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- (21) Application No. 35589/77
- (22) Filed 24 Aug. 1977
- (23) Complete Specification filed 26 May 1978
- (24) Complete Specification published 29 April 1981
- (51) INT. CL.<sup>3</sup> B28B 1/26
- (52) Index at acceptance  
B5A 1R151 1R400 1R420 1R424 2B2 2E3 2V T13P
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(54) CASTING INSTALLATIONS

(71) We, IDEAL-STANDARD LIMITED, a British company, of P.O. Box 60, Kingston-upon-Hull, HU5 4JE, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an installation for casting ceramic material in slip form and particularly although not exclusively, for casting articles of sanitary ware of vitreous china; the invention is also concerned with a method of casting articles in such a casting installation.

According to one aspect of the present invention, there is provided an installation for casting ceramic material in slip form, comprising a mould unit including a first mould part and a second mould part, which mould parts are adapted to be assembled for a casting operation to define between them at least two casting cavities into which slip can be introduced and which correspond respectively to the shapes of discrete articles, and mould parts being arranged on a support structure and being adapted so that they can be separated for removal of cast articles or assembled for casting by relative movement of the mould parts in a generally horizontal direction, at least one of the parts being carried by transport means to enable that part to be moved relative to the support structure in a generally horizontal direction.

According to another aspect, the present invention provides an installation for casting ceramic material in slip form, comprising a plurality of mould units, each mould unit including a first mould part and a second mould part, which mould parts are adapted to be assembled for a casting operation to define between them at least two casting cavities into which slip can be introduced and which correspond respectively to the shapes of discrete articles to be cast in the mould unit, the mould units being arranged in a generally horizontal line on a support with the first mould part of one mould unit being

connected to the second mould part of the next adjacent mould in the line, and each mould unit being adapted to be opened and closed by relative movement of the respective mould parts in a direction longitudinally of the line of mould units.

The casting cavities in the or each mould unit may for example be disposed one above the other or side by side, i.e. transversely of each other relative to the horizontal separation and assembly direction; or, if more than two cavities are provided in the or each mould unit, both side by side and on two or more levels or tiers.

An advantage of the present invention is that for each mould unit providing two or more articles, the mould handling time is less than if individual, one-article moulds are used. Only one separation step is needed to permit removal of the two or more articles. Since the mould parts are always supported, and the opening of the or each mould unit is effected by horizontal movement, the weight of the mould parts of the or each mould unit, which weight will, of course, be greater than that of mould parts of individual moulds for forming such articles individually, is not important because the mould parts do not have to be lifted bodily at any time in the casting operation but are simply slid or moved on roller carriers, for example, in the horizontal direction for opening and closing. Further advantages of the invention are the economy of the space taken up by each mould unit, and the increased production capacity by filling and draining all the multiple cavity mould units in the same casting operation.

According to a preferred feature, the first and second mould parts of the or each mould unit are each formed as an integrally cast mould part. Thus each mould part is a unitary structure so that the mould making operation is more efficient. Mould parts for casting ceramic material are generally made of plaster which is itself cast and according to this feature, therefore, each mould part, having the two or more cavity halves, is cast integrally in one piece.

Alternatively, the first and second mould

parts of the or each mould unit may each be formed by securing together a number of individual mould portions corresponding to the number of casting cavities in the mould unit, each mould portion affording the male or female half of one casting cavity of which the other half (female or male respectively) is provided in the other mould part. Thus, a mould unit may be made by taking two individual, one-article moulds and securing the two male portions together to form a first composite mould unit part and the two female portions together to form a second composite mould unit part, the two male portions and the two female portions being correspondingly arranged relative to each other side by side or one above the other, for example, so that the two composite mould unit parts can be brought together by movement in a horizontal direction to close simultaneously both the casting cavities of the two, previously individual, moulds, in the one mould unit.

The casting cavities in the or each mould unit will each be provided with an inlet, which may in each case communicate interiorly of the mould unit with a common slip supply duct leading to the outside of the mould so that all the mould cavities are filled by introducing slip at a single inlet to the mould unit. Alternatively, the inlets of the mould cavities may be connected to separate slip supply pipes but preferably they are connected outside the mould unit with a common slip supply in such a way that the casting cavities are filled simultaneously or successively. In another alternative, the inlet for one of the casting cavities may be connected to an outlet from the or another casting cavity of the mould unit whereby, in use, the slip for filling that one cavity passes through the or another cavity before entering that one cavity; such a connection may conveniently be effected outside the mould simply by means of a piece of flexible tube, for instance, but it would alternatively be possible to provide a connecting duct between the casting cavities internally of the mould unit.

The casting cavities in the or each mould unit may be shaped to cast similarly shaped or sized articles or differently shaped or sized articles, and the casting cavity of the or each mould unit may be designed for casting solid-cast articles or articles having one or more hollow cast regions. In the latter case, each casting cavity will have a drain outlet at the lowermost point of the hollow cast region for draining excess slip from the mould cavities.

If the casting cavities are disposed side by side draining will probably but not essentially be carried out simultaneously either via separate drain outlets from the mould unit or via a common drain outlet

of the mould unit communicating interiorly of the mould unit with each casting cavity.

If the casting cavities in the or each mould unit are disposed one above the other, it may be advantageous for the upper casting cavity to be designed for casting an article having one or more hollow cast regions with a thinner cast wall thickness than that of the hollow cast region or regions of the article which is cast in the lower casting cavity, and for the drain outlet from the upper cavity to be connected to an inlet of the lower cavity so that in use the excess slip from the upper cavity drains through the hollow cast regions of the article formed in the lower casting cavity. Whilst this through-draining is not important in itself, it is believed that during the casting stage when the casting cavities are left full for a while before draining, because the lower cavity wall be under a slightly greater head of slip pressure than is the upper cavity a thicker cast wall is formed in the lower article. This feature is not seen to be of great advantage however since economically it will probably be better to cast similar articles in each cavity or at least articles which have the same production demand.

The invention may be carried into practice in a number of ways but certain specific embodiments will now be described, by way of example only with reference to the accompanying drawings in which:—

Figure 1 shows diagrammatically part of a first casting installation in accordance with the invention for casting washbasins;

Figure 2 is an end view of the installation of Figure 1;

Figure 3 shows a casting installation in accordance with the invention and including a plurality of mould units, similar to that shown in Figure 1, arranged in a line;

Figure 4 shows diagrammatically a casting installation for casting washbasin pedestals;

Figure 5 is an end view of two adjacent lines of mould units such as those shown in Figure 4;

Figure 6 is a perspective view of the inside of the male part of one of the mould units shown in Figure 4; and

Figure 7 is a perspective view of the inside of the female part of one of the mould units shown in Figure 4.

Referring to Figures 1 and 2, there is shown a mould unit comprising first and second mould parts 1 and 2 each part being made up of integrally formed upper and lower mould portions. The first mould part 1 includes upper and lower male mould portions 3 and 4 each having the male half of a casting cavity for forming a washbasin (in Figure 1 a cast washbasin is shown on the upper portion 3 ready for removal), and

the second mould part 2 includes upper and lower female mould portions 5 and 6 each having the female half of a casting cavity corresponding respectively to the male mould portions 3 and 4. The mould parts 1 and 2 are supported on respective carriers 9 provided with rollers 7 which are arranged to run along longitudinal tracks 8 extending horizontally. As shown in Figure 2, one track is higher than the other so that the moulds are tilted transversely, by 12° for example, to facilitate draining, as will be explained.

The upper and lower female mould portions 5 and 6 of mould part 2 are provided with respective inlets 10 and 11 for admitting slip into the two casting cavities formed when the mould parts 1 and 2 are assembled; the inlets 10 and 11 which are in the same relative position in each case are disposed in that region of the mould which forms the back wall of the basin at the lowermost corner of the mould cavity. The upper and lower female mould portions 5 and 6 are also provided with respective slip outlets 12 and 13 which are afforded by short pieces of plastics tube embedded in the mould wall and protruding a short distance outside the mould. The outlets 12 and 13, in use, each have one end of a respective clear plastics tube 15 removably connected on it, the tube extending up to a connector in a line 16 connectible to a source of air under pressure and extending along above the mould units. The inlets 10 and 11 of the upper and lower mould portions are both connected to a common slip entry tube 17 afforded by a piece of plastics tube embedded in the mould wall, which can be connected by a piece of flexible tube 19 to a slip supply and drainage pipe 20 (see also Figure 3) extending along underneath the mould units.

As can be seen particularly in Figures 2, and in Figure 3 which will be referred to in more detail below, the cavity inlet 10 communicates interiorly of the mould unit with the common slip entry tube 17 by an internal channel 14 extending up the mould unit, this channel 14 and the short branch channel leading to the lower inlet 11 comprising a surface channel in the face of the female part 2; when the male and female parts 1 and 2 are brought together for casting, the surface channel lies adjacent the face of the male part 1 and thereby becomes a closed wall internal duct.

As shown in Figure 1, the male part 1 of each mould unit illustrated is rigidly connected by means of resin-bonded wedges 21 to the female part 2 of the next adjacent mould unit in back-to-back arrangement so that those two mould parts 1 and 2 are supported on a common carrier 9 for movement together along the tracks 8. A com-

plete installation of such mould units is shown in Figure 3, the horizontal line comprising fifty mould units 1A, 2A; 1B, 2B; 1C, 2C; etc, the male part of each mould unit being rigidly connected back to back with the female part of the next adjacent mould unit. It may of course be possible to form the back-to-back parts (2A, 1B) (2B, 1C) (2C, 1D) etc., integrally as unitary cast mould pieces. Like the mould parts shown in Figure 1, they are each disposed generally vertically, i.e. so that the basins are each cast in a position in which the rim lies in a vertical plane with the back wall of the basin facing downward. The tracks 8 are somewhat longer than the mould line so that the mould parts can be moved horizontally along the track a short distance for opening and closing each mould unit. An overall clamping arrangement, e.g. a pneumatic ram, is provided at one end of the line for pressing all the mould parts together against an abutment 25 at the other end of the line.

Adjacent one end of the line is a tank 27 for containing ceramic slip, connected at the bottom to the lower manifold pipe 20 extending with a gradual slope along underneath all the mould units of the line. All the mould units are connected by the individual flexible tubes 19 to the lower manifold pipe 20.

In operation, the mould parts in turn are cleaned and each female part is treated with a releasing agent and each male part is treated with a holding agent. The male and female parts of each mould unit are closed up to each other, located in each case by co-operating projections and recesses, and when all the mould units are closed the complete line is clamped up under pressure.

The mould units are then all filled in one operation with slip flowing under gravity from the tank 27 the slip passing via the lower manifold pipe 20, up through the individual flexible tubes 19, into the mould entry tubes 17 and into the inlets 11 at the lowermost region of each lower casting cavity, the slip rising in the lower cavity of each mould unit simultaneously until the level rises to the level of the outlet 13 when slip will flow out from the lower mould cavity into the plastics tube 15 connecting it to the upper air manifold pipe 16. As the lower cavity fills the level of the slip will also rise in the internal duct 14 and when the lower cavity is full the slip will continue to flow up the duct 14 in to the upper cavity to fill that cavity. The slip level continues to rise until it flows out through the outlet 12 of the upper cavity and into the respective plastics header tube 15 above the mould unit to the same level 22 as the level in the tank. Small vent ducts are provided at the top of each mould cavity

to allow escape of air displaced during filling; these ducts become blocked with slip once the mould cavity is filled and play no further part.

5 The mould units are then left for about 1 hour during which time casting takes place, moisture being absorbed by the plaster of the moulds; during this casting time a small amount of top-up slip will enter the  
10 mould cavities both from the tank via the lowermost inlets 10 and 11 and from the header tubes 15 to replace the volume of moisture absorbed. Throughout the casting time, the slip in the lower cavity of each  
15 mould unit will be under a slightly greater head of pressure than the slip in the upper cavity.

After the casting time has elapsed the lower manifold pipe 20 is opened to drain  
20 and at the same time air is applied to the upper line 16 so that air is injected into all the individual header tubes 15, through the mould apertures 12 and 13, to the hollow cast regions of the articles in the upper and  
25 lower portions of each mould unit at the point (depending upon the design of the washbasins being cast) approximately half-way down each mould cavity, the air pressure being of 3 to 4 lbs per sq. in., the air  
30 initially passing up through the liquid slip in the region of each article which is to be hollow in the finished article, thereby to prevent a suction effect occurring as the excess liquid slip is drained, which suction  
35 would otherwise cause the soft cast slip to be pulled away from the surface of the mould. The air pressure forces the surplus slip out through the lower apertures 10 and 11 of the two mould cavities and into the lower manifold pipe 20. In other embodiments it may  
40 be arranged to have a single air supply tube 15 for each mould unit, to supply air to the upper mould cavity, the air then passing via a suitable internal duct to the hollow  
45 cast regions of the article being cast in the lower cavity.

When all the excess slip has been drained the operator releases the overall clamping arrangement and, starting at one end of  
50 the line, opens each mould unit in turn and removes the upper and lower articles, in turn, from the mould unit on a respective setter, placing them on a shelf nearby for drying and further processing. When  
55 each mould unit is opened the cast articles adhere to the male part as shown on the upper mould portion 3 in Figure 1. Before releasing each article a setter is placed onto two pins 24 projecting from the male mould  
60 part below each article-forming portion 3, 4, to hold the setter in a position to support the article when it is released. With the setter so positioned, a blast of air is directed at the top edge of the article to release the  
65 slight adhesion of the green cast material

to the male mould portion and the article settles onto the setter which is then removed from the pins 24. At this stage the soft slip which will have cast-up slightly  
70 in the internal duct 14 can be removed to clean the duct for the next operation. After removing the lower and upper basins from one male part in this way the operator then pulls that male part along the tracks pulling  
75 with it the female part of the next mould unit thereby simultaneously opening the next mould unit to allow the operator access to the next two basins. That operation is repeated down the line.

In the construction shown, the upper and  
80 lower cavities are shaped to cast similar sized washbasins. However, it would be possible to cast two different sizes of washbasin in each mould unit, the smaller preferably  
85 being cast in the upper cavity. Owing to the slightly greater head of pressure during the casting time on the slip in the lower cavity, and also where the lower cavity is filled first and drained last relative to its associated  
90 upper cavity, it is believed that the resultant cast wall thickness of the hollow cast regions in the lower article will be greater than the wall thickness of the hollow regions of the upper article; these different  
95 wall thicknesses may conveniently match the different required wall thicknesses of the particular small and large basins.

In the embodiment illustrated the upper and lower mould portions 3, 4 and 5, 6  
100 are formed integrally as single cast mould parts with the upper cavity portions directly above the lower ones. However, it would be possible to make each mould part from separate upper and lower pieces which have  
105 been rigidly secured together. The upper portions 1A, 2A may also be offset slightly in the longitudinal direction if desirable.

Whilst the mould units illustrated are for casting washbasins, other articles may be  
110 cast in a similar way.

A second embodiment is shown in Figures 4 to 7 for casting washbasin pedestals. Each  
115 mould unit 30, of which there are for example fifty in each line, comprises integrally cast female and male mould parts 31 and 32 arranged on carriers 33 running on tracks 34, the male part 32 of one mould unit being connected back-to-back with the female part 31 of the next adjacent mould  
120 unit. As indicated by dash-dot line in Figure 4, and as will be appreciated from Figures 6 and 7, the pedestals are cast in a generally vertical position, two pedestals being cast side by side, relative to the longitudinal  
125 direction of the tracks 34, in each mould unit 30. Each pedestal includes hollow cast regions extending throughout its height. As shown in Figure 5, the lines of moulds are again tilted transversely, here at 4°.

The two side-by-side mould cavities are  
130

filled and drained simultaneously via respective apertures 36 (see Figure 7) at their lower ends which communicate with a lower common slip duct 41 extending across the mould unit below both cavities. This duct 41 which is open at the parting face of the female mould part 31 and which is closed by the adjacent face of the male mould part 32 when the mould unit is closed for casting, also communicates with a slip inlet and drain pipe 42 comprising a short piece of plastics tube embedded in the wall of the mould which can be connected to a manifold slip supply pipe 40 by a flexible tube. When the cavities are filled, the slip level rises through respective apertures 37 at the top of the mould cavities into header tubes 38 connected to an air line 39.

The casting operation is generally the same as that described above in relation to the first embodiment except that when the mould parts are opened the articles adhere to the female mould parts.

Although in the first embodiment each mould unit includes two mould cavities, one above the other, and in the second embodiment each mould unit again includes two mould cavities, side by side, the invention is not restricted to the provision of two cavities in each mould unit. Thus is it envisaged that in future development three, four or more pedestals may be cast side by side in a single mould unit, and in other constructions more than two tiers of mould cavities may be provided one above the other. Also, it may be practical, in some cases, to provide four casting cavities in each mould unit, two side by side at a lower level and two more side by side above them, and of course for small items such as accessories, e.g. soap dishes, toilet roll holders, towel rail ends, there may be many more cavities, e.g. three vertical rows each of five cavities one above the other.

If it is required to fill and drain the upper and lower mould cavities independently but using a common slip supply and drain pipe, a separate tube may be provided for each cavity, each being connected onto a respective flexible tube 19 connected with the manifold slip supply and drain pipe 20. It may also be possible to use top filling of the moulds.

Whilst the described embodiments show several mould units, in its broadest aspect the invention would also be useful as applied to one mould unit having the two or more casting cavities.

#### WHAT WE CLAIM IS:—

1. An installation for casting ceramic material in slip form, comprising a mould unit including a first mould part and a second mould part, which mould parts are adapted to be assembled for a casting operation to define between them at least two

casting cavities into which slip can be introduced and which correspond respectively to the shapes of discrete articles, the mould parts being arranged on a support structure and being adapted so that they can be separated for removal of cast articles or assembled for casting by relative movement of the mould parts in a generally horizontal direction, at least one of the parts being carried by transport means to enable that part to be moved relative to the support structure in a generally horizontal direction.

2. An installation for casting ceramic material in slip form, comprising a plurality of mould units, each mould unit including a first mould part and a second mould part, which mould parts are adapted to be assembled for a casting operation to define between them at least two casting cavities into which slip can be introduced and which correspond respectively to the shapes of discrete articles to be cast in the mould unit, the mould units being arranged in a generally horizontal line on a support with the first mould part of one mould unit being connected to the second mould part of the next adjacent mould in the line, and each mould unit being adapted to be opened and closed by relative movement of the respective mould parts in a direction longitudinally of the line of mould units.

3. A casting installation as claimed in claim 1 or claim 2, in which the casting cavities in the or each mould unit are disposed one above the other.

4. A casting installation as claimed in claim 1 or claim 2, in which the casting cavities in the or each mould unit are disposed side-by-side, i.e. transversely of each other relative to the horizontal separation and assembly direction.

5. A casting installation as claimed in claim 1 or claim 2, in which the casting cavities in the or each mould unit are disposed in at least two tiers, each tier having at least two cavities side-by-side.

6. A casting installation as claimed in any one of claims 1 to 5, in which the first and second mould parts of the or each mould unit are each formed as an integrally cast mould part.

7. A casting installation as claimed in any one of claims 1 to 5, in which the first and second mould parts of the or each mould unit are each formed by securing together a number of individual mould portions corresponding to the number of casting cavities in the mould unit.

8. A casting installation as claimed in claim 7, in which each mould portion affords the male or female half of one casting cavity of which the other half (female or male respectively) is provided in the other mould part.

9. A casting installation as claimed in any one of the preceding claims, in which the casting cavities in the or each mould unit are each provided with an inlet for slip, which inlets are connected with a common slip supply.

10. A casting installation as claimed in claim 9, in which the inlets are connected by a duct disposed interiorly of the mould unit with a common slip inlet communicating with the outside of the mould unit.

11. A casting installation as claimed in claim 10, in which the duct disposed interiorly of the mould unit comprises a surface channel disposed in the face of one of the mould parts whereby the duct is closed by the adjacent face of the other mould part when the two mould parts are assembled for a casting operation.

12. A casting installation as claimed in claim 9, in which the inlet for one of the casting cavities is connected to an outlet from the or another casting cavity of the mould unit whereby, in use, the slip for filling that one cavity passes through the or another cavity before entering that one cavity.

13. A casting installation as claimed in claim 12, in which the said connection is effected outside the mould by means of a piece of flexible tube.

14. A casting installation as claimed in claim 12, in which the said connection is provided by a connecting duct between the casting cavities interiorly of the mould unit.

15. A casting installation as claimed in any one of the preceding claims, in which the casting cavities in the or each mould unit are shaped to cast similarly shaped or sized articles.

16. A casting installation as claimed in any one of claims 1 to 14, in which the casting cavities in the or each mould unit are shaped to cast differently shaped or sized articles.

17. A casting installation as claimed in any one of the preceding claims, in which the or each mould unit is designed for casting articles having one or more hollow cast regions therein, each casting cavity having a drain outlet at the lowermost point of the hollow cast region for draining excess slip from the mould cavities.

18. A casting installation as claimed in claim 17, in which each casting cavity is provided with a separate drain outlet from the mould unit.

19. A casting installation as claimed in claim 17, in which there is provided a common drain outlet of the mould unit communicating internally with each casting cavity.

20. A casting installation as claimed in any one of claims 17 to 19, in which the casting cavities in the or each mould unit

are disposed one above the other, the upper casting cavity being designed for casting an article having one or more hollow cast regions with a thinner cast wall thickness than that of the hollow cast region or regions of the article which is cast in the lower casting cavity.

21. A casting installation as claimed in claim 20, in which the drain outlet from the upper cavity is connected to an inlet of the lower cavity so that, in use, the excess slip from the upper cavity drains through the hollow cast regions of the article formed in the lower casting cavity.

22. A casting installation as claimed in any one of claims 17 to 21, in which the drain outlet or outlets from the or each mould unit are connected to a slip supply line, which line has a valve for opening that line to drain.

23. A casting installation as claimed in any one of claims 17 to 22, in which there is provided a removable header tube extending from an aperture in the wall of the mould unit to an air supply tube for applying air under pressure to the mould.

24. A casting installation as claimed in claim 23, in which a separate air supply connection is provided for each mould cavity in the or each mould unit.

25. A casting installation as claimed in claim 23, in which a single air supply connection communicates with each cavity in the or each mould unit.

26. A casting installation as claimed in any one of claims 23 to 25, in which each mould cavity has an air inlet aperture for the admission of air under pressure during draining, the air inlet aperture being located relative to the cavity such that during casting it is spaced downwardly from the top of the hollow region formed in the article cast in that cavity so that in use air passes upwardly through the surplus slip in the hollow region to the top of that region.

27. A casting installation as claimed in claim 2 or in any claim appendant to claim 2, in which the inlets of all the mould units in the line are connected to a common slip supply line.

28. A casting installation as claimed in claim 27, in which the common slip supply line is connected to a slip supply tank disposed at a level such that the mould units can all be filled under gravity.

29. A casting installation as claimed in claim 27 or claim 28, in which there is provided a common air supply line extending along and above the line of mould units, there being provided at least one connector tube for each mould unit connectible between the air supply line and the mould unit.

30. A casting installation as claimed in any one of the preceding claims, in which

the casting cavities in the or each mould unit are shaped to cast washbasins.

31. A casting installation as claimed in any one of claims 1 to 29, in which the casting cavities in the or each mould unit are shaped to cast washbasin pedestals.

32. A casting installation as claimed in any one of claims 1 to 29, in which the casting cavities in the or each mould unit are shaped to cast sanitaryware accessories.

33. A casting installation substantially as specifically described herein with reference to Figures 1 to 3 of the accompanying drawings.

34. A casting installation substantially as specifically described herein with reference to Figures 4 to 7 of the accompanying

drawings.

35. Articles cast from ceramic material when cast in a casting installation as claimed in any one of the preceding claims.

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COMPLETE SPECIFICATION

5 SHEETS

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Sheet 1

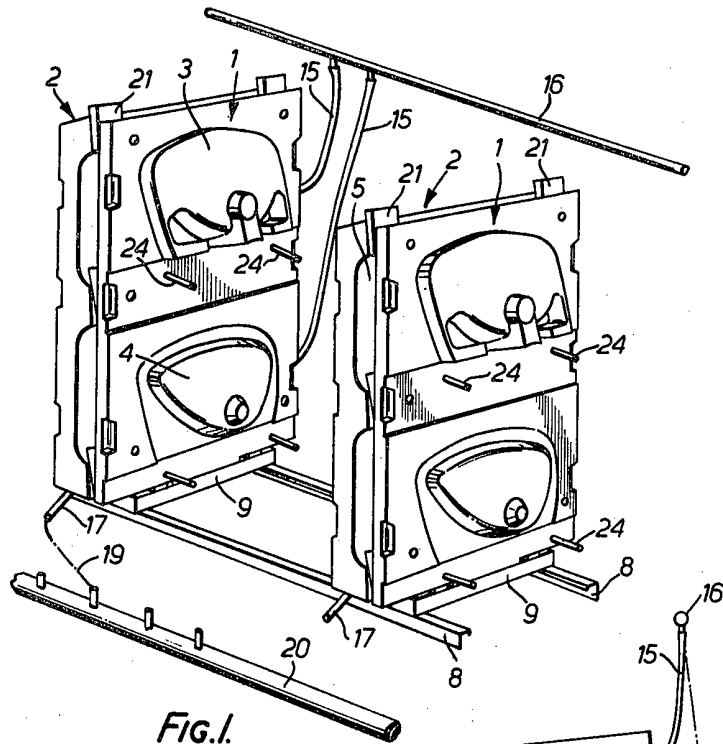


Fig. 1.

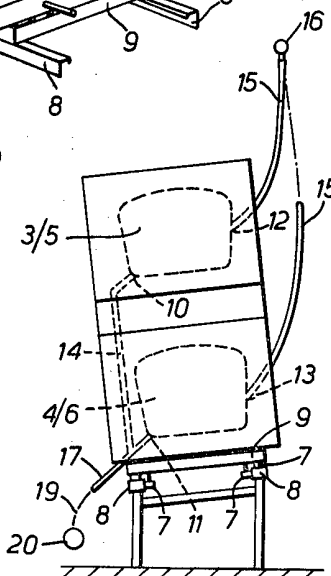


Fig. 2.

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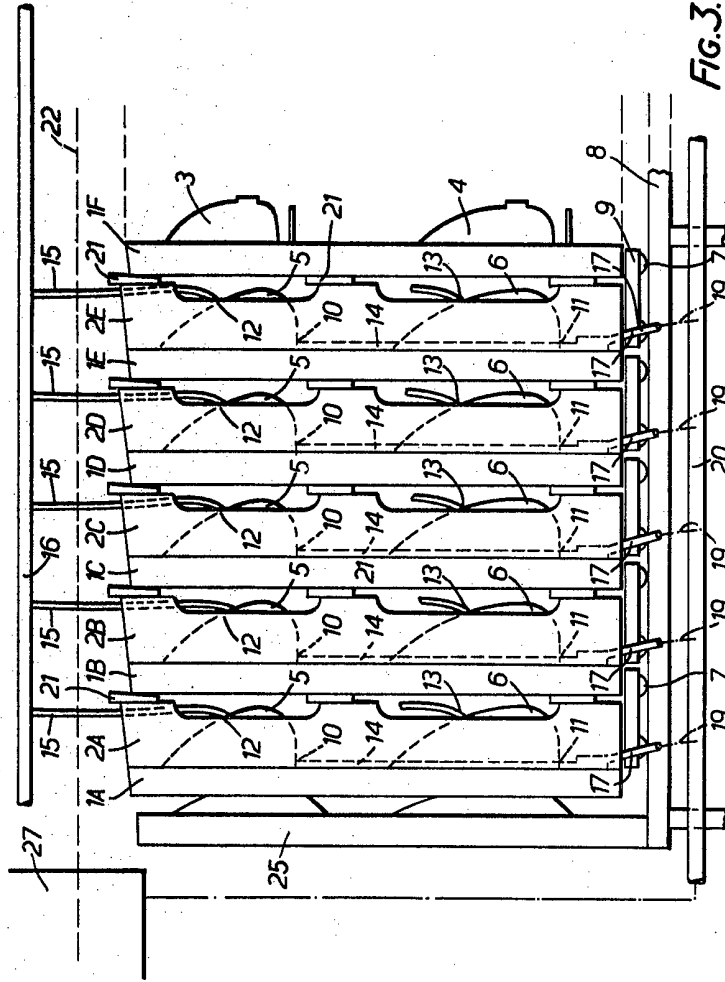


FIG. 3.

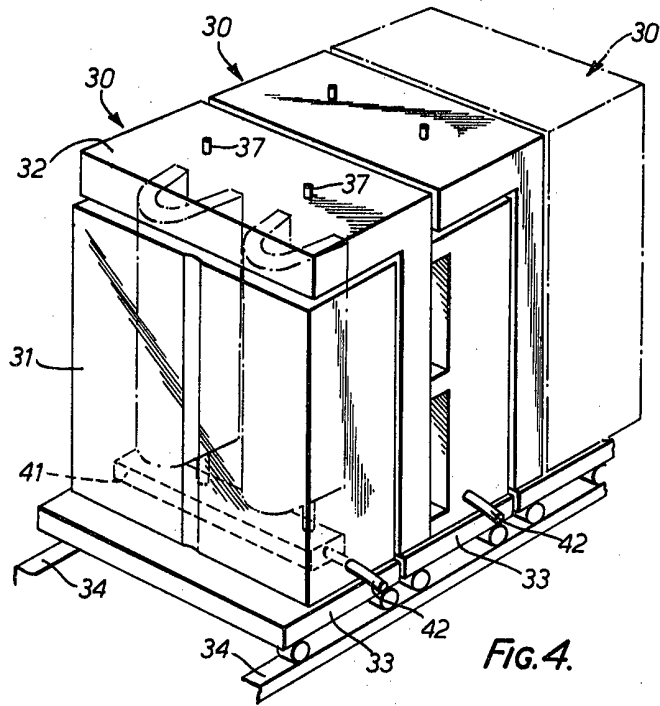


FIG. 4.

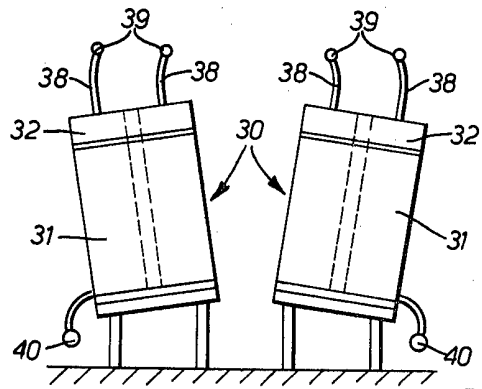


FIG. 5.

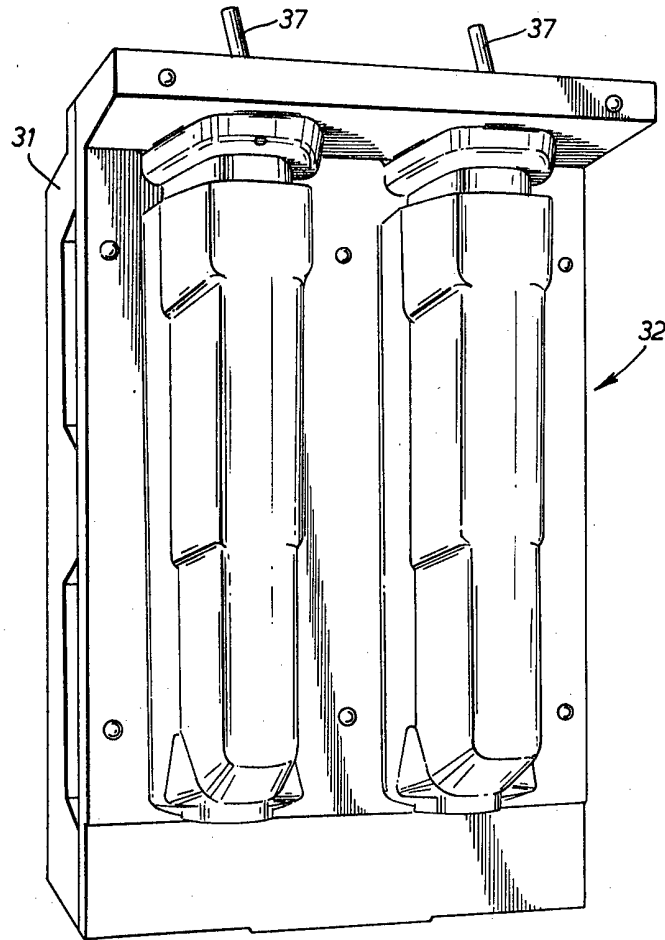


FIG.6.

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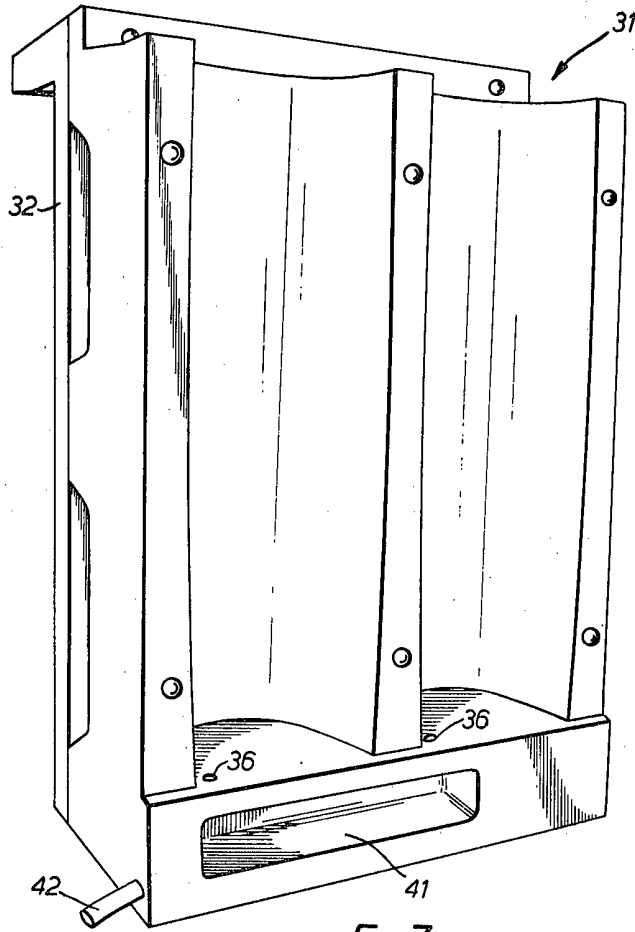


FIG. 7.