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(71) Applicant *(for all designated States except US)*: MO INDUSTRITRANSPORT A.S [NO/NO]; Svenskeveien 20, N-8600 MO I Rana (NO).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: OLSEN, Gunnar [NO/NO]; Hammervn 89, N-8600 MO I Rana (NO).

(74) Agent: LARSEN, Rolf, Chr., B.; ABC-Patent, Siviling. Rolf Chr. B. Larsen a.s, Brynsveien 5, N-0667 Oslo (NO).

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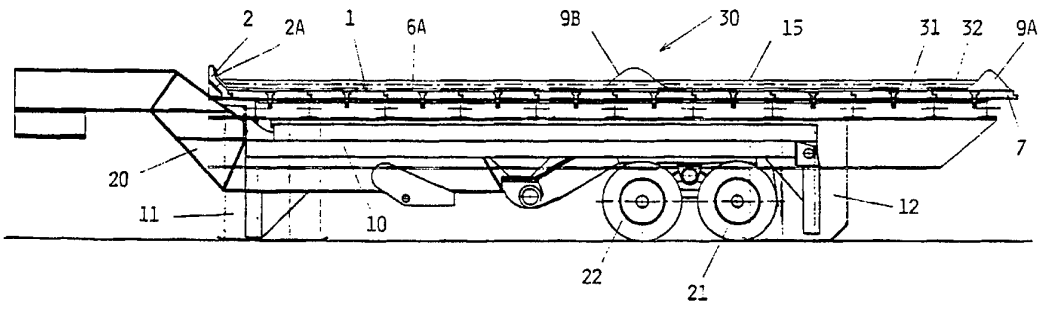

(57) Abstract

Method of transporting molten material in the smelting industry in a wheeled vehicle (20) provided with a dump body (1, 2) adapted to be emptied of its load by tipping. Before loading of melt the dump body (1, 2) is provided with a lining (6A, 2A, 9A) of loose material being resistant to the melt, so that the interior of the dump body is protected against the melt. Then loading of melt is effected and the vehicle is driven to a receiving location for the melt load. There the dump body (1, 2) is tipped so as to discharge both the melt load (15) and the lining of loose material (6A, 2A, 9A).

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Transport of metal and slag melts in the melting industry.

This invention relates to a method of transporting molten material in the smelting industry, such as molten metal or slag, with a wheeled vehicle equipped with a dump body or container adapted to be emptied of its load by tipping. Moreover the invention comprises two designs of a dump body for use in the method.

In certain types of such industry, for example for producing ferrochrome, there will be large amounts of liquid slag to be handled and transported away from the furnace plant or the like concerned. In this connection there may also be the question of other forms of hot, possibly corrosive and more or less liquid masses to be transported. Furthermore, what may be of interest in the smelting industry can be the actual metal or alloy product being produced that is to be hauled away.

A common form of transportation concerning such melts, is to convey these in large, open pots or ladles which are usually employed in the smelting and casting industry. When an amount of metal melt or slag conveyed in such a ladle, is to be emptied from it, residues will often be left, which solidify and will be difficult to remove from the interior of the ladle. The very manipulating and emptying from the ladle can also involve problems. Important considerations in this connection are the environment and the safety of the workers.

There are also grounds for mentioning that in certain forms of smelting industry, including the ferro-alloy industry, a common method of casting both of metals and possibly accumulating liquid slag, has been to form a "bed" of a suitable material in a loose mass directly on the floor or ground in the plant concerned, furnace hall or the like, as a supporting base during casting, i.e. instead of an actual casting mold.

A method presently employed in the production of ferrochrome, consists in pouring the metal from the bottom of a ladle onto a bed in the casting hall. This bed is lined with ferrochrome fines of grading 200-400 mm. The bed has a size of approx. 6-8 m, and the metal is cast with layer upon layer until a total thickness of about 0,5-1 m. When the metal has

been cooled to about 1000°C it is broken up, by, for example a wheel loader, and is transported to bins for further cooling. In addition to problems mentioned above this method also presents problems because the breaking operation using the wheel loader leads to great strain on the machine and therefore corresponding maintenance costs. Moveover it is a desire to have the metal cast into layers of thickness less than 100 mm for the purpose of facilitating subsequent crushing. Additionsof fine fractions of crushed or loose masses of ferrochrome from the bed, should be as small as possible in the resulting metal product. As regards the transporting of hot goods, such as slag, US patent 3.288.530 can also be referred to as an example, showing a vehicle with a dump body intended for tipping and provided with a lining adapted to be cooled by air circulation. Such transportation equipment will obviously be expensive, and the above mentioned problems of residues of the load after emptying, will be present.

On the other hand US patent 4.561.885 describes the employment of slag as a refractory lining, but not in connection with transportation equipment. The method described is directed to employing a solidified layer of slag as a lining in containers for use in the smelting industry.

The present invention is directed in principle to a transport system for molten metal, alloys, slag and the like taking as a basis a particular dump body adapted to be provided beforehand with a bed or lining of a suitable loose material, in particular solidified and crushed material of the same kind as the liquid melt to be transported. When the transported load has arrived at the receiving location the whole dump body is tipped by means of a suitable mechanism, so that both the melt load and the loose mass constituting the lining or bed, are unloaded from the dump body.

A more definite specification of the method as well as the dump body according to the invention, are found in the claims.

The invention involves the advantage inter alia, that problems with residues of metal or slag left in the actual dump body are eliminated. Another advantage is that wear and tear on the interior surface of the dump body are to a large

degree reduced as a consequence of the fact that these surfaces are well protected and isolated from the melt or slag mass that constitutes the load. Among further advantages improved safety and working environment can be mentioned, as well as, and not least, the fact that the transport equipment will be simple and relatively inexpensive.

When in particular conveying of produced metal, for example ferrochrome, is concerned, it is very significant how the dump body is designed with respect to heat capacity, since the load, especially during the actual loading, can have very high temperatures. This involves, inter alia, that the structural materials being employed in the dump body, can be subjected to expansion problems. It is one of the objects of the invention to provide a solution to such problems.

As mentioned above the molten load can be both the metal produced (possibly in the form of an alloy) as well as slag in liquid condition, and it may be an advantage to have one particular design of the dump body for the metal product, and another separate design for slag melts. For the latter purpose a preferred embodiment of the dump body is also described in the following description with accompanying drawings. In this connection it is of great advantage to design the supporting structure in these two embodiments of the dump body in such a manner that they can be hauled by the same vehicle or trailer. Thus in a given smelting industry plant where both a metal product and a slag smelt are tobe conveyed, the transport equipment can be built and operated with gains in rationalization.

In the following description the invention shall be explained more closely with reference to the drawings, in which:

fig. 1A in a partially schematic longitudinal section shows a first embodiment of the dump body according to the invention, for conveying metal melts, with an accompanying trailer.

fig. 1B shows the same as fig. 1A, but with the dump body lifted by the trailer, so that the whole is supported thereby,

fig.2 shows the trailer and dump body in figs. 1A and 1B in tipping position for emptying of the load,

fig. 3 in perspective view shows how the dump body of figs. 1A, 1B and 2 is composed of elements so as to form the interior surfaces of the dump body, but without showing the supporting structure or frame,

fig. 4 shows an enlarged cross-section of a dump body according to this first embodiment, with the supporting frame structure and legs belonging thereto,

fig. 5 in elevation and partial longitudinal section as well as somewhat schematically shows a vehicle (trailer) with a dump body according to a second embodiment of the invention, after loading of the melt, and

fig. 6 shows the actual dump body in figure 5 as seen from above, and without any load.

The supporting structure of the dump body in the embodiment illustrated in figures 1-4 comprises legs or supports 11 and 12 as well as a frame generally designated 10. The actual loading compartment in this first embodiment is best illustrated in fig. 3, from which it appears that the dump body or compartment has a bottom 1, side walls 3 and 4 as well as an end wall 2, which preferrably constitutes a front end wall of the dump body. At the opposite or rear end there is not provided any end wall in this embodiment.

In figs. 1A, 1B and 2 the dump body is shown in cooperation with a trailer being generally designated 20, which inter alia comprises a set of wheels 21, 22. By means of a tipping aparatus that is incorporated in the trailer structure the dump body can be tipped to the position shown in fig. 2 for emptying of the load.

It is seen from figs. 1-4 of the drawings that the actual dump body is formed by walls 2, 3 and 4 that are comparatively low in relation to the area of the bottom 1, or in other words: the dump body has substantially larger length and/or width than depth, i.e. wall height. These relative dimensions are associated with the particular method to be described below, for the transportation of the metal product

concerned, for example ferrochrome from the casting hall of the smelting plant.

The dump body constitutes a separate unit being able to stand on its own legs 11 and 12, with the possibility available for a trailer 20 to be moved in between the dump body legs to a position as shown in fig. 1A. Preferrably the trailer 20 is provided with a lifting device making it possible to elevate the dump body so that this will rest with its whole weight on the trailer. This position is shown in fig. 1B, from which it is seen that the supporting legs 11 and 12 have been elevated from the ground.

In a smelting plant where the transportation system concerned shall convey both molten slag and the metal produced, there will in addition to dump bodies for the metal product according to the first embodiment and as illustrated in figs. 1-4, also be employed another form of dump bodies being particularly intended for molten slag, as described below with reference to figs. 5 and 6. The trailer 20 (120 i fig. 5) and the two types of dump bodies will constitute an efficient transportation system by being designed for the use of the same trailer for both types of dump bodies.

As will be seen in best detail from figs. 3 and 4, the dump body in this embodiment comprises a relatively large number of separate bottom elements having a substantially plate-like shape and together covering the whole bottom 1. Two such elements are indicated at 31 and 32, whereby joints between the elements are shown at 33. These joints 33 being shown in cross-section in fig. 4, in the first place serve to make possible a certain relative freedom of movement of the bottom elements, which is a substantial advantage in view of the large temperature fluctuations that will occur when such a dump body is put to use and during operation thereof in a smelting plant.

This element structure also has the advantage that individual elements can easily be replaced if damage should occur. Each of the elements, such as the element 32 is attached to the supporting frame 10 of the dump body by means of fastening members at the central portion of the element, where there is shown a through opening 32A. As shown in fig.

4 there can be provided a through bolt 32B for example, which by means of disc nut 32D and a key 32C can keep the element 32 in position. It is obvious that a variety of types of fastening means can be contemplated for this central anchoring of each element 32 to the frame 10.

In addition to the bottom elements, for example elements 31, 32, the dump body also comprises wall elements that form the respective walls 2, 3 and 4. These wall elements, for example as shown at 34, are arranged in a row with joints between the elements of the row as shown at 35, and besides with similar joints 37 against adjacent bottom elements. In this way also the wall elements will have a corresponding freedom of movement as explained above with respect to the bottom elements.

A suitable material for these elements that form the dump body or compartment, is cast iron. The choice of this material and moreover the dimensions chosen for the respective types of elements, is to a high degree based upon the desire of having a high heat capacity in these parts of the dump body, which normally involves a significant degree of excess dimensions from those determined by purely mechanical strength considerations. In a practical design, intended for example for a load of metal weighing approx. 40 tonnes, the total weight of the cast iron elements in the dump body could also be approx. 40 tonnes or somewhat more. These values also illustrate the dimensions of transport equipment being of interest in the smelting industry. Thus, for example, the length of the dump body can be about 10 m and the width about 4,5 m.

Based on the above examples of values and dimensions, the individual bottom elements in the dump body of the drawings can have an extension (length/width) of approx. 1 m. Thus, each of these elements cover only a small fraction of the total bottom surface 1 in the dump body.

The joints 33,35,37 between the separate elements of the dump body shall be so shaped and dimensioned that loose material laid into the dump body as a lining before introducing the actual load in the form of a metal melt, cannot fall or seep out through the joints. As will be seen in fig. 3,

the joints can have a more or less labyrinth-like shape for this purpose, for example with a stepping as shown with respect to joint 33 in fig. 4. Also a shape of the groove and tongue type can be used for these joints.

As will appear in particular from fig. 4, the side wall elements 3 and 4 have inclined interior wall portions, of which the lower portion is not so steep as the upper portion. In view of the lining of loose material to be arranged in the dump body before the loading of melt, the lower wall portion has such a moderate inclination that the lining material as shown at 3A and 4A in fig. 4 will be able to lie on these wall portions without sliding downwards before the melt load has been introduced. With the lining material concerned, i.e. solidified and preferrably crushed metal or alloy of the same kind as the melt concerned, for example ferrochrome, it is preferred that the angle of inclination of the wall portion is not larger that 45°. In many instances an angle of inclination of less than 35° is preferred.

The main part of the lining covers the bottom 1 of the dump body, as shown at 6A in figs. 1A and 4. In fig. 1A there is also shown a lining layer 2A at the end wall 2.

Thus, as a substantial feature the method according to the invention comprises the step of arranging the lining discussed above, in the dump body so that the same will be protected against the melt to be later loaded into the dump body. The vehicle employed, for example a trailer 20 as described above, is then driven with the melt load in the dump body to the receiving location concerned, where the dump body is tipped so as to discharge both the melt load and the lining of loose material. As already mentioned the tipping position is shown in fig. 2, where the arrow 40 indicates that the load and the lining are on their way out of the dump body.

Reverting then to the method step that constitutes a preparation for the loading proper and what takes place during loading, a layer of solidified, crushed material as shown at 2A, 3A,4A and 6A in fig. 1A and 4, is put in at a thickness being as regular as possible. When the metal product in question is ferrochrome, the thickness of the

lining suitably can be 20-30 mm, and consisting of the fine fraction of the crushed metal mass. At the rear end 7 of the dump body, as shown in figs. 1A and 1B, instead of a rear wall there is formed an enlarged, transverse amount or dam 9A of loose mass so as to confine the load compartment rearwards. The dam 9A will then be sufficiently high and strong to prevent liquid metal being loaded, from overflowing at the rear end 7 of the dump body.

When transporting molten slag is concerned , that may possibly also be conveyed with the dump body of the first embodiment in figs. 1-4, the melt can be poured during loading onto an inwardly inclining surface 9F of the dam 9A. In this connection it is significant to note that whereas a load of slag melt normally will be maintained liquid during a relatively long time, i.e. also during the actual transport and tipping, metal melts of the products concerned often have quite different properties with respect to solidifying temperature, heat conduction and heat capacity.

A melt of an alloy or metal product such as ferrochrome, with a relatively shallow dump body as described above and shown in figs. 1-4, will solidify rather quickly and form a rigid flake as the melt load in the dump body. It is of significance to introduce or pour such a metal melt into the dump body at a central region thereof. Then the melt can more easily flow out in all directions and utilize the whole bottom area of the dump body. For the purpose of preventing a jet of molten metal as shown at 30 in fig. 1A, from flushing away some of the bottom lining 6A, it is an advantage to provide a heap 9B of loose lining material centrally on the dump body. This particular heap 9B has an important function and in practice should have a substantially larger height than the thickness of the lining 6A, preferrably 8-10 times higher than the thickness of the lining. Moreover it is an advantage to use a significant proportion of more coarse material fractions as the loose material in the heap 9B, than in the remaining lining of regular thickness, for example the bottom lining 6A. These coarser material fractions will be more able to resist the effect of the melt stream 30 than more finely fractioned material. With a bottom lining of for

example 20-30 mm as mentioned above, the heap 9B can have a height of 200-300 mm with fractions or gradings 0-100. As an alternative a cover of fine fractions can be laid over the heap.

It is remarked here that loading of melt in the form of a poured stream as mentioned above, constitutes a very critical and rather dramatic phase during the type of transport operation being of interest in this connection.

In view of the type of metal load, i.e. metal or alloy in this embodiment as described above, and also in view of the form of dump body described, the melt load will to a substantial degree be allowed to solidify during and after loading. Thus the whole load will not be so liquid, perhaps almost entirely solid, before the vehicle or trailer 20 is driven away to a receiving location. Preferrably the conditions including the time relationships are so adjusted that full solidification of the whole melt load has occurred before tipping at the receiving location. In many cases the metal melt after 5-10 minutes upon loading will no longer be liquid. Thus, in view of this, the transport or hauling of this dump body for example on trailer 20, can take place immediately upon loading.

The fact that the melt load is more or less solidified during the drive, involves the advantage, inter alia, that the risk of splashing, i.e. spilling and accidents, is eliminated to a substantial degree. As usual in this type of industry, however, care is imperative because of the high temperatures being present even though the load is no longer in a liquid condition.

As a contribution towards safeguarding against accidents during loading, the walls 2, 3,and 4 of the dump body have a larger height than would be needed for a normal load 15. In particular from fig. 4 it appears that the wall height is sufficient in an emergency situation for accommodating an additional melt volume 15' of a similar magnitude as the normal melt load 15.

The solidifying of the melt load taking place before and possibly during transport to the receiving location, results in a shrinking, which across the dump body width of 4-5 m can

be 2-3 cm. This shrinkage will to a high degree facilitate the emptying of the load by tipping, so that there is no need for any particular design of the dump body, which, however, is a great advantage in the case of molten slag to be transported, as will be described below in connection with the second embodiment of the invention shown in figs. 5 and 6.

A factor of significance in connection with the relative dimensions of the dump body for metal melts, is that the thickness of the melt load 15 as seen in relation to the surface area thereof, i.e. broadly corresponding to the bottom surface 1 of the dump body, will not be larger than what brings the solidified melt load will to a large extent break up of itself during tipping at the receiving location.

During operation of smelting plants whereby transportation of melts can take place by utilizing the present invention, it is essential that the work plan and work timing are as rational as possible. Work timing being influenced by the solutions described here, comprise loading, driving, tipping and return driving as well as possible waiting before new loading can take place on to the dump body concerned. In connection with this invention it is a great advantage that these work cycles are arranged so in time that the temperature relationships, including the temperature variation in the dump bodies and in particular inside them, are maintained within a desired range. The significance of these temperature relationships is seen perhaps most particularly during loading of a new load after arranging a new lining in the dump body, as discussed above. A practical range of temperatures in this connection is from 100-400°C. As known to foundry and smelting industry experts, high risk factors are involved in connection with moisture which may be present when molten metal is handled. By keeping the temperature relationships in the dump body under control as stated here, it may be assured that the dump body is free of moisture, in order thereby to prevent accidents.

Another aspect of the question of temparatures has already been mentioned above, namely in connection with the heat capacity of the dump body elements. When the elements

are made of cast iron they will resist temperatures up to 800°C.

When a dump body is to be put into use from cold condition, it may be appropriate to pre-heat the dump body, as otherwise known in connection with smelting plants and foundries, for example by pre-heating melt ladles. On the other hand and according to circumstances there may also be the question of providing for forced cooling of the dump body, possibly with the melt load therein, for example before or during tipping at the receiving location.

The lining material in the form of a loose or crushed mass, is preferrably of the same type as the metal load, for example ferrochrome, as mentioned above. One of the advantages in this connection is that such material as a rule will be present in the smelting plant concerned and to a large extent as waste material generated during the production. Accordingly such material can be taken advantage of in connection with the transport method described here. When needed it is of course possible to provide for a particular crushing and/or screening step so as to obtain the material fractions desired at the various parts of the lining to be laid into the dump body, including the particular heap 9B described, that shall receive the poured jet, or stream during loading.

In the second embodiment of the dump body according to the invention, intended in particular for molten slag and illustrated in figs. 5 and 6, some of the structural features from the preceeding description are recognised.

The dump body in figs. 5 and 6 comprises a bottom plate 51, an inclined front wall 52 and correspondingly inclined side walls 53 and 54. These form together a load compartment which to a very high degree is open for tipping rearwardly (to the right in figs. 5 and 6). The angle of inclination of plate parts 52, 53 and 54 shall be so low that a filling of solidified loose slag mass, as for example shown at 52A in fig. 5, without problem will be kept in place until the liquid slag 65 is loaded in. In figs. 5 and 6 there is also shown an upper, vertical wall part 55 of common type, that

terminates the load compartment upwards at both sides and at the front end (to the left in the drawing).

Whereas the main part of plates in 51, 52, 53 and 54 that form the support for the load, according to fig. 5 has a layer of solidified, crushed slag mass with a regular thickness, as shown for example at 51A and 52A, there is provided at the rear end of the dump body a larger transverse heap or dam 59A for delimiting the load compartment rearwards. Thus the dam 59A must be sufficiently high and strong to prevent the liquid slag 65 from overflowing at the rear end 57 of the dump body during hauling. Preferrably in this embodiment there is not provided any rear wall in the usual sense.

At 80 in fig. 6 there is schematically indicated a pouring spout or the like from a pot or ladle from which the liquid slag or the like shall be transported. The ladle 81 is carried by a carriage 82. It may be an advantage that the liquid slag from the mouth of the pouring spout 80 falls as a stream 80A against the inwardly inclined surface 59F of the heap 59A.

It is to be noted that the bottom 51 of the dump body of figs. 5 and 6 in the normal, horizontal operational position thereof, has a small inclination upwards in the rearward direction. It is more essential, however, that bottom 51 has an increasing width rearwardly towards the end portion or edge 57, as will be clearly seen in fig. 6. This contributes to a widening of the interior section represented by the dot-dash lines 58 in fig. 6, in a rearward direction towards the edge 59, so that the loading compartment to a substantial degree will be open and widened in the rearward direction. In this connection it is also significant that the side walls 53 and 54 preferrably have the same inclination over the whole length of the dump body and besides that the total interior width thereof between the longitudinal upper wall portions 55 increases somewhat in the rearward direction. In fig. 6 this increase is indicated by the magnitudes 55A and 55B, showing how much narrower the dump body is at the front end than at the rear end. It may also be an advantage that the dump body has a substantially larger length and possibly

larger width than depth, as in the embodiment shown in figs. 5 and 6.

As mentioned above and as shown in figs. 5 and 6 the walls 52, 53 and 54 og the dump body have an inclined position, that on the one hand is adapted to make possible a stable deposition of the lining of a loose mass before the loading of the melt, and on the other hand is appropriate for the intended emptying of the whole melt load together with the lining without problems, by tipping over the rear edge 57. At this point it has been found that these interior surfaces of the dump body to be covered by the lining, should form an angle being smaller than 45° and preferrably smaller than 35° with respect to the horizontal plane when the dump body has a normal, horizontal position. This corresponds substantially to the angle relationships being also discussed above with respect to the first embodiment of figs. 1-4.

Similarly to the first embodiment, the second embodiment of the dump body is provided with a supporting frame 110 having preferrably support legs 111 and 112, so that the whole unit can be set up for receiving liquid slag or the like from a ladle having a spout 80 as already explained. Moreover there is shown a separate trailer 120 having wheels as indicated at 121, 122, intended for cooperation with the conveying dump body and its supporting frame and legs 111, 112. Thus the trailer 120 is adapted to be moved in underneath the frame 110 and by means of jacks or the like the trailer 120 can then take over the whole weight of the dump body with its load. The necessary tipping apparatus (not shown here) preferrably will belong to the trailer 120, but depending on the circumstances it can also be integrated with the frame 110 or the dump body itself.

As mentioned, it is a fundamental idea according to this invention to lay a lining or bed of a cheap material, in particular solidified, crushed slag of the same kind as the liquid slag to be transported, in a suitable dump body, and then pour in the liquid slag, then comes the intended transporting step and thereafter emptying of the whole load, comprising both the liquid slag and the loose lining, so that a clean and empty dump body can be returned for new loading.

In practice the lining or bed of solidified, crushed slag will be put in by means of some form of loading or excavating machine, since rather large volumes are of interest in this connection. A usual thickness of the slag lining can be for example 15-20 cm. There is reason to emphasize that the solidified, crushed slag discussed here, is a mass or material normally being immediately accessible almost as a waste product in the industry concerned. When the liquid slag being transported, has solidified, it will as a rule be reloaded for final deposition, and during this reloading for example by means of a wheeled loading machine, the solidified slag plates by themselves will be broken up to a large extent into a suitable structure, for example with a maximum piece size og about 10 cm in lateral dimensions.

In the above description particular reference is made to the lining of the dump body with a metal mass or crushed slag respectively. An alternative could be to employ a cheap and easily available material, for example sand or gravel as the lining mass. This latter possibility, however, is less advantageous than to utilize a filling mass being inherently incorporated in, or a result of, the process in the industrial plant concerned.

C L A I M S

1. Method of transporting molten material in the smelting industry with a wheeled vehicle (20,120) being equipped with a dump body (1-4,51-54) adapted to be emptied of its load by tipping
c h a r a c t e r i z e d in
- that before loading melt (15,65) the dump body (1-4,51-54) is provided with a lining (6A,2A,9A,51A,52A,59A) of a loose material being resistant to the melt, so that the interior of the dump body is protected against the melt,
- that loading of melt is effected,
- that the vehicle is driven to a receiving location for the melt load, and
- that the dump body (1-4,51-54) is tipped (Fig. 2) so as to unload both the melt load (15,65) and the lining of loose material (6A,2A,9A,51A,52A,59A).

2. Method according to claim 1,
c h a r a c t e r i z e d in that the lining (6A,2A,9A,51A,-52A,59A) is formed of a loose material consisting substantially of the melt concerned in a solidified and preferrably crushed condition.

3. Method according to claim 1 or 2,
c h a r a c t e r i z e d in that the lining at the edge portion of the dump body (1-4,51-54) where the tipping takes place, is formed as a stronger dam (9A,59A) of the loose material, preferrably at the rear end portion (7,57) of the dump body (1-4,51-54).

4. Method according to claim 3,
c h a r a c t e r i z e d in that during loading the melt is introduced onto an inwardly inclined surface (9F,59F) of the dam (9A,59A).

5. Method according to claim 2 or 3, whereby the melt is a molten metal,
c h a r a c t e r i z e d in that the melt load (15) to a substantial degree is allowed to solidify during or after loading before the vehicle (20) is moved, preferrably with full solidification of the whole melt load before tipping at the receiving location.

6. Method according to claim 5,
c h a r a c t e r i z e d in that the loading takes place until the thickness of the melt load (15) seen in relation to the surface area thereof, attains a maximum value which leads to at least a partial breaking up of the solidified melt load during tipping thereof (fig.2).

7. Method according to claim 5 or 6, whereby the loading takes place in the form of a melt stream (30) into the dump body (1-4),
c h a r a c t e r i z e d in that in the dump body (1-4) in addition to the lining (6A,2A,9A), a heap (9B) of loose material of a substantially greater height than the thickness of the lining (6A), is positioned centrally on the dump body, before loading and that the melt stream (30) is directed against this heap (9B).

8. Method according to claim 7,
c h a r a c t e r i z e d in that the loose material in the heap (9B) comprises a significant proportion of more coarse material fractions than the lining, and that the heap is preferrably more than 10 times higher than the thickness of the lining (6A).

9. Method according to any one of claims 5-8,
c h a r a c t e r i z e d in that the work phases comprising loading/driving/tipping/return driving/possible waiting before new loading, are so adjusted in time that the surface temperature inside the dump body (1-4) at new loading, lies

within a desired range, preferrably 100-400°C, in particular for the purpose of keeping the dump body free from moisture.

10. Dump body for use in the method according to any one of claims 1-9, for transporting molten material in the smelting industry, in particular molten metal, and adapted to be placed on a wheeled vehicle (20) and to be emptied of its load by tipping,
c h a r a c t e r i z e d in that at least the bottom (1) of the dump body (1-4) comprises a number of separate, plate-shaped elements (31,32) each covering a small fraction of the total bottom area of the dump body, and that joints (33) are provided between the elements for allowing a certain relative freedom of movement of the elements (31,32).

11. Dump body according to claim 10,
c h a r a c t e r i z e d in that the joints (33) are shaped and dimensioned so as to substantially prevent loose lining material (6A) from seeping out through the joints.

12. Dump body according to claim 11,
c h a r a c t e r i z e d in that the joints (33) form a kind of labyrinth, such as a step shape or groove and tongue.

13. Dump body according to claim 10, 11 or 12,
c h a r a c t e r i z e d in that each element (32) is attached at its central portion (32A) to a supporting frame structure (10) for the dump body (1-4).

14. Dump body according to any one of claims 10 - 13,
c h a r a c t e r i z e d in that along an end edge (2) and two side edges (3,4) of the dump body (1-4) there are provided separate wall elements (34) in a row and with joints (35,37) against adjacent elements and wall elements, so as to allow for a certain relative freedom of movement.

15. Dump body according to any one of claims 10 - 14, c h a r a c t e r i z e d in that the material and in particular the dimensions of each element (31,32) and wall element (34) respectively, is so chosen that the resulting mechanical strength is significantly greater than what would be determined by the weight of the lining (6A,2A) and the melt load (15), in order to obtain an appropriately large heat capacity, and that the material of the elements (31,32, 34) preferrably is cast iron.

16. Dump body for use in the method according to any one of claims 1 - 4, for transporting molten material in the smelting industry, in particular molten slag and adapted to be placed on a wheeled vehicle and to be emptied of its load by tipping,
c h a r a c t e r i z e d in that the interior cross-section (58) of the dump body (51-55) between side walls (53,54,55) and bottom (51) is completely open and widened in a direction towards the edge portion (57) of the dump body where tipping takes place, preferrably at the rear end portion of the dump body (51,55).

17. Dump body according to claim 16,
c h a r a c t e r i z e d in that the bottom (51) of the dump body has an increasing width in the direction towards said edge portion (57) and preferrably as known per se has a low inclination upwards in direction towards the edge portion (57) when the dump body has a normal horizontal position.

18. Dump body according to claim 16 or 17,
c h a r a c t e r i z e d in that the interior width of the dump body (51,55) between upper wall portions (55) at the top of the side walls (53,54) is increasing (55A,55B) gradually in direction towards said edge portion (57).

19. Dump body according to any one of claims 10 - 18, c h a r a c t e r i z e d in that all the interior surfaces (1-4,51-54) of the dump body, being adapted to be covered by said lining (6A,2A,9A,51A,52A,59A) of loose material, form an angle less than 45° and preferrably less than 35°, with the horizontal plane when the dump body (1-4,51-54) has a normal, horizontal position.

20 Dump body according to any one of claims 10 - 19, c h a r a c t e r i z e d in that it has a substantially greater length and/or width than depth (wall height).

21. Dump body according to any one of claims 10 - 20, c h a r a c t e r i z e d in that it constitutes a separate unit, preferrably provided with support legs (10,12,111,112) or the like, and is adapted to be placed on a wheeled trailer (20,120) provided with tipping means.

22. Dump body according to claim 21, c h a r a c t e r i z e d in that both in the embodiment for molten metal (fig. 1-4) and in the embodiment for molten slag (fig. 5,6) it is adapted to be transported and tipped by the same trailer (20,120).

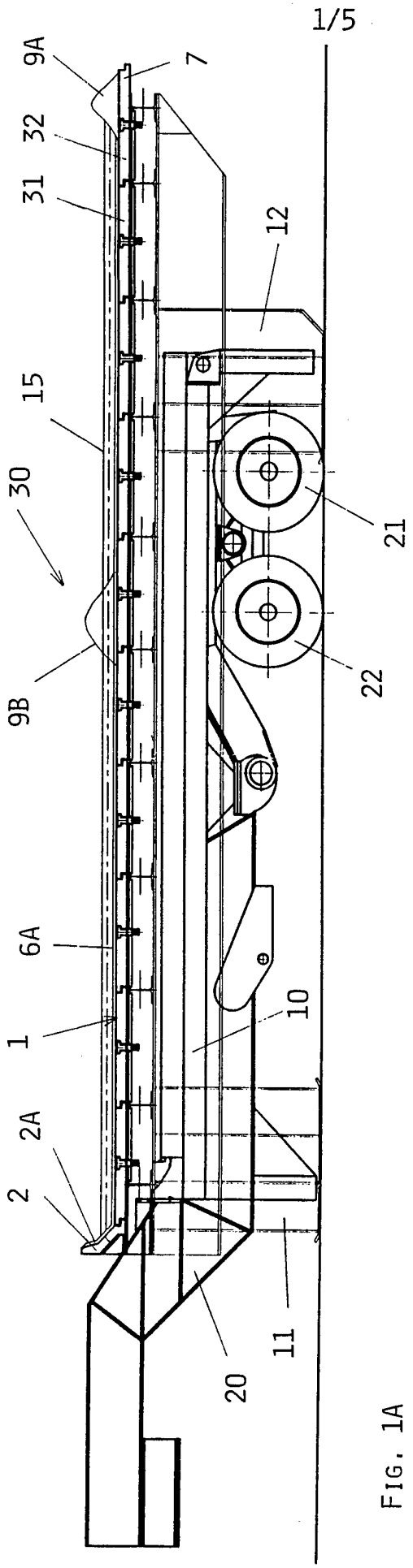


FIG. 1A

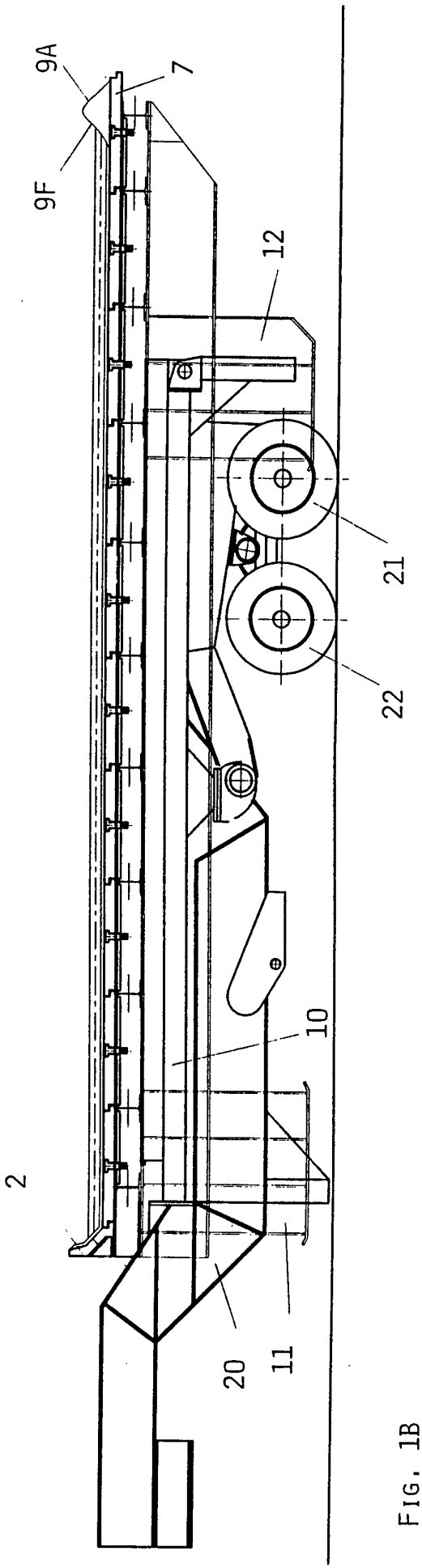


FIG. 1B

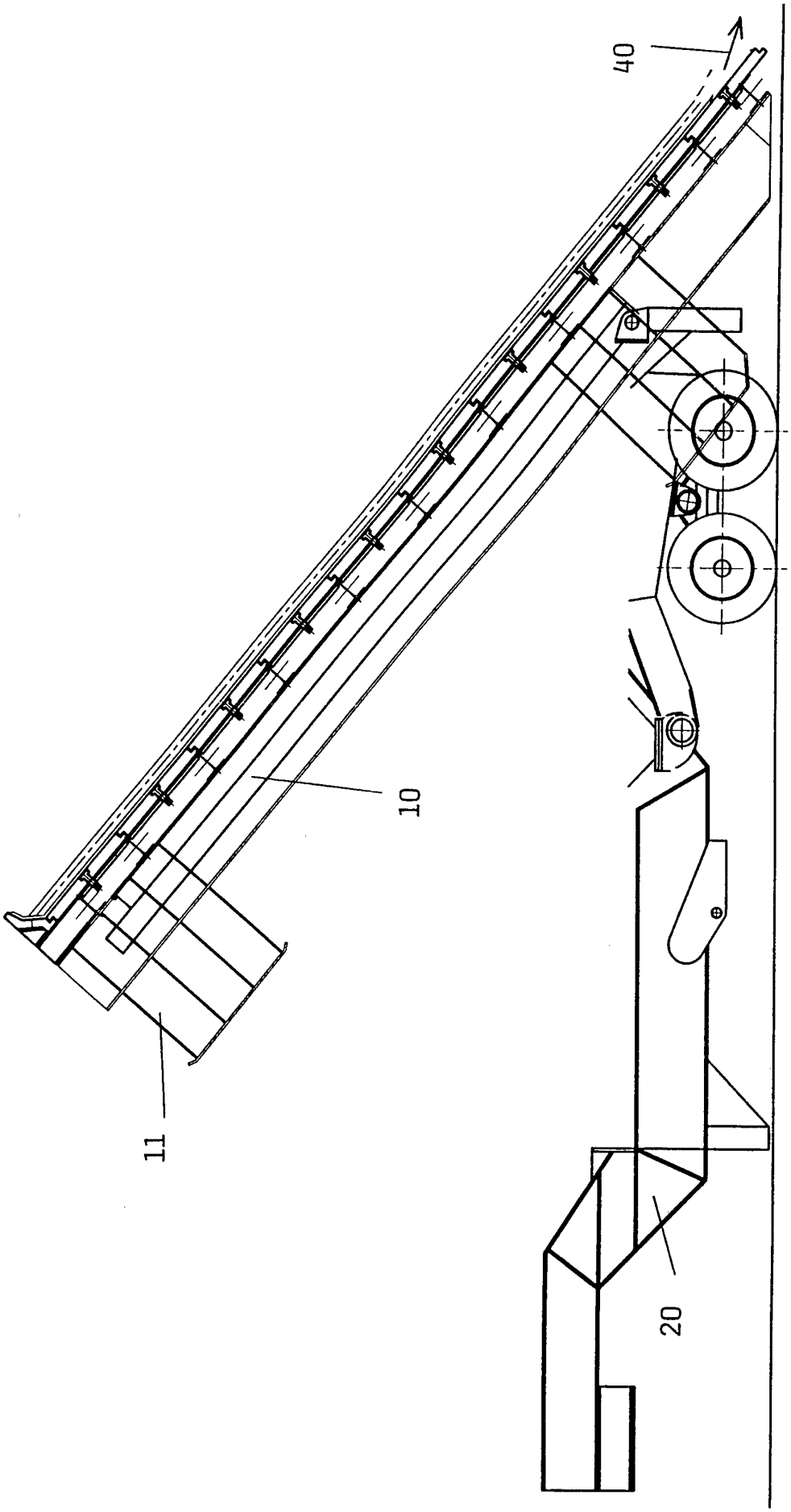


FIG. 2

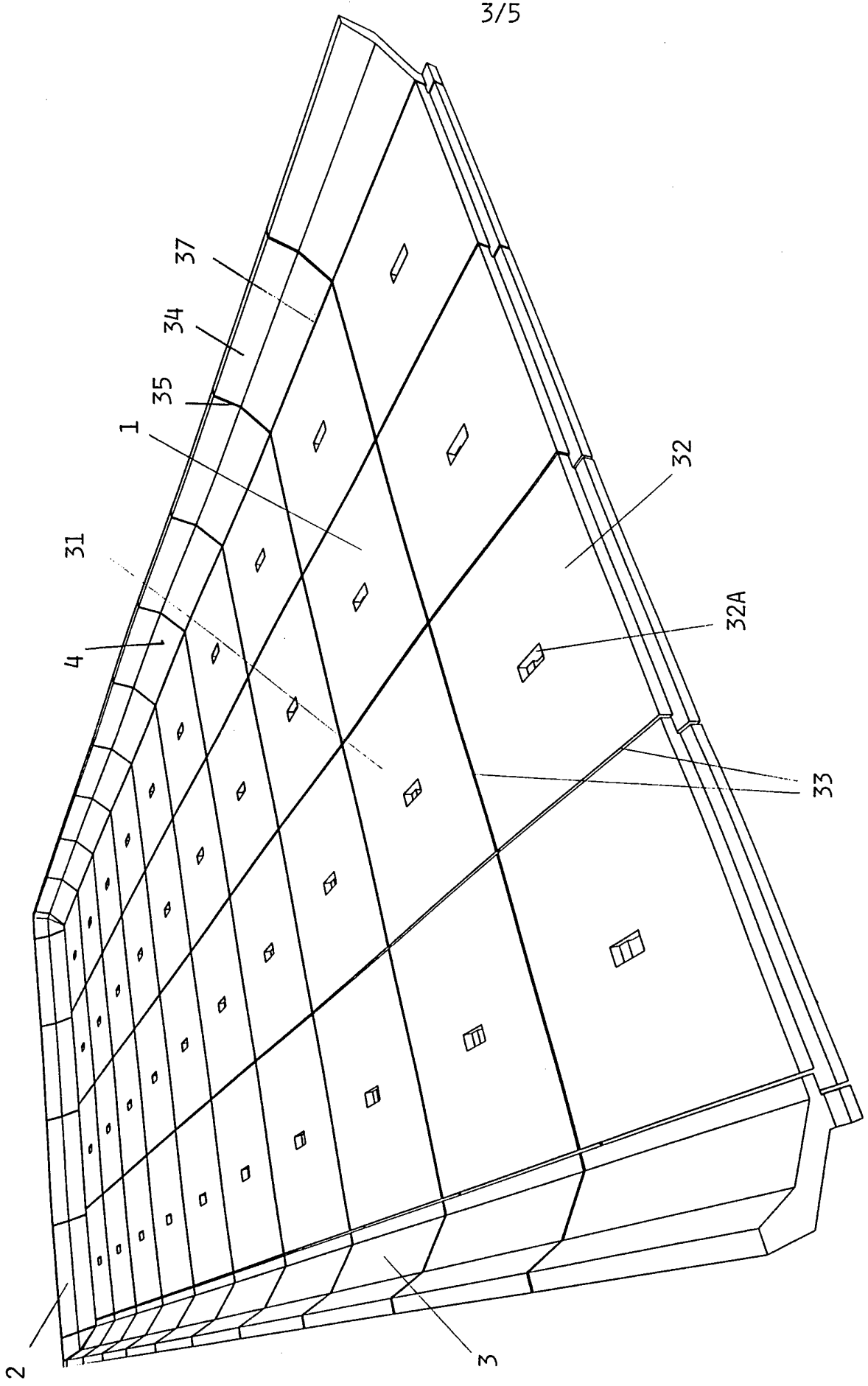


FIG. 3

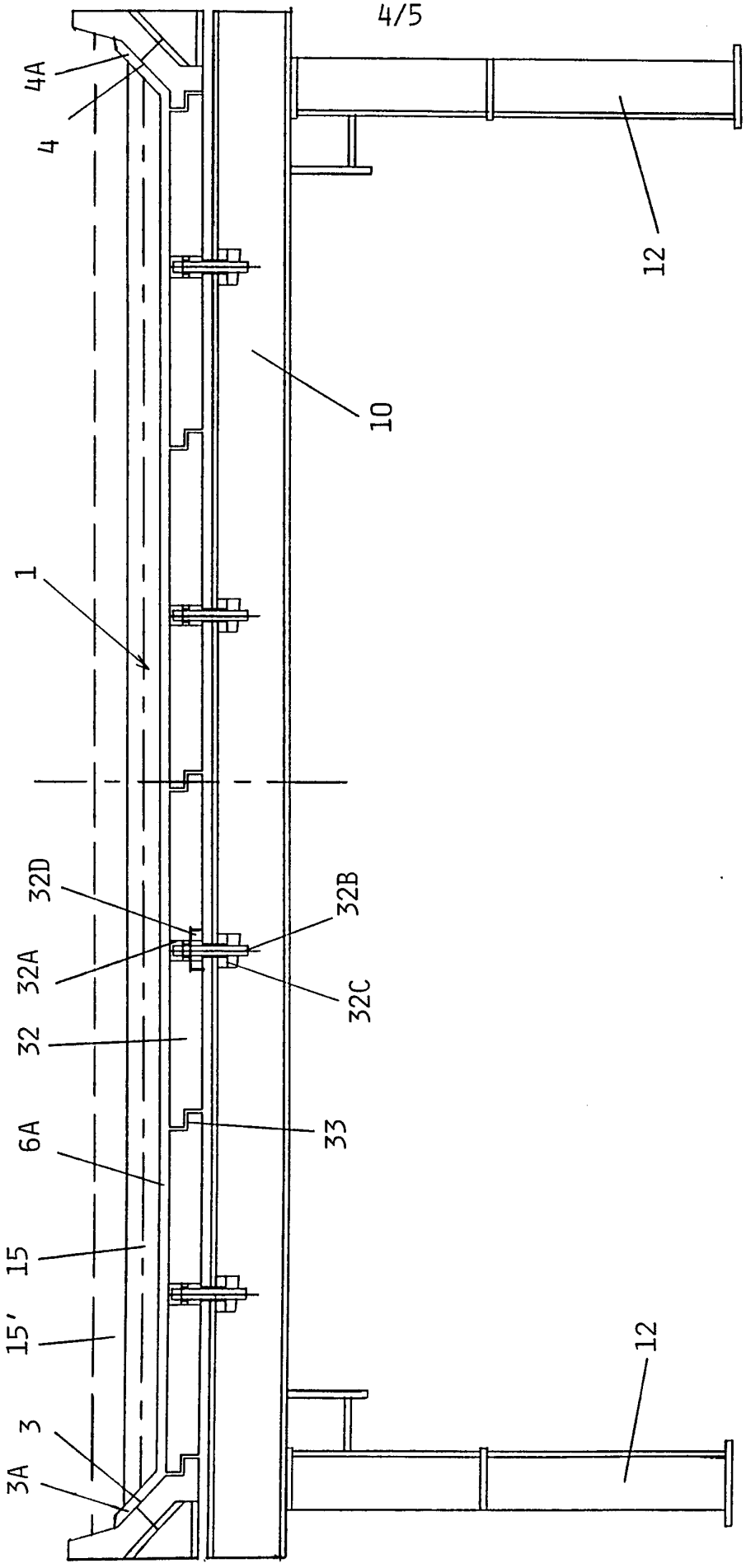


FIG. 4

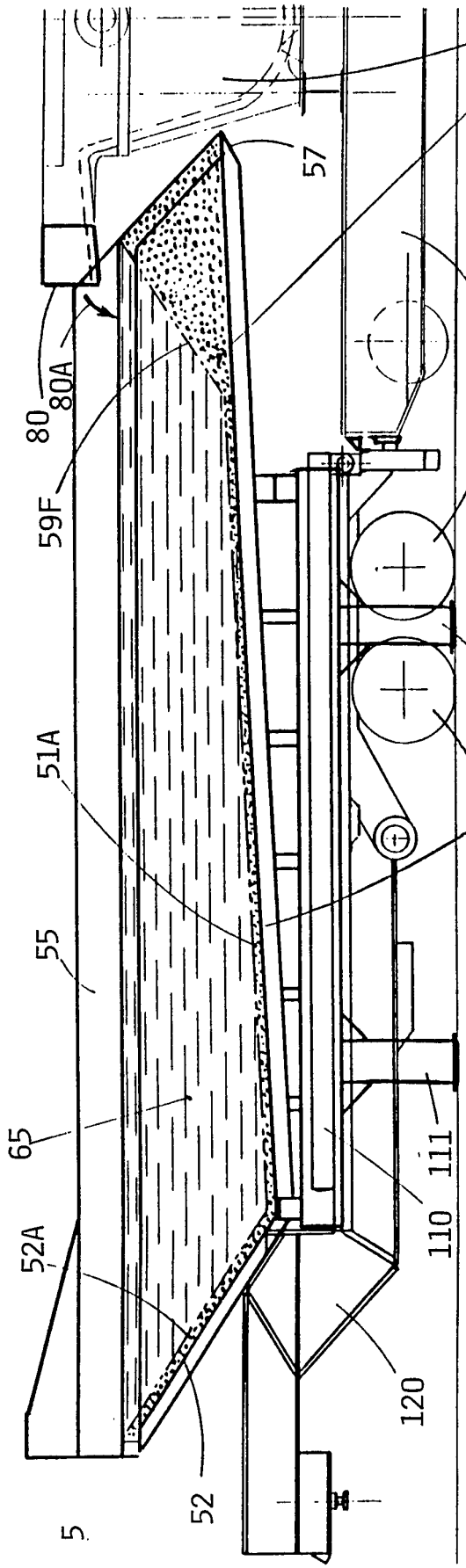
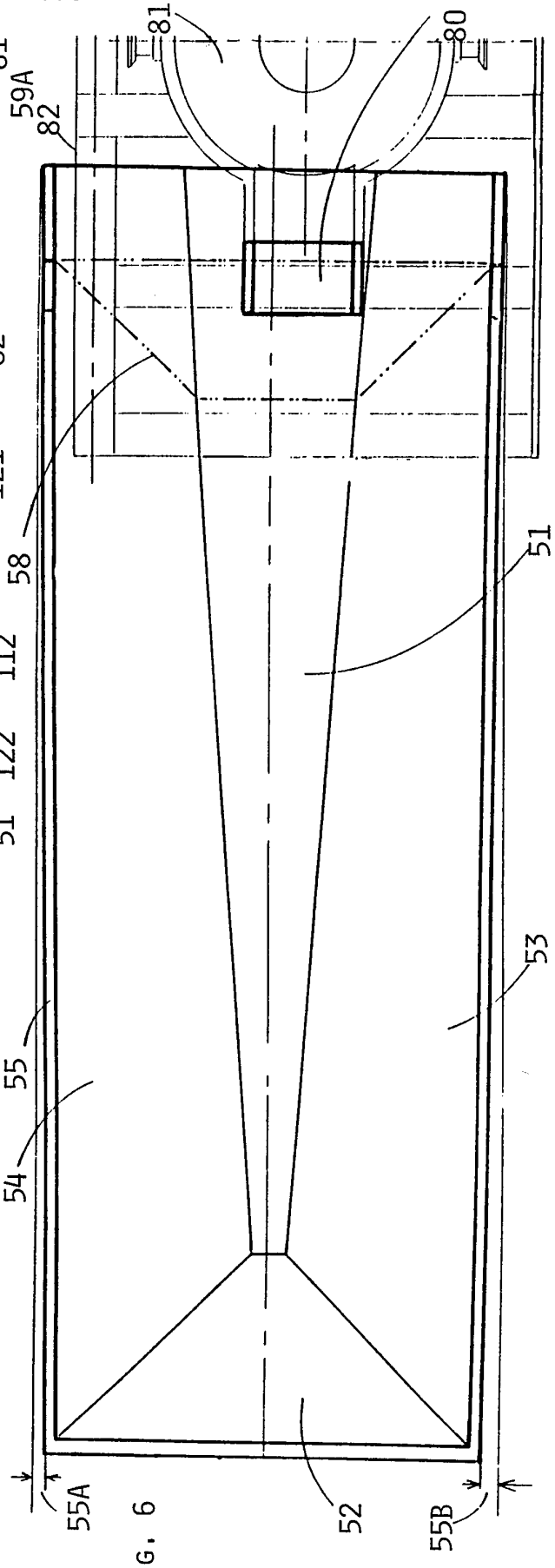

81
57
59A
82
80
80A
59F
82
121
112
122
51A
51
55
65
111
110
52A
120
52

FIG. 5


81
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59A
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55A
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55B

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 94/00155

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C21B 3/10 // B62D 33/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C21B, F27D, B62D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, CLAIMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent's abstract, No 84-218541/35, week 8435, ABSTRACT OF SU, 1067045 (DNEPR METAL WKS), 15 January 1984 (15.01.84)	1,2
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X	Derwent's abstract, No 86-257428/39, week 8639, ABSTRACT OF SU, 1211293 (VASILEV V YA), 15 February 1986 (15.02.86)	1,2,5
Y		9
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 December 1994	20 -12- 1994
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Mårten Hulthén Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 94/00155

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR, A, 1003551 (SOCIETE D'ELECTRO-CHIMIE, D'ELECTRO-METALLURGIE ET DES ACIERIES ELECTRIQUES D'UGINE), 19 March 1952 (19.03.52), figure 1, claims 1,2	1,2,5
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Y	Derwent's abstract, No 93-180819/22, week 9322, ABSTRACT OF SU, 1740422 (URALS FERR METALS RES INST), 15 June 1992 (15.06.92)	9
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Y	EP, A1, 0098127 (PHILIPPI-HAGENBUCH, INC.), 11 January 1984 (11.01.84), figure 1, claims 11,12, abstract	10-15,19-22
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A	US, A, 3288530 (W.H. MCGLADE), 29 November 1966 (29.11.66)	16-18
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A	US, A, 4314790 (PAUL METZ), 9 February 1982 (09.02.82), figure 1, abstract	1,2
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INTERNATIONAL SEARCH REPORT

Information on patent family members

26/11/94

International application No.
PCT/NO 94/00155

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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EP-A1- 0098127	11/01/84	AU-A-	1573683	05/01/84
		CA-A-	1199048	07/01/86
		JP-A-	59011981	21/01/84
		US-A-	4474404	02/10/84
		US-A-	4826233	02/05/89
US-A- 3288530	29/11/66	NONE		
US-A- 4314790	09/02/82	AU-B-	531997	15/09/83
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		BE-A-	878275	17/12/79
		CA-A-	1149349	05/07/83
		DE-A,C-	2900497	06/03/80
		FR-A,B-	2438227	30/04/80
		GB-A,B-	2032309	08/05/80
		JP-A-	55047316	03/04/80
		LU-A-	80145	21/04/80
		NL-A-	7906234	26/02/80
		SE-B,C-	437568	04/03/85
		SE-A-	7906822	23/02/80