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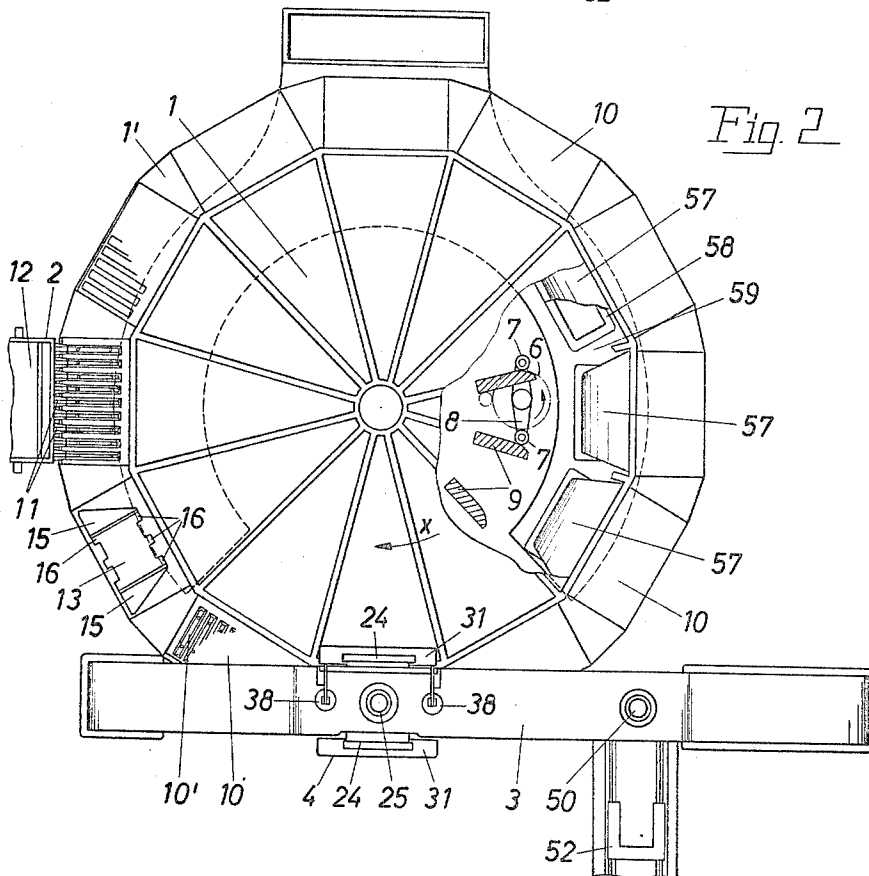
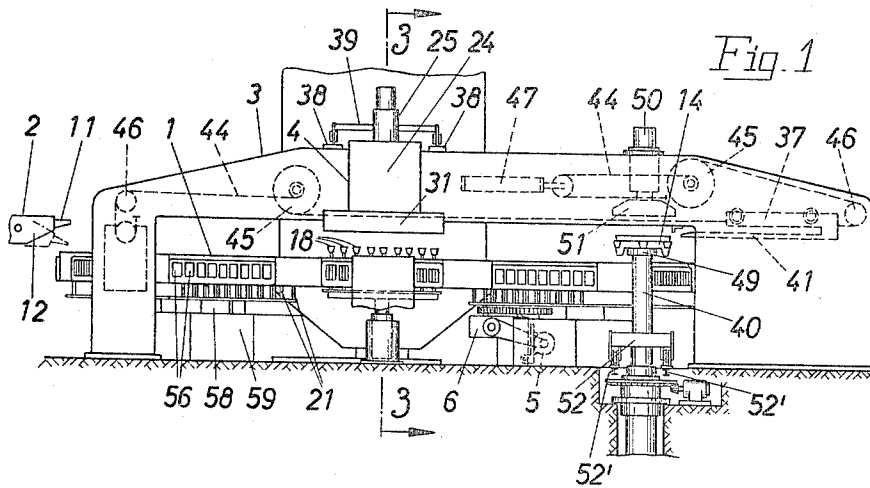
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FIG CASTING MACHINE

Filed Nov. 19, 1963

4 Sheets-Sheet 1



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PIG CASTING MACHINE

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4 Sheets-Sheet 2

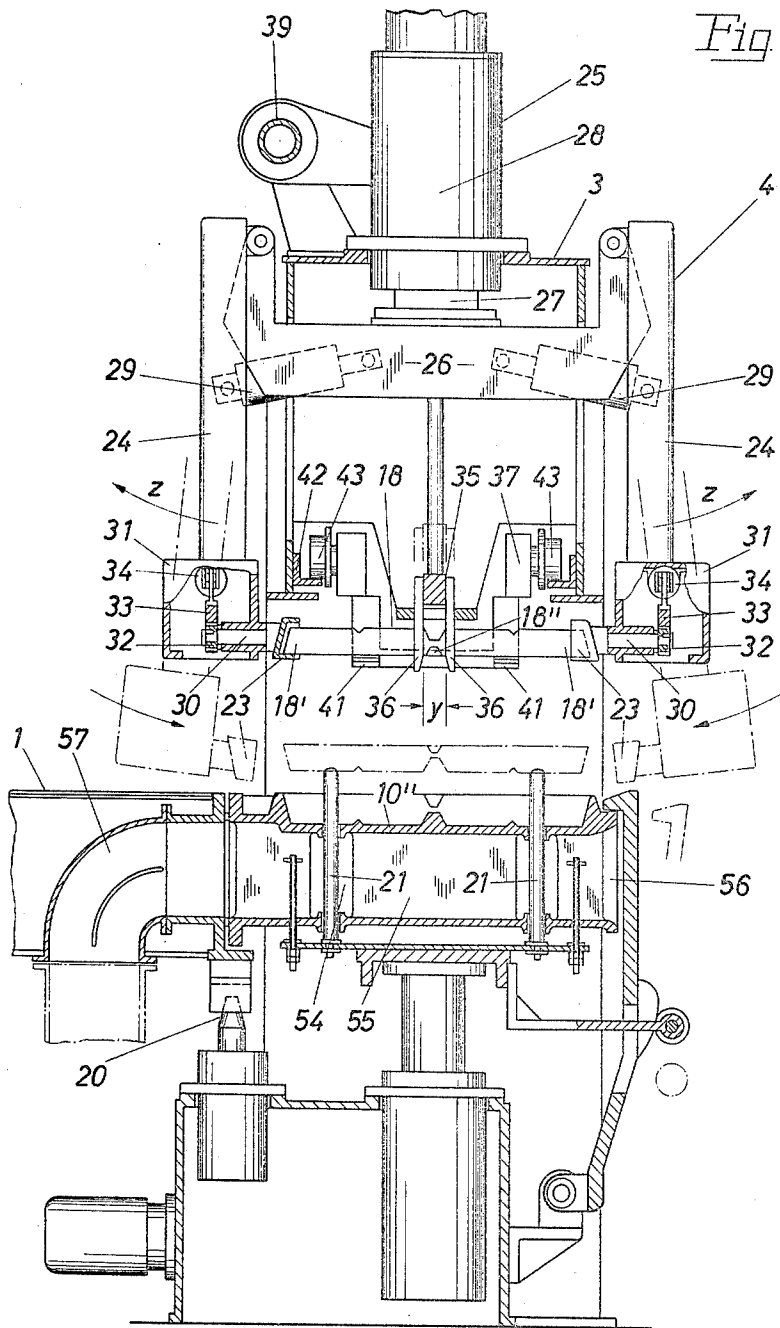
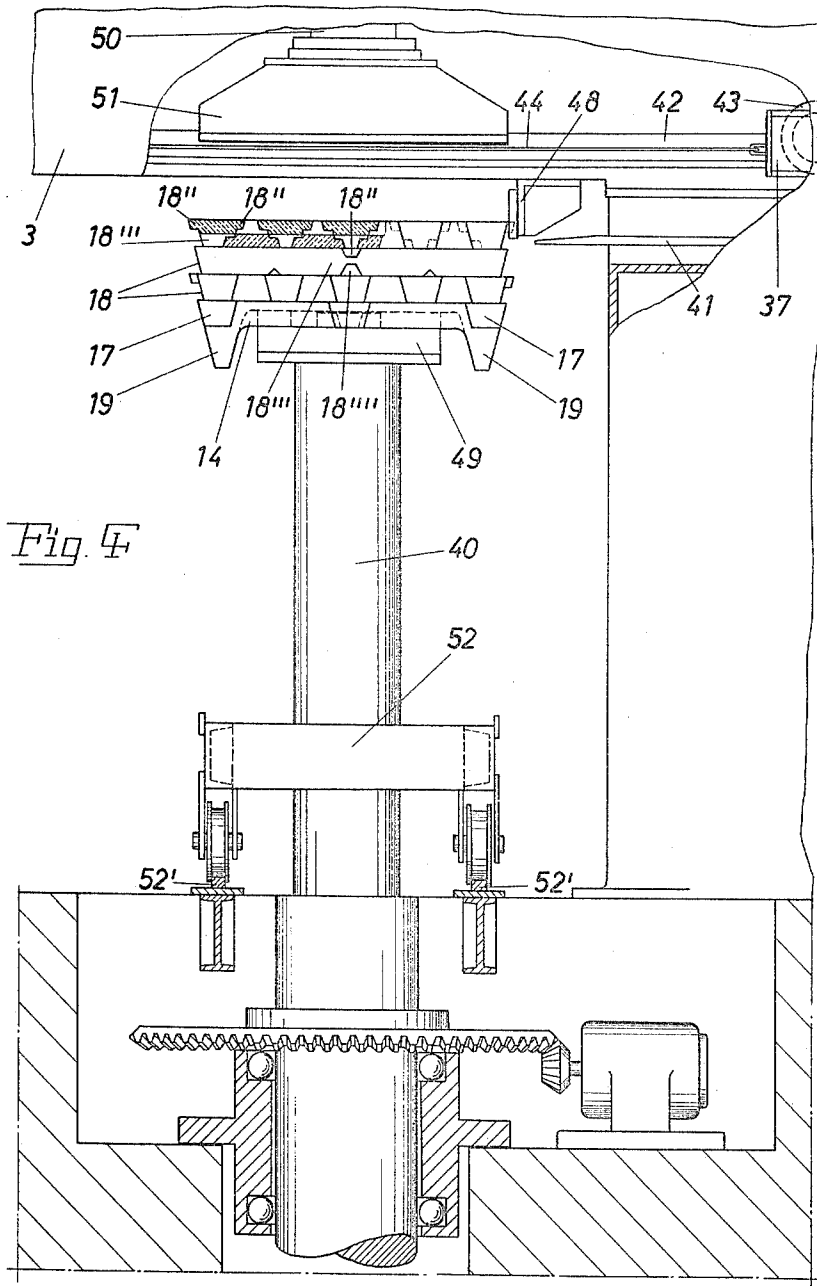


Fig. 3

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4 Sheets-Sheet 3



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FIG CASTING MACHINE

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4 Sheets-Sheet 4

Fig. 5

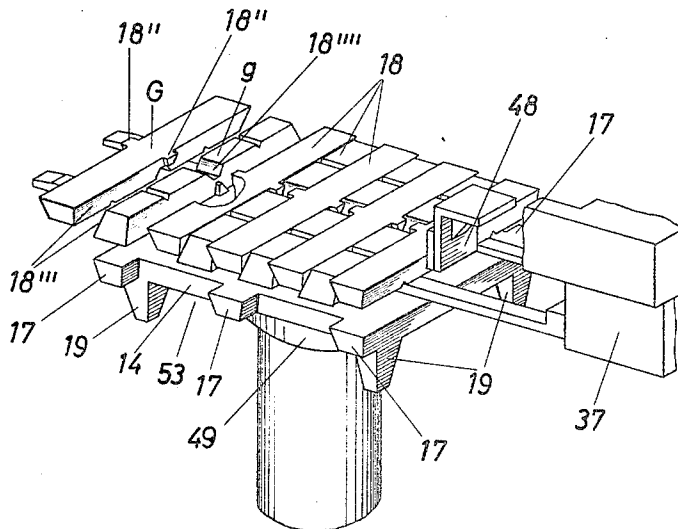


Fig. 6

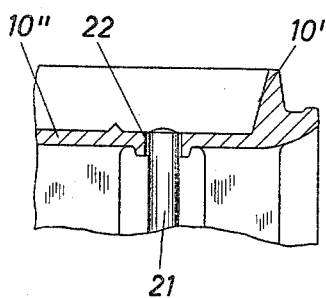
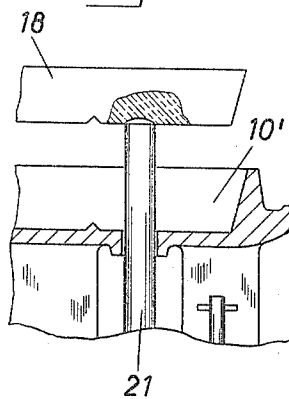


Fig. 7



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## PIG CASTING MACHINE

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W 34,085

6 Claims. (Cl. 22—63)

The present invention relates to a pig casting machine, in general and to such pig casting machine in particular, in which always one group of adjacently arranged chills is conveyed below a casting device and from there to a pushing and lifting device, which is followed by a storing device moving together in layers the pigs of each group of chills.

During the always more consequently performed automation of pig casting machines, the point has been reached to perform as much as possible automatically not only the operational steps connected directly with actual casting of the pigs, rather all operational steps up to the removal of a finished pile unit. Furthermore, the casting output was still more increased by the incorporation of effective cooling devices.

A pig casting machine is, thus, already known, which casts, defoams and stamps always simultaneously a plurality of pigs by means of a rotary table advanced by intermittent strokes and carrying the sets of chills and finally pushes the cooled pigs by means of cam-controlled or hydraulically operated shafts out of their chills. Such a pushing device brings about in cooperation with a lifting device, which is arranged above and movable out of the range of the discharging point, the removal of an entire group of pigs, in order to feed the same to a rotary piling table. In order to grip the pigs, the latter are individually taken from below by tongues which are operated by a pressure medium. In order to make possible hereby an easy gripping of the pigs from below, the latter are equipped with corresponding gripping projections at their free ends.

Working cylinders, extending in the direction of movement of the movable removal device, coordinated to the gripping tongues and subjected to the action of a pressure medium, bring about subsequently a moving near to each other of the pigs of the lifted group of pigs, and in particular from the outside toward the inside, so that the center pig retains its present position, while all the other pigs join the horizontal displacement performed by means of the gripping tongues. Thus, upon setting the group of pigs upon the rotary piling table, an abutting staple layer results. The piling table can be turned for 90° after each depositing of a layer of pigs, until, after reaching the desired height of the pile, the transportation of the finished pile can be performed.

The means causing the moving near to each other of the pigs, however, are too cumbersome, due to their complicated manner of mounting also too liable to interferences and thus by no means adapted to the rough manner of operation of a pig casting machine. Aside from the fact that only by moving the pigs near to each other, by no means the desired inner position stability of the layers of a piled-up heap of pigs can be obtained, it is to be considered, that the pigs usually have a trapezoidal cross-section, so that by movement of such pigs near to each other only an engagement along the edges and not along the surfaces is achieved.

On the other hand, it is already known for piling up of pigs with trapezoidal cross section, to turn over every second pig of a pig layer, whereby the desired abutment along the surfaces is given. However, no operating or

2

auxiliary devices are provided therefor; the piling is rather performed manually, so that the operators piling up the pigs are constantly within the range of heat radiation of the pigs. Moreover, such manner of operation is time-consuming and complicated, particularly since the pigs are provided with inter-engaging projections and recesses and have to be deposited accordingly.

It is, therefore, one object of the present invention to provide a pig casting machine, as set forth above, in which the pigs discharged from the chill are assembled to the smallest possible, safely standing pile in a fully automatic operation and with a simple and strong design of the machine.

It is another object of the present invention to provide a pig casting machine, wherein a transportation fork is inserted below the pigs, which are carried by a lifting device and which have trapezoidal cross-section and gripping projections, and wherein the lifting device turns every second pig about its longitudinal axis and the transportation fork takes over the pigs, and wherein an abutment enters between the prongs of the fork above a piling table adjustable as to its height, which abutment strips off the pigs from the transportation fork during the return movement of the latter, thereby moving the pigs near to each other.

Due to the now also mechanically performed turning over of every second of the pigs having a trapezoidal cross-section, the advantageous, stable and space-saving formation of the pile can now also be performed within the working cycle of the machine. The turning over of the respective pigs is brought about always during the upwardly directed movement of the lifting device. Subsequently a transportation fork takes over the pigs which are still spaced apart from each other, in order to pile up the latter directly above a combined lifting and rotary table, by means of a stationary abutment moving the pigs near to each other and stripping them off from the fork. Thus, the movement of the fork carriage is used in an advantageous manner for the moving of the pigs near to each other and for the subsequent stripping off of the latter. The friction produced by the own weight of the pigs during their movement near to each other has, thereby, a favorable effect on the uninterrupted and on large surfaces abutting assembling of each layer of pigs. It has been found that the abutting position is sufficiently maintained during the sliding off of the pigs from the fork onto the piling surface. Thus, the formation of a transportable pile is achieved.

It is another object of the present invention to provide a pig casting machine, wherein the favorable formation of the pile is coordinated to the working cycle by the fact that a pressing stamp is disposed above the piling table which turns always for about 90°, which pressing stamp presses down the piling table stepwise for the height of the pigs. In the first place, the pressing stamp produces with sufficient accuracy the free space required for the next layer of pigs and the movement therebelow of the fork, and, on the other hand, the same pressing stamp prevents an edging of the pigs of the previously deposited layer. During the lowering movement of the piling table the pigs are pressure-loaded.

It is still another object of the present invention to provide a pig casting machine, wherein a favorable design, an operation free of breakdowns, and in particular a safe transfer of the pigs from the combined lifting and turning device to the transportation fork is realized in an advantageous manner.

It is yet another object of the present invention to provide a pig casting machine, wherein a movement-controlled straightening rake is provided between the shoes of the lifting and turning device, which shoes grip the pigs at their

front ends and the prongs of which rake extend in their lowermost position between the pigs.

It is a further object of the present invention to provide a pig casting machine, wherein in an advantageous manner the straightening rake has two rows of prongs and the distance between the two prong rows is substantially equal to the width of gripping projections provided at the pigs and entering in slots of the adjacent pigs. The arrangement of the prongs of the straightening rake which can be lowered onto the pigs is such that an adjustment of the position of the individual pigs in the direction of their longitudinal axis, as well as in crosswise direction relative to each other is achieved. According to the present invention it is favorable for the entry of the straightening rake, capable of being lowered into the row of pigs, if the prongs of the straightening rake are bevelled inside at their ends.

It is still a further object of the present invention to provide a pig casting machine, wherein the chills are designed such that it is advantageous for the depositing of the pigs onto the surface of the pile and also for the holding by the straightening rake, so that the finished pigs have gripping extensions projecting laterally on both sides at the base of the trapezoidal cross-section at about the longitudinal center of the pigs, while the upper side of the pigs has a slot extending over the entire width of the pigs.

With these and other objects in view, which will become apparent in the following detailed description, the present invention will be clearly understood in connection with the accompanying drawings, in which:

FIGURE 1 is a front elevation of a pig casting machine, designed in accordance with the present invention;

FIG. 2 is a top plan view of the pig casting machine disclosed in FIG. 1;

FIG. 3 is a fragmentary vertical section taken along the lines 3—3 of FIG. 1;

FIG. 4 is an elevation of the piling device of the pig casting machine according to the present invention, shown partly in section and disclosing the position after deposit of a group of pigs;

FIG. 5 is a perspective view of the portion of the machine disclosing a group of pigs on a previously deposited piling pallet;

FIG. 6 is a fragmentary section through the end of a chill showing the shaft which expels the pig from the chill; and

FIG. 7 is a section similar to that of FIG. 6, showing the pig in expelled position.

Referring now to the drawings, and in particular to FIGS. 1 and 2, the completely automatically operating pig casting machine comprises a rotary table 1, a pouring device 2 and, furthermore, a bridge 3 disposed tangentially to the rotary table 1 and including a removal device 4 and a piling device 40.

The drive for the rotary table 1 is obtained by a motor 5. An intermittently operating actuating means 6 is coordinated to the motor 5, a switching lever 8 of which, being equipped with rollers 7, is in mesh with switching teeth 9 of the rotary table 1, so that the latter is moved stepwise in the direction of the arrow x (FIG. 2).

A plurality of groups 10 of individual chills 10' are arranged annularly and in radial direction on the edge portion 1' of the rotary table 1, which groups 10 pass successively the pouring device 2, in order to then reach the removal device 4 during the stepwise advancing movement. A casting lip 11 is coordinated to each individual chill 10' of a chill group 10 and the casting material flows through the lips 11 into the chills 10' upon tipping the ladle 12.

Furthermore, a chill 13 is inserted in the sequence of the chill groups 10 for the production of a pallet 14 (FIG. 5). The casting material is fed also into this pallet chill 13 by means of all casting lips 11, so that the time for filling is the same for all chills. Therefore, the

pallet chill 13 has inlet troughs 15 projecting on opposite sides beyond the proper square form of the pallet body, which troughs 15 extend at their widest portions over the area of the casting lips 11. The depth of the troughs 15 is, however, relatively small, so that only relatively little metal circulating between casting and melting remains in those troughs 15. Thus, during the same casting time of the casting lips 11 substantially the same amount of material can flow into the pallet chill 13 as into a chill group 10. Opposite the range of the casting lips 10, the inlet troughs 15 are tapered down to the actual width of the square pallet chill 13.

During the subsequent lifting of the pallet 14 from the chill 13 prior to reaching the storing device, which pallet 14 is already sufficiently cooled before reaching the storing device, the cast-on projections, formed by the contents of the inlet troughs 15 and representing circulating material, break off easily, this breaking off being caused by the expulsion device. They are then fed again to the melting furnace.

Finally, the pallet chill 13 is provided with recesses 16 arranged at opposite sides and spaced apart from each other at a predetermined distance. These recesses 16 produce the gripping projections 17, serving the purpose of gripping of the pallet by the removing device 4. The gripping projections 17 have moreover the same cross-section as the pigs 18 (FIG. 5). The pallet 14 is equipped with legs 19, so that a four-way penetration of the lifting fork, for example, a fork storing device, into the tunnel-like, free space is made possible.

The removal of the meanwhile cooled groups of pigs 18 as well as of the pallet 14 repeating in predetermined intervals, is also performed within the cycle of the casting process.

Referring now again to the drawings, and in particular to FIG. 3, the corresponding removal device 4 is disclosed. At first, the rotary table 1 is automatically adjusted as to its position by means of an arresting device 20, after a group 10 of chills 10' is in a position below the removal device 4. Hydraulically or pneumatically operated cylindrical shafts 21, which are simultaneously projecting through the bottoms 10'' of all chills 10' of a chill group 10, lift the pigs 18 of this chill group into the position indicated in point-dotted lines in FIG. 3. In the position in which the chills 10' are ready to be filled, however, the cylindrical shafts 21 are returned to be almost flush with the surface of the bottom 10'' of the chills 10' (FIG. 6). Only the slightly spherically designed free ends of the shafts 21 project for a short length into the hollow space defined by the chills 10'. Furthermore, the openings 22 for the passage of the cylindrical shafts 21 are dimensioned such that no liquid metal can pass through these passage openings 22. It has been found that the spherically designed ends of the shafts 21 are suitable in an advantageous manner for a safely operating lifting of the pigs 18. The swingable gripping arms 24 of a lifting device 25, which gripping arms 24 are equipped with shoes 23, grip the free ends 18' of the pigs 18, in order to move the latter into the position shown in full lines in FIG. 3.

The gripping arms 24 are pivotally mounted on a yoke 26, which is secured to the lower end of the piston rod 27 of a working cylinder 28 and thus transmits the lifting movements. The relatively performed swinging movement of the gripping arms 24 is brought about by means of hydraulically controlled cylinders 29, which are pivoted at one end to the yoke 26 and at the other end to the gripping arms 24.

During the upwardly directed movement of the lifting device 25 a turning of every second pig 18, and in particular for 180°, about its longitudinal axis takes place simultaneously, so that at a later time point a moving to each other of the individual pigs 18, without leaving any space therebetween, is possible, whereby the pigs 18 have a trapezoidal cross-section also for reasons of the casting

technique. Rigidly secured shoes 23 are, therefore, coordinated to the pigs 18 which are not to be turned over, whereas rotatable shoes 23 are coordinated to the pigs 18 to be turned over. The rotatable shoes 23 are provided with shaft pins 30, which reach into a housing-like projection 31 of the gripping arms 24. A toothed gear 32 is keyed to the free end of each of the shaft pins 30, which toothed gear 32 is in connection with a gear rack 33 (FIG. 3), which is subjected to the action of a pressure medium and causes the turning movement. The working cylinder 34 driving the gear rack 33 is, preferably, housed in the housing-like projection 31.

After the turning of every second pig 18 is completed, a straightening rake 35 (FIG. 3), the movement of which is controlled by the pressure cylinders 38, is now lowered, which rake 35 is provided with a double row of teeth 36. The straightening rake 35 has the function to adjust the position of the group of pigs 18 such, that each pair of teeth 36 engages the gripping projections 18'' cast at about the longitudinal center of the pigs 18 at the base G (FIG. 5) of the trapezoidal cross-section of the pigs 18. The free distance y (FIG. 3) of the two tooth rows corresponds substantially with the width of the gripping projections 18''. Furthermore, the teeth 36 of the straightening rake 35 are bevelled at their ends on the inner side. Any movement of the pigs 18 in the direction of their longitudinal axis, as well as in crosswise direction relative to each other is prevented, so that now the entire group of pigs 18 can be released for the purpose of transferring it to a transportation carriage 37, that means, the gripping arms 24 swing out, therefore, in the direction of the arrow z (FIG. 3). The straightening rake 35, controlled by means of the two pressure cylinders 38 (FIG. 1), is equipped with a connecting frame 39 for the purpose of providing a good parallel guidance.

The transportation carriage 37, conveying the pig group from the removal device 4 to the piling device 40 (FIGS. 1 and 4), has a transportation fork 41 gripping from below the pig group and furthermore rollers 43 running on stationary rails 42 (FIGS. 3 and 4). The drive of the transportation carriage 37, appropriately adapted to the working cycle of the machine, takes place by means of pulling chains 44, which in turn are guided over winches 45 and directional pulleys 46 and are connected with a working cylinder 47 (FIG. 1).

Shortly before terminating the movement of the transportation carriage 37 in the direction towards the piling device 40, a movement near to each other and a following stripping off of the group of pigs 18 takes place, and in particular, by means of a stationary abutment angle 48 (FIG. 5) which extends into the path of the carriage 37. At first the pig 18 closest to the abutment angle 48 strikes against the abutment 48. The fork 41, moving away continuously below the pigs 18, feeds each following pig 18 in the direction of the abutment 48 against the previously moved pig 18, so that the narrow longitudinal side faces 18''' of the pigs 18 engage each other totally over their engaging faces and abut against each other without any spacing. The gripping projections 18'' cast to the narrow longitudinal side faces 18''' enter successively into corresponding slots 18'', which extend over the entire width of the upper face g of the pigs 18. The engagement of the individual pigs 18 with each other causes an advantageous abutting position of the pigs 18, even then, if they perform a passing slight tipping movement at the moment of sliding off of the pigs from the pointedly shaped carrying fork 41. The stripping off of the pig groups, as well as the stripping off of the pallet 14, previously performed in the same manner, which pallet 14 serves as a loading surface, thereby takes place exactly above the combined lifting and rotary table 49 (FIGS. 1 and 4) constituting the piling device 40.

After each deposit of a layer of pigs 18, a pressure stamp 50 arranged directly above the piling device 40 in the bridge 3 presses the pile downwardly for a corre-

sponding length by means of a stamping plate 51, so that a sufficiently large free space for the displacement of the transportation fork 41 of the carriage 37 is again available. In addition, the pressure stamp 50 maintains also the pig group free from turning. The lowering movement of the pressure stamp 50 is also performed within the working cycle of the machine.

A car 52 (FIG. 4) guided on tracks 52' carries the completed pile, for example, into a pile store, where it is taken over by a lifting device and can be fed to a weighing device, in order to be shipped as a pile unit ready for selling.

During the expulsion of the pallet 14 from the pallet chill 13, the shoes 23 only, which are rigidly mounted on the gripping arms 24, grip the gripping projections 17 formed at the pallet 14. The shoes 23, which normally bring about the turning of every second pig 18, turn, thereby, idle, and in particular in the recesses 53 (FIG. 5) of the pallet 14 formed at a distance identical with that of the gripping projections 17.

The casting output of a pig casting machine depends, not at last, also upon a possibly fastest cooling of the chill groups. Cooling air channels 54 (FIG. 3) are provided below the bottom 10'' of the chill groups 10, as well as, below the pallet chill 13. These channels 54 have guide walls 55 (FIG. 3) disposed in the direction of the flow of the cooling air, furthermore outwardly directed suction openings 56 and inwardly disposed-knee-shaped branches 57 (FIGS. 2 and 3). The latter move within the cycle of the stepwise advance stroke over corresponding branches 58 of a cooling channel 59 (FIGS. 1 and 2), which is connected to a suction blower (not shown). The cooling channel 59 is of about horseshoe shape, so that the chill groups 10, disposed in the closer range of the removal device 4, are not connected with the cooling air.

While we have disclosed one embodiment of the present invention, it is to be understood that this embodiment is given by example only and not in a limited sense, the scope of the present invention being determined by the objects and the claims.

We claim:

1. A pig casting machine, comprising
  - a plurality of groups of adjacently arranged chills,
  - a device pouring material successively into each of said groups of chills to form pigs complementary to said chills,
  - means for moving successively said groups of chills below said pouring device,
  - means for removing said pigs from said chills,
  - means for lifting each of said group of pigs from said removing means to a conveying position,
  - means for piling up adjacent each other said pigs of each of said groups,
  - said piling means following said lifting means,
  - said pigs being of trapezoidal cross-section and having gripping projections,
  - said lifting means including means for turning each second pig of each of said groups for an angle of about 180° about its longitudinal axis,
  - a transportation fork having at least two teeth and receiving said pigs from said lifting means,
  - means for changing the level position of said piling means, and
  - an abutment means disposed between said teeth of said transportation fork above said piling means and stripping off said pigs from said transportation fork and, thereby, moving closely to each other said pigs during the return stroke of said transportation fork.
2. The pig casting machine, as set forth in claim 1, which includes
  - means for turning intermittently said piling means for an angle of about 90°,
  - a pressure stamp disposed above and engaging the

7

- uppermost of said groups of pigs supported by said piling means, and  
 said pressure stamp lowering intermittently said piling means and, thereby, said groups of pigs supported by the latter for substantially the height of said pigs. 5
3. The pig casting machine, as set forth in claim 1, wherein  
 said lifting means includes shoes gripping the end positions of said pigs,  
 a straightening rake having at least two teeth and disposed between said shoes, and 10  
 said teeth of said straightening rake enter between said pigs in the lowermost position of said teeth.
4. The pig casting machine, as set forth in claim 3, wherein 15  
 said teeth of said straightening rake are inclined at their inside at the ends thereof.
5. The pig casting machine, as set forth in claim 3, wherein

8

- each of said pigs has gripping projections extending from one of the longitudinal faces of said pigs and the diametrical opposite face of said pigs has a complementray recess receiving said gripping projections from closely adjacent pigs, and  
 said teeth of said straightening rake are spaced apart at a distance equal with that of the width of said gripping projections.
6. The pig casting machine, as set forth in claim 5, wherein  
 said chills have recesses complementary to said gripping projections of said pigs and projections complementary to said recesses of said pigs.

No references cited.

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