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(54) IMPROVEMENTS IN OR RELATING TO DIE APPARATUS FOR MOULDING TUBES

(71) We, ENGLEFIELD PLASTIC INDUSTRIES LIMITED, a company incorporated under the laws of New Zealand, of Queen Street, Waimate, New Zealand, 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:—

The invention relates to apparatus for use in the manufacture of tubes, the invention having for its object to deal with the problem that arises when the tube is produced from a mouldable material that becomes substantially rigid after moulding, and the tube has to include a straight portion and a bend which necessitates formation of the tube by a moulding operation involving the use of a die containing a mould cavity defining the external size and shape of the tube to be formed, in combination with a core which is positioned in the mould cavity to thereby define the bore of the tube and has to be removed from the tube after completion of the moulding operation.

Previously, to produce such tubes, that is to say, tubes having a straight portion and a bend, one method has been to use a die and a core for use in moulding the straight portion of the tube, and a separate die and a core for use in moulding the curved portion, the two portions being bonded or otherwise connected together after withdrawal of the cores from their respective positions in the two portions. This method suffers from the drawback that the tube has to be made in two initially separate parts which then have to be joined together in some way that ensures a leak-proof whole.

It has also been proposed to mould tubes of the shape in question by using, in combination, a die containing a mould cavity defining the exterior size and shape of the tube to be produced, and a composite core defining the bore of the tube and consisting of a straight section and a curved section, these two sections being detachably connected together. While this method ensures the pro-

duction of a tube all in one piece, it suffers from the drawback that, after completion of the moulding operation, the two portions of the core can be removed from the tube only with difficulty.

The present invention provides apparatus which is intended for use in the production of J-shaped tubes (hereinafter referred to simply as J-tubes), namely tubes consisting of a straight portion merging into a single bend the curvature of which conforms to the shape of part of a circle, usually a semi-circle, tubes of this shape being adapted for connection to others of similar shape suchwise as to form S-traps that are usually incorporated in the sinks of wash bowls, laundry tubs and the like. The apparatus of the invention enables tubes of the kind indicated to be produced without the drawbacks and difficulties pertaining to previous methods.

In accordance with the invention, apparatus for use in the manufacture of a J-tube with a mouldable material that becomes substantially rigid after moulding, comprises a die and a core, these two members having, respectively, the following constructional characteristics:— the die contains a mould cavity adapted to define the exterior shape and size of the tube to be formed, the die being formed of a plurality of complementary sections, which can be separated from each other to permit of engagement of the core in and its removal from the mould cavity; the core is made up of four initially separate pieces whereof the first has a straight portion corresponding to the straight portion of the bore of the tube to be produced, the second forms the concave or inner edge part of the bend of the bore and is detachably secured to the straight portion of the first piece, while the third and fourth pieces are arranged tandem fashion and together form the convex or outer edge part of the bend of the bore, the third and fourth pieces being connected to the second piece suchwise that they can move along it in an arcuate path; the apparatus further including means acting to hold the several pieces of the core in correct

juxtaposition when the core has been applied to the mold cavity and the sections of the die have been brought together, means for then enabling mouldable material to be injected into the free space left between the moulded cavity and the core to thereby form the tube, and means which, after separation of the die sections from each other and removal of the core with attached moulded tube, enables fluid under pressure to be supplied to the core in such a manner as to cause the third and fourth pieces thereof to move along the second piece to such an extent that they will be successively ejected or can readily be plucked from the free end of the bend of the tube, the second piece of the core then being free for disconnection from the first piece to thereby permit of its removal from the same end of the tube, whereupon the first piece of the core becomes free for removal from engagement with the straight portion of the tube through the free end of this portion.

An embodiment of the apparatus of the invention will now be described with reference to the accompanying drawings, in which:—

Figure 1 is a side elevational view of a J-tube when made with the aid of the present embodiment of the apparatus of the invention;

Figure 2 is a side elevational view of a J-tube which is complementary to the tube shown in Figure 1 and can be made with the aid of the same apparatus after this has been modified in certain minor respects as will be explained later;

Figure 3 is a vertically sectional view showing how the two tubes of Figures 1 and 2 can be coupled together to form an S-trap;

Figure 4 is a plan view of the bottom section of a die forming part of the apparatus used to make the tube of Figure 1;

Figure 5 is an inverted plan view of the top section of the die;

Figure 6 is a side elevational view of the core;

Figure 7 is a sectional view taken along the axis of the core;

Figure 8 is a sectional plan view on the line VIII—VIII in Figure 7;

Figure 9 is a cross-sectional view to an enlarged scale on the line IX—IX in Figure 7;

Figure 10 is a cross-sectional view to a correspondingly enlarged scale on the line X—X in Figure 7;

Figure 11 is a plan view of the bottom section of the die with the core applied thereto;

Figure 12 is a side elevational view of the core when taken from the die with the J-tube attached thereto as a result of the moulding operation;

Figure 13 is a view similar to that of Figure 12 but showing the tube in section and also illustrating the first of four steps in-

involved in the process of removing the core from the moulded tube;

Figure 14 is a view similar to that of Figure 13 but showing the second stage in the core-removing process;

Figure 15 is a view also similar to that of Figure 13 but showing the third stage in the core-removing process, and

Figure 16 is a view again similar to that of Figure 13 but showing the fourth and final stage in the core-removing process.

The J-tube generally indicated at 1 in Figure 1 and also illustrated in the left-hand part of Figure 3, and which is produced with the aid of the apparatus shown in Figure 4 to 16, is made from a thermo-plastic or a thermo-setting plastic, a preferred example being cross-linked polyethylene.

The tube has a straight portion 2 which merges at one end into a bend 3 whose curvature conforms to that of part of a circle, in the present instance a semi-circle. At the free end of the bend 3, the tube has a short straight extension 4 lying in parallelism with the straight portion 2. The tube is circular in cross-section, this applying to both its external surface and its bore. The diameter of the bore of the straight portion 2 is not constant in that the bore has a slight taper to assist in the removal of the core after the tube has been moulded, this taper being such that the diameter of the base of the tube adjacent the mouth is greater than the diameter of the bore of the tube adjacent the root thereof. Near the free end of the straight portion 2, the tube is formed with an annular flange 5 which projects radially from the external surface of the tube. At the junction between the bend 3 and the short straight extension 4 at the free end thereof the tube is formed with an annular flange 6 which also projects radially from the external surface of the tube and is of the same size as the flange 5. The purposes for which these flanges are provided will be explained hereinafter.

The die is made in two main sections, namely a bottom section and a top section, which are fitted together during the moulding step and are separated from each other on completion of that step, the bottom section being indicated generally at 7 in Figures 4 and 11 and the top section generally at 8 in Figure 5.

The bottom section 7 of the die comprises a base plate 9 the upper surface of which is formed or otherwise provided with blocks 10 shaped to provide one half of a mould cavity which, in its complete form, corresponds in shape and size to the external shape and size of the J-tube to be formed. The half cavity, which is generally indicated at 11, is itself of J-shape so that it has a straight portion 12 merging at one end into a bend 13 the free end of which has a relatively short straight extension 14 lying

parallelly to the straight portion 12, the half cavity 11 corresponding in size and shape exactly to one half of the external surface of the J-tube to be produced, when the said half is divided from the other half by a plane passing through the axis that is common to the straight portion 2, the bend 3 and the short extension 4, collectively, of the tube. Near the free end of the straight portion 12 of the half cavity 11, the blocks 10 are formed to provide an outwardly projecting groove 15 corresponding circumferentially to one-half of the flange 5 on the tube 1, while at the junction between the free end of the bend 13, of the half cavity and the short extension 14, the blocks 10 are formed to provide an outwardly projecting groove 16 corresponding circumferentially to one-half of the flange 6 on the tube 1.

On the upper face of the base plate 9 of the die section 7 there is provided bearing block 17 which is spaced from the free end of the straight portion 12 of the half cavity 11 and is formed with a semi-cylindrical and concave seating 18 arranged in axial alignment with the said portion of the half cavity.

To the upper face of the base plate 9 there are secured two guide bars 19 which are spaced parallelly from each other and are so arranged that one end of each lies in lateral alignment with the terminal end of the short extension 14 of the bend 13 of the half cavity 11, while the other end of each lies at a distance from the extension 14, the two guide bars being arranged symmetrically on either side of the axis of the extension. A bridge member 20 extends between the ends of the guide bars 19 that are remote from the extension 14 of the bend 13 of the half cavity 11, the bridge member being formed with a semi-cylindrical groove 21 lying in axial alignment with the extension 14.

To the side edge portions of the upper face of the base plate 9 of the die section 7 there are secured plates 22 carrying pegs 23 which project vertically upwards from these plates.

In the upper surface of that one of the blocks 10 that defines the concave edge portion of the bend 13 in the half cavity 11, that is to say, the outer edge portion of the bend, there is formed a semi-cylindrical channel 24 of relative small diameter, this channel extending from an outer edge of the said block to the end 13 so that it opens into the half cavity.

The top section 8 of the die is, as shown in Figure 5 and save for one variation, made up of parts of the same form as those so far described with reference to the bottom section 7, it being understood, of course, that when the top section is turned over from its upside-down position shown in Figure 1, its parts will come into matching relationship with the corresponding parts of the bottom section 7. To avoid repetition of description,

the parts of the top section 8 that coincide with the parts of the bottom section 7 are identified by the same reference numerals with the addition of the suffix a. The variation referred to above consists in providing the plates 22a with holes 25 instead of pegs, the holes being of a diameter which is just a fraction greater than the outside diameter of the pegs 23 on the plates 22 of the bottom section 7.

When the top section 8 has been turned over from the position shown in Figure 5, the plate 9a will be at the top and what were the upper faces of the blocks 10a, block 17a guide bars 19a, bridge member 20a and plates 22a will become the bottom faces. When in this reverse condition, the top die section 8 is correctly applied to the bottom die section 7, the following effects will result:—

The pegs 23 on the plates 22 of the bottom section 7 will enter the holes 25 in the plates 22a on the top section 8, thus accurately locating the two sections relatively to each other. The bottom faces of the blocks 10a of the top section 8 will mate with the top face of the blocks 10 of the bottom section 7, thus converting the half cavities 11 and 11a into a complete mould cavity of J-shape and of circular cross-section, while the half grooves 15a and 16a will register with the half grooves 15 and 16 respectively to thereby form two complete annular grooves positioned adjacent the two ends of the mould cavity. The bottom faces of the bearing blocks 17a of the top section 8 will mate with the top faces of the bearing blocks 17 of the bottom section 7, thus converting the two concave seatings 18a and 18 into one complete cylindrical seating. The guide bars 19a on the top section 8 will be brought to a position in which they lie above and in register with the guide bars 19 on the bottom section 7. The bottom face of the bridge member 20a of the top section will mate with the top face of the bridge member 20 of the bottom section 7, thus converting the two grooves 21a and 20 into a single cylindrical hole. The channel 24a in one of the blocks 10a of the top section 8 will come into register with the channel 24 in the corresponding one of the blocks 10 of the bottom section 7, thus converting the two channels into a single cylindrical injection orifice.

The core for co-operation with the mould cavity 11, 11a is generally of J-shape so that it has a straight portion merging into a bend, the core being illustrated in Figures 6 to 16. The core is comprised of four initially separate pieces whereof the main piece is generally indicated at 26 while the remaining three pieces are marked 27, 28 and 29 respectively.

The main piece 26 of the core includes a cylindrical head portion 30 which is of such

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diameter that it can fit snugly in the cylindrical seating 18, 18a formed by the bearing blocks 17 and 17a when the two sections 7 and 8 of the die have been mated together, the head portion being followed by a cylindrical flange portion 31 which can fit closely in the space between the bearing blocks 17 and 18 and the adjacent end of the mould cavity 11, 11a. The flange portion 31 is of greater diameter than the cross-sectional diameter of the mould cavity so that, when it is engaged in the aforesaid space, it will bear against those extremities of blocks 10 and 10a that define the free end of the straight portion 12, 12a of the mould cavity, the flange portion 31 thus acting as a closure for this end of the cavity. The flange portion 31 is formed with upper and lower flats one of which is indicated at 32, the arrangement in this respect being such that when the core is in operative position one of the flats will bear against the upper surface of the base plate 9 of the bottom section 7 of the die, while the other flat will bear against the underface of the plate 9a of the superimposed die section 8, thus restraining the core against angular rotation. The main piece 26 of the core further includes a straight shank portion 33 which is cylindrical and of the same length as the straight portion 12, 12a of the mould cavity 11, 11a. The shank portion 33, is however, of smaller diameter than that of the straight portion of the mould cavity.

When the four pieces 26, 27, 28 and 29 of the core are in assembled condition, the pieces 27, 28 and 29 together form the bend of the core, the bend commencing at the free end of the shank portion 33 and having a curvature conforming to that of an arc of a circle. The length of the bend is a little less than that of a semi-circle and the bend is of the same external diameter as that of the shank portion 33.

The piece 27 forms the concave or inner edge portion of the bend of the core, the convex face of the piece being formed with a rib 34 which extends along this face and is so shaped in cross-section as to provide the equivalent of a dovetail as can best be seen by reference to Figure 9 and 10. The piece 27 is detachably secured to the shank portion 33 of the main piece 26 by means of a bolt 35 which passes closely but rotatably and removably through a hole 36 formed through the head portion 30, the flange portion 31 and the shank portion 33, the screw-threaded part of the bolt being engaged in a screw-threaded hole 37 in the piece 27. To ensure correct location of the piece 27 relatively to the piece 26, the end of the piece 27 lying against the free end of the shank portion 33 of the piece 26 is provided with locating pins 38 which engage in recesses 39 formed in the free end of the shank portion 33 (see Figures 7, 8 and 15).

The pieces 28 and 29 are arranged end-to-end tandem fashion, and together form the convex or outer edge portion of the bend of the core, that is to say, the portion of the bend that is not occupied by the outer surface of the piece 27. Grooves 40 and 41 are formed in and along the concave faces of the pieces 28 and 29 respectively, the grooves being of the same cross-sectional shape as the rib 34 on the piece 27 and serving to accommodate the rib with a close working clearance, thus causing the two pieces 28 and 29 to become attached to the piece 27 while allowing the pieces 28 and 29 to be moved in a curved path towards and beyond the free end of the piece 27.

The free ends of the pieces 27 and 29 are each formed with an extension, the two extensions being so mutually shaped that when the piece 29 is fully engaged with the piece 27, the extensions will together form a short tapered spigot as indicated at 42 in Figures 6, 7, 8, 11 and 12.

An air passage 43 extends through the head portion 30, flange portion 31 and shank portion 33 of the piece 26 of the core, this passage lying laterally of the bolt hole 36 and being otherwise so positioned that one end thereof opens directly opposite the end of the piece 28 that normally butts against the free end of the shank portion 33 of the piece 26. To the opposite end of the air passage 43 there is secured a union 44 adapted to be connected to a pipe (not shown) extending from a controlled compressed air supply.

As shown in Figures 4 and 11, the cylinder 45 of a double-acting compressed air ram is secured to the base plate 9 of the bottom die section 7, the cylinder being spaced from the short strength extension 14 of the bend 13 in the half cavity 11, and having its axis in line with the axis of the said extension. The cylinder 45 contains the usual piston (not shown) the rod 46 of which projects from the cylinder in the direction of the extension 14 of the bend 13, and is formed with an enlarged cylindrical portion 47 which is engaged slidably in the groove 21 in the bridge member 20. The enlarged portion 47 of the piston rod 46 carries a cylindrical crosshead 48 which is of larger diameter than that of the extension 14, and is formed along its diametrically opposite sides with ribs 49 which engage slidably in rebates 50 formed along the inner edges of the guide bars 19. Similar rebates 50a are formed along the inner edges of the guide bars 19a of the top die section 8 (Figure 5). The end of the crosshead 48 that lies nearest to the free end of the extension 14 of the bend 13 in the half cavity 11 is formed with a short cylindrical and centrally positioned projection 51 of the same external diameter as that of the shank portion 33 and bend of the core already described, the projection containing

a tapered recess 52 (see Figure 11) corresponding to the spigot 42 on the free ends of the pieces 27 and 29 of the core. One of the two pipe connections for admitting compressed air to and exhausting it from the two ends of the ram cylinder 45 in succession, is indicated at 53.

Initially, the crosshead 48 is so positioned in the guide bars 19 that, as shown in Figure 4, the projection 51 thereon lies clear of the free end of the extension 14 of the bend 13 of the half cavity. When the air ram is so operated as to cause the piston rod 46 to move outwardly of the cylinder 45, the crosshead 48 will be moved towards the extension 14, the position eventually being reached where, as shown in Figure 11, the projection 51 on the crosshead enters the extension 14, while the corresponding end of the crosshead comes into engagement with the parts of the blocks 10 that define the free end of the extension, thus closing this end of the half cavity 11. When the air ram is operated to cause retraction of the piston rod 46, the crosshead 48 and its projection 51 will return to their inoperative positions as shown in Figure 4.

The apparatus described in the foregoing is used as follows, it being assumed that the die sections 7 and 8 have been separated from each other and that the crosshead 48 and its projection 51 are in their inoperative positions as shown in Figure 4:—

The core in its completely assembled condition, is applied to the bottom section 7 of the die in such a manner that the shank portion 33 and bend of the core lie in the corresponding parts of the half cavity 11, in the section 7, while the head portion 30 of the core engages in the seating 18 in the bearing block 17 and the flange portion 31 of the core becomes engaged in the space between the block 17 and the adjacent ends of the blocks 10 that define the half cavity. Under these conditions, the head portion 30 and flange portion 31 will act to locate the shank portion and bend of the core correctly in the half cavity 11, whereby there will be left between the parts of the core that lie in the half cavity and the surface of the half cavity, a band of clear space the thickness of which corresponds to the wall thickness of the tube to be produced.

With the core positioned as just described, the flange portion 32 thereof will act to close off the corresponding end of the straight portion 12 of the half cavity 11, as can be seen from Figure 11. The air ram is now operated to cause the piston rod 46 to move outwardly of the cylinder 45, the result being that as also shown in Figure 11, the crosshead 48 will be moved to a position in which it engages with the parts of the blocks 10 that define the free end of the portion 14 of the half cavity, thus closing this end of

the half cavity, while the projection 51 on the crosshead will enter the portion 14 and its recess 52 will closely receive the spigot 42 on the free end of the bend of the core. In this way, the crosshead 48 will not only act as a closure for the extreme end of the bend 13 of the half cavity 11, but the projection 51 thereon, by engaging closely around the spigot 42 will act as additional means for ensuring that the shank portion 33 and bend of the core are correctly located in the half cavity.

The top section 8 of the die is now taken and mated with the bottom section 7, the two sections then being firmly clamped together. Any suitable means may be used for this latter purpose. The pegs 23 on the bottom die section 7 may, for example, be of tubular form and there may be provided bolts which pass through the pegs and also through the holes in the top section 8, the bolts being fitted with nuts.

When the top die section 8 is in applied position, the two half cavities 11 and 11a will be converted into a complete mould cavity which will be positioned completely around the shank portion 33 and bend of the core, with an intervening space between. The flange portion 31 of the core will at the same time act to fully close one end of the complete cavity, while the crosshead 48 will act to fully close the other end of the cavity. The grooves 21 and 21a in the bridge members 20 and 20a will come together to form a cylindrical hole along which the enlarged part 47 of the piston rod 46 can move, while the rebates 50a in the guide bars 19 will act in conjunction with the rebates 50 in the guide bars 19 to form additional guides for the ribs 49 of the crosshead 48 during movement of the latter in either direction. The channels 24, 24a will come together to form the injection orifice previously referred to.

Instead of moving the crosshead 48 to its operative position before application of the top die section 8, the crosshead may be left in its inoperative position until after the top die section has been applied, the crosshead then being moved to its operative position.

The next step consists in injecting a plastics material in heated and thus fluid, condition into the unoccupied part of the complete mould cavity 11, 11a, this being done by supplying the fluid plastics material, under pressure, to the injection orifice 24, 24a from a suitable source. The supply is continued until the whole of the unoccupied part of the mould cavity, including the grooves 15, 15a and 16, 16a, has become filled, whereupon the supply is cut off.

The injected plastics material is now allowed to cool and harden, whereupon the air ram is operated suchwise as to cause the crosshead 48 and its projection 51 to be retracted from their operative to their inopera-

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tive positions. The top section 8 of the die is now separated from the bottom 7, thus leaving the core with moulded J-tube 1 attached, to be lifted clear of and removed from the bottom section 7. Figure 12 shows the core and attached J-tube 1 when completely removed from the bottom section 7 of the die.

The procedure of removing the shank portion 33 and bend of the core from the interior of the tube 54 is now carried out, reference in this connection being made to Figures 13 to 16.

As the first step in this procedure, the union 44 on the head portion 30 of the main part 26 of the core, is connected to an air hose 54 (Figure 13) which is, in turn, connected to a controlled source of compressed air.

As the second step, compressed air is admitted to the hose 54 and thus passes through the union 44 and along the air passage 43 in the main piece 26 of the core, the air applying sufficient pressure to the end of the piece 28 that butts against the shank portion 33 of the main piece 26 as to cause the piece 28 to move along the piece 27 towards the free end of the bend of the core, the piece 28 at the same time pushing the piece 29 in the same direction. When the piece 29 has been pushed far enough to cause a substantial part of it to project from the free end of the extension 14 on the bend 3 of the tube 1, as shown in Figure 13, the supply of compressed air is temporarily cut off, leaving the piece 29 in a position in which it can easily be plucked, between finger and thumb, from its engagement with the pieces 27 and 28, and thus completely removed from the tube 1 and put aside.

As the third step, the supply of compressed air through the air passage 43 is recontinued, causing the piece 28 to move further along the piece towards the free end of the bend of the core. When, like the piece 29, the piece 28 arrives at a point at which it projects to a substantial extent from the free end of the extension 14 on the bend 3 of the tube 1, as shown in Figure 14, the supply of compressed air is again cut off, leaving the piece 28 in a position in which it can similarly be easily plucked from engagement with the piece 27 and thus completely removed from the tube.

As the fourth step, the bolt 35 is turned in a direction causing the piece 27 to become detached from it. The piece 27 then lies freely in the bend of the tube 1 as shown in Figure 15, thus permitting it to be easily tipped out and put aside.

In carrying out the final step, use is made of a plug 55 of rubber or the like shown in Figure 16, the plug being formed with an air hole 56 to which is connected an air hose 57 leading to the controlled compressed air

source. The plug 55 is of such size that, as shown in Figure 16, it can be fitted tightly but removably in the extension 14 of the bend 3 of the tube 1. When this has been done, compressed air is supplied to the hose 57, the air flowing through the hole 56 in the plug 55 and into the unoccupied interior of the bend 3 of the tube 1, the pressure of the supplied air being sufficient to cause the shank portion 33 of the main part 26 of the core to be entirely ejected from the straight portion 2 of the tube through the end thereof that is adjacent the flange 5, the supply of compressed air being thereupon cut off. As an alternative the supply of compressed air for ejecting the shank portion 33 of the core may be continued for only so long as to cause the major part of the shank portion to be expelled, the shank portion then being finally removed by pulling the main piece 26 of the core away from the tube 1 by hand. Figure 16 shows the main piece 26 in a position in which the shank portion 33 thereof has been almost separated from the straight portion 2 of the tube 1.

When the tube 1 has been entirely freed of the core, and the plug 55 is then removed, the tube will be of the form shown in Figure 1.

Figures 2 and 3 show how the tube 1 of Figure 1 can be connected to another J-tube generally indicated at 58 and of complementary form to produce an S-trap.

The tube 1 is first fitted with two collar-nuts 59 and 60, the nut 59 being associated with the flange 5 and the nut 60 with flange 6. The nut 59 is formed with an intumed rim 61 adapted to engage behind the flange 5, while the nut 60 is formed with a similar rim 62 adapted to engage behind the flange 6.

The free end portion of the bend of the complementary J-tube 58 is formed with a recess 63 (Figure 3) corresponding to the short extension 4 on the bend 3 of the tube 1, while the same end portion of the tube 58 is formed with external screw-threads 64 matching the screw-threads of the nut 60.

The opposite end portion of the tube 58 is also formed with external screw-threads 65.

To join the tube 58 to the tube 1, the tube 58 is inverted as shown in Figure 2 and the recess 63 in the free end portion of its bend is engaged around the extension 4 of the bend of the tube 1, the nut 60 then being turned into engagement with the screw-threads 64 and tightened to thus join the two tubes together in reclining S-formation as shown in Figure 3. A sealing washer 66 (Figure 3) of resilient material may be interposed at the junction between the two tubes to thereby ensure the provision of a leak-proof joint when the nut 60 is tightened up.

The nut 59 is used for joining the J-tube to the usual screw-threaded drain hole fitting

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projecting from the bottom of a wash bowl or the like, the corresponding end of the tube being provided also with a resilient sealing washer 67 to provide for a leak proof joint at this place when the nut has been tightened on to the drain hole fitting.

5. The complementary J-tube 58 may be, and preferably is, made of the same kind of plastic material as that used for making the J-tube 1. In that case, and as the tube 58 is also of J-shape it could be made with apparatus similar to that described with reference to the tube 1, the only difference being that the half cavities 11 and 11a in the die sections 7 and 8 would then be so shaped that when the tube 58 is made, its end portions would be formed with the external screw-threads 64 and 65 in place of the flanges 5 and 6 pertaining to the J-tube 1.

20 In a modification of the apparatus, instead of the convex edge part of the bend of the core being made up of only the third and fourth pieces 28 and 29 respectively, this part is made up of three or more pieces also arranged tandem fashion and similarly connected to the second piece 27.

25 The possibility presents itself of making the apparatus of such size that a plurality of the J-tubes could be moulded all at one and the same time, the several tubes then being separated from their individual cores.

30 Although in the drawings, the junction line between the concave piece 27 and the convex pieces 28 and 29 of the core is shown concentric with the inner and outer edges of the bend, the line has been shown in this way for simplicity of illustration. In practise, the pieces are so shaped that the junction line between the concave piece 27 and the convex pieces 28 and 29 is slightly eccentric, the eccentricity being such that the concave piece 27 tapers slightly in the direction of its free end while the convex pieces 28 and 29 correspondingly taper in the opposite direction and are thus thicker at the ends facing the direction of ejection. In this way, when the stage for removing the core from the moulded J-tube has been reached it becomes possible to move the convex pieces in the ejecting direction without it being necessary to use excessive air pressure as these pieces will automatically ease themselves from contact with the inner surface of the bend of the tube as the ejecting process proceeds.

55 WHAT WE CLAIM IS:—

1) Apparatus for use in producing a J-tube, as hereinbefore defined, from a mouldable material that becomes substantially rigid after moulding, the apparatus comprising a die and a core, these two members having, respectively, the following constructional characteristics:— the die contains a mould cavity adapted to define the exterior shape and size of the tube to be formed, the die being formed

of a plurality of complementary sections which 65 can be separated from each other to permit of engagement of the core in and its removal from the mould cavity; the core is made up of four initially separate pieces whereof the first has a straight shank portion corresponding to the straight portion of the bore of the tube to be produced, the second forms the concave or inner edge part of the bend of the bore and is detachably secured to the straight portion of the first piece, while the third and fourth pieces are arranged tandem fashion and together form the convex or outer edge part of the bend of the bore, the third and fourth pieces being connected to the second piece suchwise that they can move along it in an arcuate path; the apparatus further including means acting to hold the several pieces of the core in correct juxtaposition when the core has been applied to the mould cavity and the sections of the die 70 have been brought together, means for then enabling mouldable material to be injected into the free space left between the mould cavity and the core to thereby form the tube, and means which, after separation of the die 75 sections from each other and removal of the core with attached moulded tube, enables fluid under pressure to be supplied to the core in such a manner as to cause the third and fourth pieces thereof to move along the second piece to such an extent that they will be successively ejected or can readily be plucked from the free end of the bend of the tube, the second piece of the core then being free for disconnection from the first 80 piece to thereby permit of its removal from the same end of the tube, whereupon the first piece of the core becomes free for removal from engagement with the straight portion of the tube through the free end of this portion. 85

2) Apparatus in accordance with claim 1 and wherein the die is made up of two sections, namely, a bottom section and a top section, each section being constructed in such manner as to provide one half of the complete mould cavity, the halves being defined by a plane passing through both the straight portion and the bend of the complete cavity. 90

3) Apparatus in accordance with claim 2 115 and wherein the bend of the cavity has a curvature conforming to that of a semi-circle the free end of the bend having a relatively short straight extension lying parallelly to the straight portion of the cavity. 120

4) Apparatus in accordance with any one of the preceding claims and wherein the mould cavity is formed, near its two free ends, with outwardly projecting peripheral grooves. 125

5) Apparatus in accordance with any one of claims 1 to 3 and wherein the mould cavity is formed, near its two free ends, with screw-threads.

projecting from the bottom of a wash bowl or the like, the corresponding end of the tube being provided also with a resilient sealing washer 67 to provide for a leak proof joint at this place when the nut has been tightened on to the drain hole fitting.

The complementary J-tube 58 may be, and preferably is, made of the same kind of plastic material as that used for making the J-tube 1. In that case, and as the tube 58 is also of J-shape it could be made with apparatus similar to that described with reference to the tube 1, the only difference being that the half cavities 11 and 11a in the die sections 7 and 8 would then be so shaped that when the tube 58 is made, its end portions would be formed with the external screw-threads 64 and 65 in place of the flanges 5 and 6 pertaining to the J-tube 1.

In a modification of the apparatus, instead of the convex edge part of the bend of the core being made up of only the third and fourth pieces 28 and 29 respectively, this part is made up of three or more pieces also arranged tandem fashion and similarly connected to the second piece 27.

The possibility presents itself of making the apparatus of such size that a plurality of the J-tubes could be moulded all at one and the same time, the several tubes then being separated from their individual cores.

Although in the drawings, the junction line between the concave piece 27 and the convex pieces 28 and 29 of the core is shown concentric with the inner and outer edges of the bend, the line has been shown in this way for simplicity of illustration. In practise, the pieces are so shaped that the junction line between the concave piece 27 and the convex pieces 28 and 29 is slightly eccentric, the eccentricity being such that the concave piece 27 tapers slightly in the direction of its free end while the convex pieces 28 and 29 correspondingly taper in the opposite direction and are thus thicker at the ends facing the direction of ejection. In this way, when the stage for removing the core from the moulded J-tube has been reached it becomes possible to move the convex pieces in the ejecting direction without it being necessary to use excessive air pressure as these pieces will automatically ease themselves from contact with the inner surface of the bend of the tube as the ejecting process proceeds.

WHAT WE CLAIM IS:—

1) Apparatus for use in producing a J-tube, as hereinbefore defined, from a mouldable material that becomes substantially rigid after moulding, the apparatus comprising a die and a core, these two members having, respectively, the following constructional characteristics:— the die contains a mould cavity adapted to define the exterior shape and size of the tube to be formed, the die being formed

of a plurality of complementary sections which can be separated from each other to permit of engagement of the core in and its removal from the mould cavity; the core is made up of four initially separate pieces whereof the first has a straight shank portion corresponding to the straight portion of the bore of the tube to be produced, the second forms the concave or inner edge part of the bend of the bore and is detachably secured to the straight portion of the first piece, while the third and fourth pieces are arranged tandem fashion and together form the convex or outer edge part of the bend of the bore, the third and fourth pieces being connected to the second piece suchwise that they can move along it in an arcuate path; the apparatus further including means acting to hold the several pieces of the core in correct juxtaposition when the core has been applied to the mould cavity and the sections of the die have been brought together, means for then enabling mouldable material to be injected into the free space left between the mould cavity and the core to thereby form the tube, and means which, after separation of the die sections from each other and removal of the core with attached moulded tube, enables fluid under pressure to be supplied to the core in such a manner as to cause the third and fourth pieces thereof to move along the second piece to such an extent that they will be successively ejected or can readily be plucked from the free end of the bend of the tube, the second piece of the core then being free for disconnection from the first piece to thereby permit of its removal from the same end of the tube, whereupon the first piece of the core becomes free for removal from engagement with the straight portion of the tube through the free end of this portion.

2) Apparatus in accordance with claim 1 and wherein the die is made up of two sections, namely, a bottom section and a top section, each section being constructed in such manner as to provide one half of the complete mould cavity, the halves being defined by a plane passing through both the straight portion and the bend of the complete cavity.

3) Apparatus in accordance with claim 2 and wherein the bend of the cavity has a curvature conforming to that of a semi-circle the free end of the bend having a relatively short straight extension lying parallelly to the straight portion of the cavity.

4) Apparatus in accordance with any one of the preceding claims and wherein the mould cavity is formed, near its two free ends, with outwardly projecting peripheral grooves.

5) Apparatus in accordance with any one of claims 1 to 3 and wherein the mould cavity is formed, near its two free ends, with screw-threads.



- 6) Apparatus in accordance with claims 2 to 4 or 2 to 5 and wherein the two die sections are provided with bearing blocks which are spaced from the free end of the straight portion of the mould cavity and are so formed that together they provide a cylindrical seating.
- 7) Apparatus in accordance with claim 6 and wherein the two die sections are provided with bars which are shaped and positioned to form guides for a crosshead which is arranged opposite the free end of the bend mould cavity and is movable towards and away from that end.
- 8) Apparatus in accordance with claim 7 and wherein a projection is provided in the crosshead, the arrangement being such that when the crosshead is moved in one direction, the projection will enter the free end portion of the bend of the mould cavity, while when the crosshead is moved in the opposite direction, the projection will move out of the said end portion.
- 9) Apparatus in accordance with claim 8 and wherein the said projection is formed with a tapered recess.
- 10) Apparatus in accordance with claim 9 and the crosshead is carried by the piston-rod of a double-acting compressed air ram the cylinder of which is secured to the bottom section of the die.
- 11) Apparatus in accordance with claim 9 or claim 10 and wherein the first piece of the core, besides having the straight shank portion, also has a head portion adapted to fit in the seating provided by the bearing blocks, as well as a flange portion adapted to fit closely in the space between the bearing blocks and the corresponding end of the mould cavity.
- 12) Apparatus in accordance with claim 11 and wherein the said flange portion is so shaped that when engaged in the space between the bearing blocks and the corresponding end of the mould cavity, it will co-act with the mated sections of the die to prevent rotation of the core around the axis of the straight portion thereof.
- 13) Apparatus in accordance with claim 12 and wherein the free end of the bend of the core is provided with a tapered spigot which fits closely in the recess in the projection on the crosshead when the latter is moved to a position in which the projection intrudes into the free end portion of the bend of the mould cavity.
- 14) Apparatus in accordance with any one of the preceding claims and wherein the second piece of the core is detachably secured to the first piece by means of a bolt which passes closely but rotatably and removably through a hole in the first piece.
- 15) Apparatus in accordance with claim 14 and wherein the convex face of the second piece is formed with a rib which extends along this face and is so shaped in cross-section as to provide the equivalent of a dovetail.
- 16) Apparatus in accordance with claim 15 and wherein the concave faces of the third and fourth pieces of the core are formed with grooves of the same cross-sectional shape as the rib on the second piece, the grooves serving to accommodate the rib in such manner that the third and fourth pieces become attached to the second piece but can move in a curved path along this latter piece to thereby enable them to be detached from the second piece.
- 17) Apparatus in accordance with claim 16 and wherein an air passage is formed through the first piece of the core, one end of the passage being fitted with a union enabling it to be connected to a source of compressed air, while the other end of the passage opens opposite the end of the third piece that butts against the adjoining end of the first piece, the arrangement being such that when the core with moulded J-tube attached is withdrawn from the die, compressed air can be admitted to the said passage for the purpose of expelling the third and fourth pieces of the core in succession from the free end of the bend of the tube, or of moving them to such an extent that they can then readily be withdrawn from the said end of the tube by hand.
- 18) Apparatus in accordance with claim 17 and wherein after removal of the third and fourth pieces of the core from the tube and release of the bolt from the second piece this latter piece will become free and can be simply tipped out of the tube through the free end of the bend thereof.
- 19) Apparatus in accordance with claim 18 and including a plug of rubber or the like which is formed with a hole and can be fitted tightly but removably in the free end of the bend of the tube after removal of the second, third and fourth sections of the core therefrom, the arrangement being such that when compressed air is supplied to the then unoccupied part of the tube by way of the hole in the applied plug, the air will act to move the first part of the core out of engagement with the straight portion of the tube through the free end of this portion, or displace the first part of the core to such an extent that it can readily be removed from the said portion of the tube by hand.
- 20) A modification of the apparatus claimed in any one of the preceding claims, according to which, instead of the convex edge part of the bend of the core being made up of two pieces only, namely, the third and fourth piece, this part is made up of three or more pieces also arranged tandem fashion and similarly connected to the second piece.
- 21) Apparatus for use in producing a J-tube, as hereinbefore defined, the apparatus



being constructed and adapted to operate substantially as described with reference to the accompanying drawings.

For the Applicants
RAWORTH, MOSS & COOK
36 Sydenham Road,
Croydon, Surrey
and
75 Victoria Street,
Westminster,
London, S.W.1.

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