the design requirements.

[0049] Then, a second wall 14 is also present, said wall too being transverse to the bottom and generally parallel to the fixed wall 11 although spaced apart therefrom so as to define a gap susceptible of being possibly filled with refractory material. This second wall 14 is fastened to the load bearing body 12 as well, but in an at least partly movable manner. In particular, the wall mobility is in a translation direction substantially parallel to the sliding direction 5 of the feed material.

[0050] In detail, a plurality of fastening slots 15 with their bigger diameters disposed horizontally as in the example in Fig. 1 are present and they enable a relative mobility between the load bearing body of the chute and the second wall 14. This mobility can for example be utilised to enable better absorption of the impact energy of the charge on the chute itself; in fact, this movable wall can dissipate part of the energy transmitted from the feed material falling down and impacting thereon by friction.

[0051] It is also to be noted that the second wall 14 is further provided with a predetermined number of beams of substantially T-shaped section 16 emerging from the inner surface of the wall 14 and defining an insulating gap 17 that can possibly be fully or partly filled with further refractory material, such as ceramic fibre or the like (see Fig. 1).

[0052] Further T-shaped structures are also disposed close to an extension of this second transverse wall 14 thereby emerging both from the side walls and the lower wall of the chute itself.

[0053] The rotating chute being the object of the particular embodiment shown has a cross section of the rear portion of semicircular shape and on the contrary, a cross section of the front portion of rectangular shape, suitable connections obtained by means of straightened out plates being present between the two sections.

[0054] Obviously, manufacture of a chute of a different shape from the described one can be provided, a fully rectangular or fully semicircular chute or a chute with different combination of sections.

[0055] On examining the outer structure of the chute, the following is to be pointed out.

[0056] The structure of the inventive chute appears to be greatly stiffened and improved as compared with chutes manufactured in accordance with the known art.

[0057] First of all, moving from the outside to the inside of the chute, there is the presence of an outer load bearing shell 19 made of steel of suitable features with sizes and thickness of about 16 mm. A first reinforcing shell 20 having a smaller thickness than the preceding one is disposed internally of said outer monolithic load bearing shell. This second shell as well is monolithic.

[0058] The two above mentioned structures are made integral with each other by a plurality of longitudinal and transverse ribs 31 (shown in Fig. 5) interposed therebetween so as to define a sandwich structure that is very rigid also in case of torsional stresses.

[0059] In particular the ribs 31 are mechanically engaged in respective seats present in the outer load bearing shell 19 so as to form a single monolithic rigid cell-like structure with the reinforcing shell 20. Said ribs 31 can be further welded to the structure to give the latter more strength.

[0060] The gap 21 that is defined between the outer load bearing shell 19 and first reinforcing shell 20 can also house suitable insulating and refractory material.

[0061] Then a second reinforcing shell 22 is also present (made of special steel with a thickness of 8 mm, for example) and it is disposed internally of and secured to the first reinforcing shell 20 (by frontal welding, for example, although any other suitable connecting system can be obviously utilised).

[0062] The second reinforcing shell 22 is monolithic too and extends transversely over the whole sliding region 3 until the impact region 2 so as to give further stiffness and strength to the chute.

[0063] In detail it is to be noted that the previously described box-shaped modules 4 are secured by welding to said second reinforcing shell 22.

[0064] Three wear-resistant walls are usually engaged internally of said second reinforcing shell 22 (and at the sliding region); said walls are assembled beforehand being secured to each other to form a U-shaped section and then are made integral with the previously described monolithic structure.

[0065] These tree walls appear to be very smooth and made of wear-resistant material to enable sliding of the feed material that in this manner can reach the appropriate speeds and be distributed on the wall in an optimal manner.

[0066] The material-delivering front region 25 is suitably sealed by a closing plug concealing the gaps present between the load bearing shell, first and second reinforcing shells and wear-resistant walls. This plug is denoted at 24 in Figs. 1 and 2.

[0067] Further to be noticed is the presence of a protection body 18 disposed at the perimeter of the exit portion, being engaged with and projecting from the closing plug 24.

[0068] This protection body 18 has the function of shielding the chute plates from fire, deviating the flames and increasing the resistance to temperature of said chute. In fact (due to the presence of this element), no flames can enter the gaps between the plates giving rise to deformation and damages.

[0069] The protection body 18 can be internally hollow or filled with refractory material and has the tapering shape shown in the accompanying figures exactly to suitably deviate the flames bursting out of the blast furnace. As can be viewed, said body is disposed at a lower position relative to the plane defined by the sliding region 3 in order to enable the material to be discharged without getting into contact therewith.

[0070] In other words, the material moving at high speed jumps over the protection body 18 without causing, by its passage, damages or wear thereto, so that said body can have a longer operating life.

[0071] The invention achieves important advantages.

[0072] It will be recognised first of all that the chute in accordance with the invention has a much stiffer structure than the chutes in accordance with the known art.

[0073] The presence of different monolithic U-shaped structures or shells rigidly connected to each other and defining a sandwich structure greatly improves the torsional stiffness in addition to increasing the resistance to temperature. In particular, conversion of the load bearing shell made of stainless steel from a single-wall system to a sandwich system made up of two walls of stainless steel connected to each other by a "cell-like frame" is one of the many distinctive characters of the system.

[0074] The presence of a plate of greater thickness at the outside prevents important deformations of the inner sheet metal that will bring about damages to the inner chute structures (which happens in the prior art where the outer sheet metal is subjected to deformation due to thermal shocks and heat thereby damaging the inner duct).

[0075] The protection body 18 protects the feed-material exit portion which is one of the most delicate regions of the rotating chute. In addition, the new structure with a rear closure can be more hardly reached by flames and is more resistant to temperatures and mechanical stresses caused by the feed charge, due to the presence of two walls one of which is movable.

[0076] In fact, conversion of the rear containment wall of the chute earlier having a mere and passive charge-containing function (which in any case was systematically destroyed by the high temperatures) into two containment walls, a fixed one and a movable one, prevents occurrence of three serious phenomena:

a) falling of the "cylindrical duct" that is over the chute, into the chute itself;
b) damages to the expensive gearcase that is necessary to regulate rotation and oscillation of the chute;
c) deformation of the "seating" on which the whole chute structure is bolted.

[0077] Not to be forgotten is the presence of the box-shaped modules enabling the material to fall onto other material which will ensure a better strength to the chute. In addition the possibility of unifying, within the chute, the so-called impact and sliding regions into a single system consisting of a series of wear-resistant chambers disposed in the optimal configuration defined as "honey-comb structure" gives the invention further advantageous aspects.

[0078] In this way, due to a very balanced solid space/void space ratio (practically identical with that of chutes in which there is a pocket impact region and a smooth sliding region) the following advantages are achieved:

a) exploitation of the "material onto material" principle not only in the impact region, but also over the whole chute surface, with optimal benefits in terms of duration of same, also because each cell consisting of four wear-resistant walls, can internally have one or more wear-resistant shelves;
b) reduction of the so-called "segregation" of the charge in the furnace. This is obtained because the material finds a homogeneous impact and sliding surface and therefore does not "wobble" during distribution in the furnace.

[0079] At all events, depending on the specific requirements of each individual customer, it is possible to introduce into the chute, regions in which the cells while maintaining their wear-resistant shape and structure, can have a further "smooth wall" at the top which is always made of bimetallic wear-resistant material.

[0080] In addition, the double bottom wall greatly improves the residual life of the installation as compared with all presently known and marketed types. In other words, the set of the modifications carried out in the present invention surely enables the mechanical and structural strength of the chute to be increased as well as resistance to temperature and wear.

Claims

1. A chute for distribution of feed material, particularly for blast furnaces, comprising:

   - a first portion (2) defining an impact region for said feed material;
   - a second portion (3) defining a sliding region for said feed material;
   - a plurality of box-shaped modules (4) positioned close to at least part of the impact region (2) to retain the feed material, **characterised in that** it further comprises an outer load bearing shell (19) and a first reinforcing shell (20) disposed internally of the preceding one; and
   - a plurality of longitudinal and transverse ribs (31) fastened between the outer load bearing shell (19) and the first reinforcing shell (20) to define a sandwich structure.

2. A chute as claimed in claim 1, **characterised in that** the load bearing shell (19) has a greater thickness than the first inner reinforcing shell (20), the gap (21) between the outer load bearing shell (19) and first reinforcing shell (20) being preferably filled with refractory material.

3. A chute as claimed in claim 2, **characterised in that** the second portion (3) further comprises a second reinforcing shell (22) which is disposed internally and is secured to the first reinforcing shell (20), the second reinforcing shell (22) extending longitudinally as far as the impact region (2), said box-shaped modules (4) being in particular secured to said second reinforcing shell (22).

4. A chute as claimed in claim 3, **characterised in that** the second portion (3) further comprises at least three wear-resistant walls (23) connected to each other to form a U-shaped section, said three walls (23) being internally secured to said second reinforcing shell (22) and having a smooth extension to enable sliding of the feed material.

5. A chute as claimed in the preceding claim **characterised in that** the second portion (3) comprises a closing plug (24) designed to seal at the front the gaps present between the load bearing shell (19), first and second reinforcing shells (20 and 22) and wear-resistant walls (23).

6. A chute as claimed in anyone of the preceding claims, **characterised in that** the box-shaped modules (4) have a substantially rectangular plan configuration defined by four side walls (4a, 4b) transversely emerging from a bottom of the module.

7. A chute as claimed in anyone of the preceding

claims, **characterised in that** the box-shaped modules (4) comprise at least one bottom (7), preferably of wear-resistant material, that is raised relative to the plane of the impact region (2).

8. A chute as claimed in anyone of the preceding claims, **characterised in that** the box-shaped modules (4) are separated and independent of each other, each of them having its own side walls (4a, 4b) independent of those of the adjacent module.

9. A chute as claimed in anyone of the preceding claims, **characterised in that** the box-shaped modules (4) are disposed in a predetermined number of transverse rows that are preferably orthogonal to a sliding direction (5) of the feed material, the modules (4) of intermediate rows being for example disposed laterally offset relative to those of the immediately preceding or immediately following row.

10. A chute as claimed in claim 6, **characterised in that** the box-shaped modules (4) are provided on each side, with double side walls (4a, 4b) emerging from the bottom.

11. A chute as claimed in anyone of the preceding claims, **characterised in that** the box-shaped modules (4) are spaced apart from the adjacent modules defining collecting/passage routes (8) for the feed material.

12. A chute as claimed in anyone of the preceding claims, **characterised in that** it further comprises a rear closing structure (10) positioned on the side opposite to the sliding region (3) relative to the impact region (2) to prevent an undesired discharge of the feed material from the back, the closing structure (10) comprising at least one first wall (11) transverse to the chute bottom and fixedly secured to a load bearing body (12) of the chute.

13. A chute as claimed in claim 12, **characterised in that** the first transverse wall (11) is positioned rearwards relative to an end portion of the load bearing body (12) and carries a given number of stiffening ribs (13) on a surface thereof that are preferably turned towards the outside of the chute.

14. A chute as claimed in claim 12, **characterised in that** the closing structure (10) further comprises a second wall (14) transverse to the bottom and secured to the load bearing body (12) of the chute in a movable manner, said second wall (14) being in particular movable in a direction substantially parallel to the sliding direction (5) of the feed material.

15. A chute as claimed in claim 14, **characterised in that** the second wall (14) has a predetermined number of T-shaped beams (16) projecting from an inner surface thereof, the second wall (14) and T-shaped beams (16) defining an insulating gap (17) that possibly can be filled with refractory material.

16. A chute as claimed in anyone of the preceding claims, **characterised in that** it comprises a protection body (18) disposed along a perimeter of the chute exit portion, said protection body (18) shielding the chute plates from flames, the protection body (18) being preferably placed at a lower position relative to the plane defined by the sliding region (3) to avoid contacts with the dropped feed material.

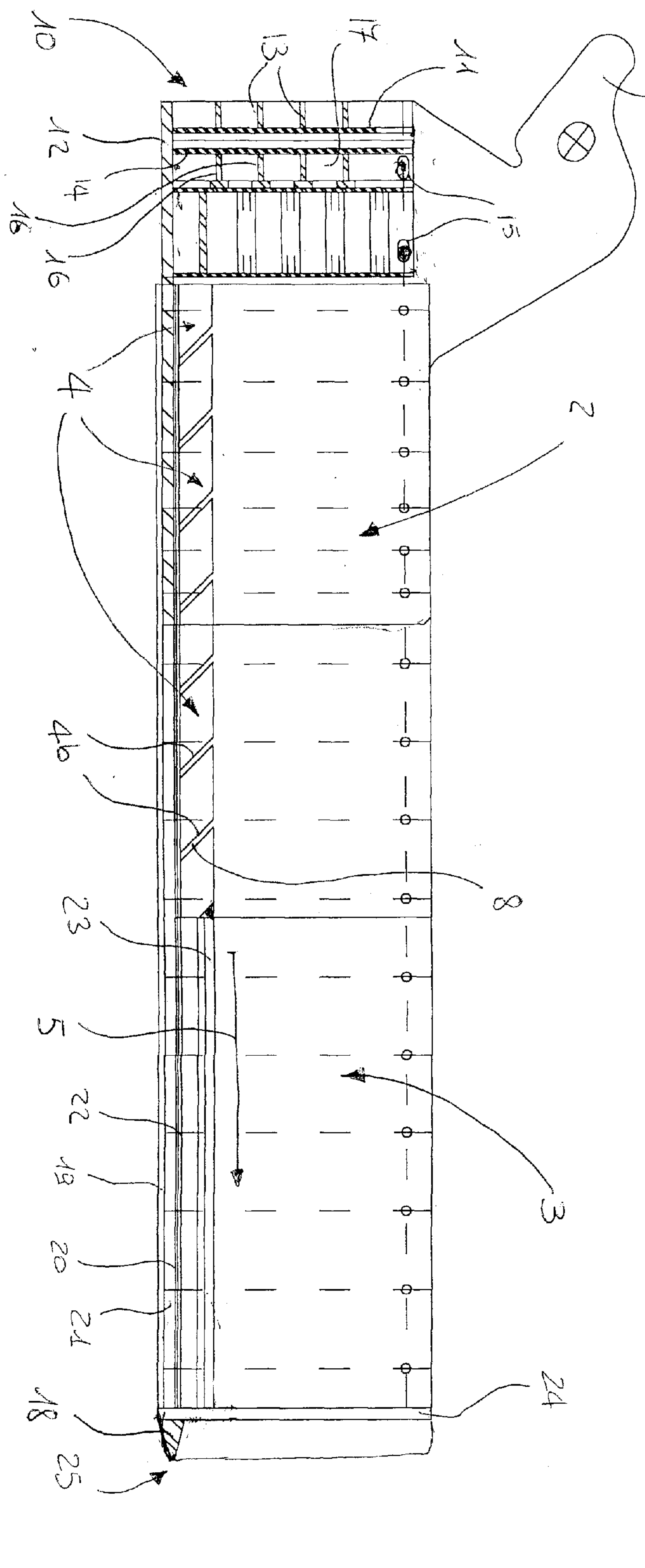

FIG. 1

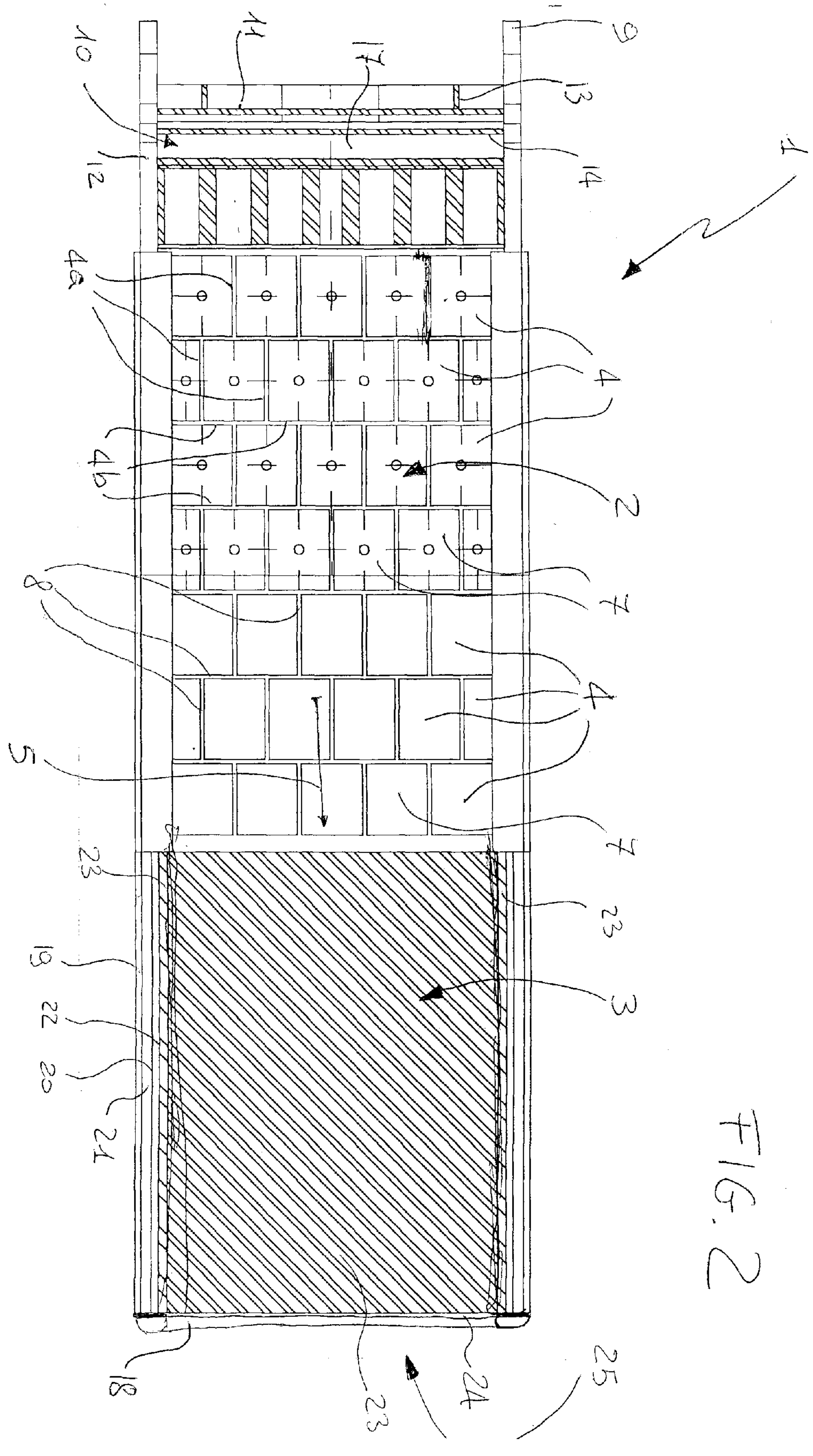

FIG. 2

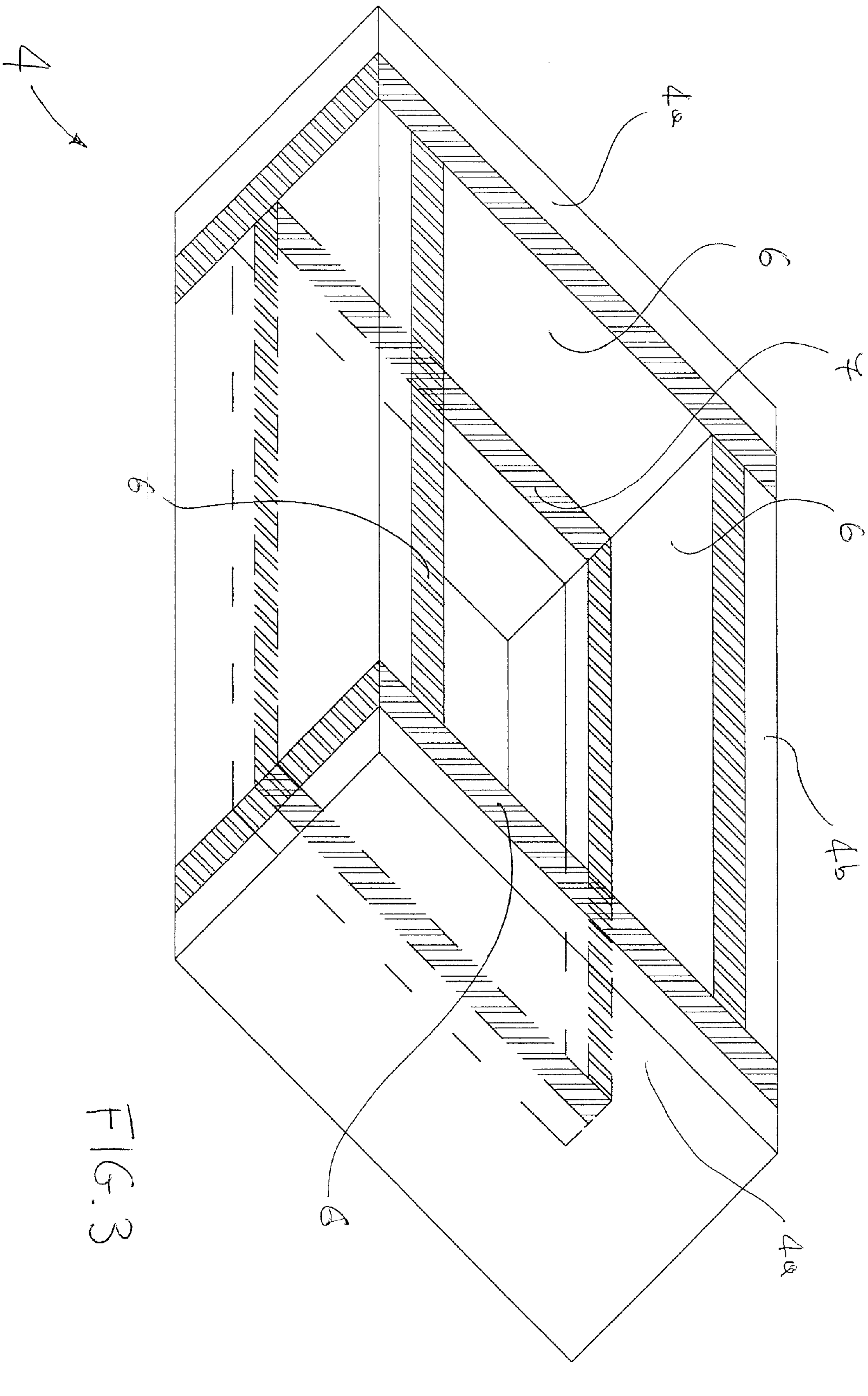

FIG. 3

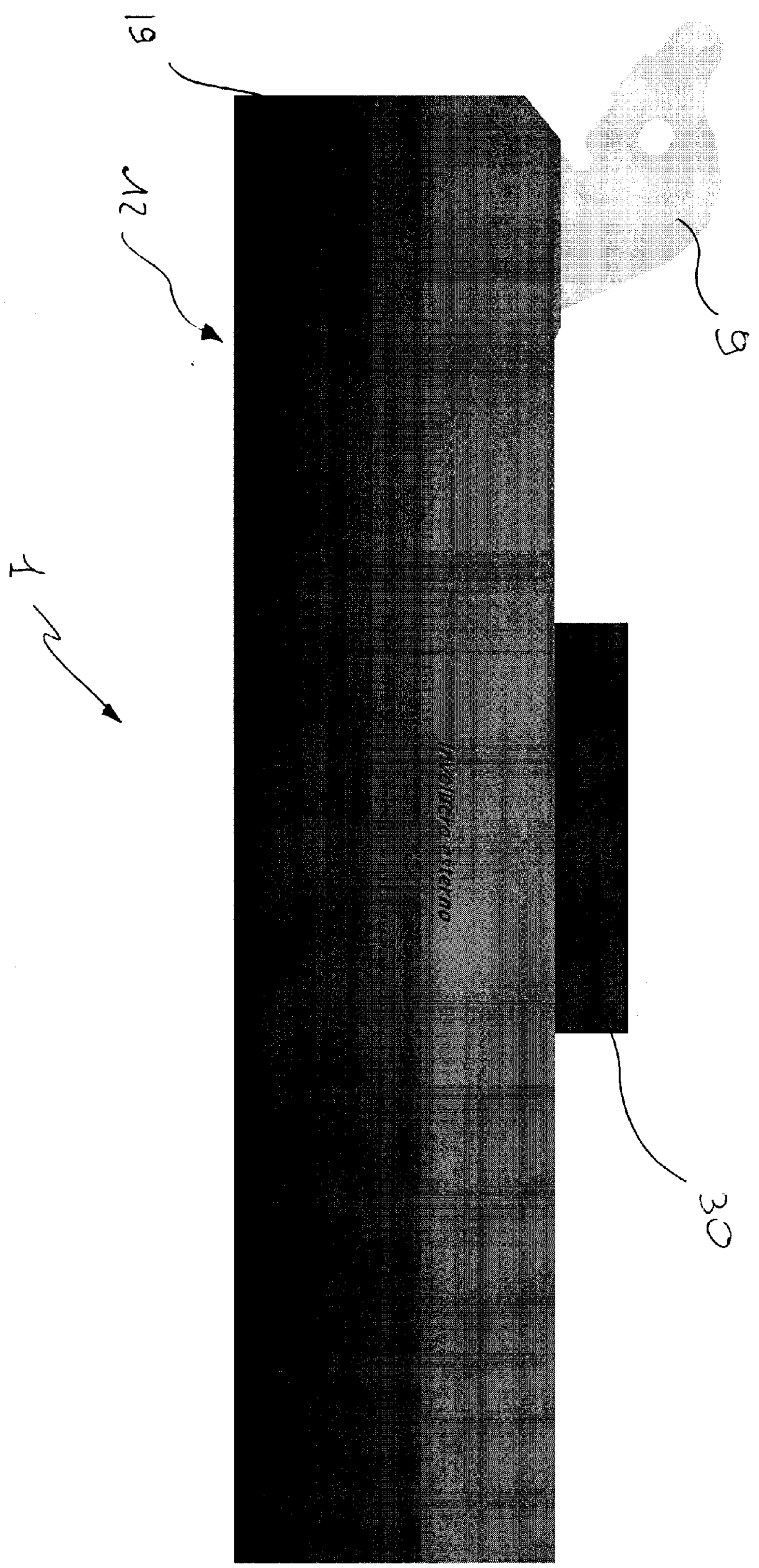

FIG. 4

FIG 5