

UNITED STATES PATENT OFFICE

2,616,127

DOUBLE FINISH DRAWING DIE

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Application September 21, 1950, Serial No. 185,933

16 Claims. (Cl. 18—14)

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This invention relates to a double finish drawing die through which plastic tubing is drawn subsequent to its extrusion for being finished to accurate size, and it particularly pertains to a finish drawing die provided with a readily detachable bushing through which extruded plastic tubing is drawn while submerged in a fluid.

Heretofore, spaced apart plates, each recessed to form die openings, have been used for the finish die. The wall of the recess has been transversely concaved to provide an annular groove surrounding each of the die openings for the tubing to be drawn therethrough. A hole leading to the groove is formed in the plate through which water can be circulated against the outside wall of the tubing as it is drawn through the die opening. These plates are clamped to the end of a tank in position to be submerged beneath the fluid level of a fluid contained within the tank. A plurality of these plates are detachably mounted to one of the tank walls which also has a die opening therein. Longitudinally spaced from these plates is another draw plate on the end of a casing projecting within the tank and recessed to admit water within the casing to surround the tubing as it is drawn through the casing and the die plates on the opposite ends thereof. A structure typifying this prior art is shown in Slaughter Patent No. 2,383,520, issued August 28, 1945. This structure, however, does not lend itself to making tubing of varying sizes, but is adapted for tubing of only one size. Even though some of the plates are detachably connected to the wall of the tank, that tank wall also has a die opening, and the casing and the opposite plate are integral therewith. This construction does not provide for the use of interchangeable dies. Moreover, the walls of the openings cannot be elongated lengthwise without using very thick plates or a series of them, and then the tubing in the die opening is not exposed to the fluid.

Accordingly the principal object of our invention is to provide a finish drawing die in which the drawing die element permits distribution of a fluid upon the outside wall of the tubing while being drawn through said die element.

Another object of the invention is to provide a drawing die in which the drawing die element is readily detachable.

Another object of the invention is to provide a drawing die which is simple in construction and efficient in operation.

Another object of the invention is to provide a drawing die in which there is more effective

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application of the fluid to the outside wall of the drawn tubing.

Another object of the invention is to provide a drawing die in which the drawing die element is non-fixedly attached to its support.

Further objects, and objects relating to details of construction and economies of operation, will readily appear from the detailed description to follow. In one instance I have accomplished the objects of my invention by the device and means set forth in the following specification. My invention is clearly defined and pointed out in the appended claims. A structure constituting a preferred embodiment of my invention is illustrated in the accompanying drawings forming a part of this specification, in which:

Fig. 1 is a side longitudinal sectional elevation of a drawing die embodying our invention.

Fig. 2 is an end view of the right hand end of the finish die.

The invention generally described comprises a finish drawing die which is adapted to be submerged in a tank of fluid, such as water, and is disposed adjacent the discharge end of a conventional tube extruding device. Air is ejected into the extruded tubing through means in the core of the extruder to keep said extruded tubing expanded until it is drawn through the finish die and cooled sufficiently to be self-sustaining. It is desired to cool the exterior surface of the extruded tubing immediately upon its emergence from the extruder so as to prevent shrinkage and warpage, and the finish die is provided with a means so disposed to insure a flow of cooling fluid to the top of the tubing and down both sides thereof.

The drawing die is a complete unit adapted to be clamped to the wall of a water tank in position to receive the extruded tubing that is discharged from the extruder and be submerged below the liquid level of the water contained within the tank. The die unit is of substantial length comprising a tubular casing having a bushing or sleeve slidably mounted in its opposite ends in spaced apart relation. The wall of the tubular casing is perforated to allow access of the water from the tank to each of the bushings and also to the space in the casing between the bushings. Accordingly, the exterior wall of the tubing is exposed to the fluid throughout the entire length of the drawing die unit. Each of the bushings has constricted opposite ends to provide an intervening space that is connected to a fluid supply hole in the unit through which fluid is permitted to surround the tubing between

the restricted ends of the bushing. The bushings or sleeves are each held within a holder attached to opposite ends of the casing. These holders have a bore conforming to the exterior conformation of the bushings so that the bushings are snugly fitted therein with an end abutting against a stepped portion formed on the core wall. The steps are on the discharge ends of the bushing. The bushings are detachably connected by being inserted in the holders on the feed side and may be held in place against the steps by the tubing being drawn through the die unit. Bushings with different size bores are interchangeable within the bushing holders by merely withdrawing one and inserting another. They do not require being fixed to the holders as they are held in place by the tubing being drawn through the unit.

Referring specifically to the drawings, in which like numerals are used to designate like parts, numeral 2 is a tubing that is extruded from a plastic mass through a conventional extruder device for forming tubing. Air is injected into the tubing 2 as it is formed to keep it inflated and prevent collapsing of the walls until drawn to final finished form and cooled to be self-sustaining.

A finish die 3 is provided adjacent the discharge end of the extruder through which the extruded tubing is drawn. The die is submerged in a tank 7 containing a cooling fluid, such as water. The die is attached to the wall of the tank, and the tank can be properly positioned on a suitable support in respect to the end of the extruder. This die is a complete unit in and of itself, and can be used with any tank. The tank does not need to be of any special construction. The finish die comprises a tubular casing 4 of substantial length having a bushing mounting 5 in one end and another bushing mounting 6 in its opposite end. The two bushing mountings 5 and 6 are spaced apart to provide an intervening chamber and are fixed to the casing by welding. Bearing mounting 5 has an annular flange 7 on its outer end for abutting against the end of the casing in which it is inserted for being secured in place. This mounting is recessed on its inner wall with an annular groove 8 to provide a chamber surrounding a bushing or sleeve 9 that is inserted therein to seat on the inner wall portions 10. An inwardly extending annular flange 11 is formed near the outer end of the bushing mounting to provide a thrust abutment for one end of the bushing, the bushing being adapted to snugly fit within the bore of the bushing mounting and is inserted therein in the end opposite to the flanged end. One or more water holes 12 are formed radially through the bushing mounting and the end of the tubular casing leading to the annular groove 8 between the bushing mounting and the bushing. These holes are preferably diametrically opposed. There are also one or more radial water holes 13 formed in the bushing between its opposite ends connecting the annular groove 8 with annular groove 14 formed in the interior wall of the bushing between resultant annular end flanges 15. These holes 13 are also preferably diametrically opposed. Accordingly water from the tank has access through the water holes to contact with the exterior wall of the tubing as it is being drawn through the bushing, and with the holes diametrically opposed the entire surrounding wall of the tubing is exposed to the fluid.

The other bushing mounting 6 has an annu-

lar groove 20 formed in its outer wall between resultant annular flanges 21 and 22 which fit within the opposite end of the tubular casing. Adjacent flange 21 is another flange 23 formed on the end of the mounting 6 for abutting against the end of the casing. A plurality of passages 25 are formed through the flange 21 leading to the front end of the bushing from the groove 20. Other passages 26 from the groove 20 are formed to be in registration with the radial passages 27 formed through the wall of a bushing 28 which slidably fits within the bushing mounting 6 to abut against a step 29 on its inner wall. This bushing 28 has an intermediate annular groove 30 formed between resulting end flanges 35 on the interior wall of the bushing. Immediately beneath the bushing 28, there is a passage 36 leading to the front end face of the bushing mounting and in communication with the bottom radial passage 27 and one of the passages 25 through the bushing mounting to the groove 20. There is still another passage 38 leading from the annular groove 22 in the bushing mounting to the front end face of the bushing mounting. This passage 38 is formed in the periphery of the flanges 21 and 23 to be between the bushing mounting and the surrounding wall of the tubular casing.

A sleeve 40 is fixed on the end of the casing 4 surrounding the bushing mounting 6 and spaced somewhat from the end of the casing for having a plate 41 also attached to the end of the casing between the end of this sleeve 40 and the flange 23 on the bushing mounting. The plate 41 provides means for attaching the drawing die unit to the wall 7 of the tank by means of bolts to be projected through perforations 43 in the plate. A gasket 44 is inserted between the plate and the wall of the tank.

A slide closure is attached to the front of the plate 41 by means of screws 45 which projects through recesses 46 in the closure 44 to be screwed to the plate 41. These recesses 46 are vertically elongated to permit the closure 44 being adjusted vertically to regulate the volume of flow of fluid through the passages 25. A series of passages 25 are provided and so disposed that the flow of fluid therethrough will fall upon the top of the extruded tubing and down both of its sides to contact and cool the entire outer circumference of the extruded tube. Holes 47 are formed through sleeve 40 and the end of the casing to form a passage from the annular groove 20 to the outside of the casing.

Other holes 48 are formed in the wall of the tubular casing between the bushing mountings so that there will be free entrance of water therethrough to the intervening chamber within the casing for surrounding the entire wall of the extruded tube which is being drawn through the die. The entire outer wall of the tubing through the entire length of the drawing die unit is exposed to the fluid.

The bores of the bushings are slightly tapered with the first bushing through which the tube passes from the extruder having a taper or from about .418 to .460 whereas the taper of the second bushing is from about .400 to .402. The air within the extruded tube inflates and expands the outer wall of the tubing in contact with the bushings through which it is being drawn.

From the foregoing description it will be apparent that the extruded tubing is immediately chilled or cooled by the fluid which is permitted to trickle down upon the top of the tubing and flow down both its opposite sides. As the tubing

is then drawn through the first bushing, it is entirely surrounded by the fluid which is permitted to circulate through the bushing and lubricate the surfaces of the flanges which are in contact with the outer wall of the tube. The extruded tubing is also surrounded by the fluid as it passes through the tubular casing from the first to the second bushing where it is also surrounded by the fluid in being drawn therethrough in contact with the flanges on the interior wall of the second bushing.

Both of the bushings are held within the bushing mountings by simply being inserted therein to abut against the steps, and either of these bushings may be readily replaced with others having a different size bore but of the same overall size to fit within the mounting. The drawing die is a complete unit in and of itself and can be fitted to any tank.

The tubing may be formed from any suitable plastic material, such as cellulose derivatives, particularly cellulose acetate and cellulose acetate butyrate, polymerized vinyl material, and other such resin compositions that are commonly extruded in continuous lengths.

We are aware that there may be various changes in details of construction without departing from the spirit of our invention, and, therefore, we claim our invention broadly as indicated by the appended claims.

Having thus described our invention what we claim as new and useful and desire to secure by United States Letters Patent, is:

1. A finish die for drawing plastic tubing comprising a bushing having an interior wall with an intermediate annular uncovered groove formed therein, between tube finishing annular flanges against which the drawn tube is adapted to be expanded and a support for the bushing, said bushing being provided with a passage leading to the annular groove for applying a cooling fluid to the exterior wall of the tubing being drawn through the die.

2. A finish die for drawing plastic tubing as set forth in claim 1 in which the bushing support is provided with a passage in communication with the radial passage in the bushing.

3. A finish die for drawing plastic tubing comprising a plurality of spaced apart bushings, each having an interior wall with an intermediate annular groove formed therein, and a common support for the bushings, said common support and the bushings being provided with passages in communication with the annular grooves in the bushings.

4. A finish die for drawing plastic tubing as set forth in claim 3 in which the common support for the bushings is a tubular casing having the bushings mounted in opposite ends thereof.

5. A finish die for drawing plastic tubing comprising a plurality of spaced apart bushings, each of which has an interior wall provided with an intermediate annular groove, a mounting for each of the bushings, and a tubular casing to which the bushing mountings are attached, said casing, bushing mountings, and the bushings being provided with passages leading to the annular grooves in the bushings.

6. A finish die for drawing plastic tubing as set forth in claim 5 having closure means on the feed side for distributing fluid from the die upon the tubing as it is fed to said die.

7. A finish die for drawing plastic tubing as set forth in claim 6 in which the means for distributing the fluid upon the tubing is adjustable for regulating the flow volume of said fluid.

8. A finish die for drawing plastic tubing comprising a tubular casing, a bushing mounting fitted to each of the opposite ends of the casing, a bushing slidably fitted in each of the bushing mountings, and means provided in tubular casing, the bushing mountings, and the bushings through which a fluid is circulated to surround the tubing as it is drawn through the die.

9. A finish die for drawing plastic tubing as set forth in claim 8 in which each of the bushings is provided with an annular groove on its inner wall for containing the circulating fluid.

10. A finish die for drawing plastic tubing as set forth in claim 9 in which closure means is also provided for distributing fluid from the die around the outside wall of the tubing as it enters said die.

11. A finish die for drawing plastic tubing as set forth in claim 10 in which the closure means for distributing the fluid on the exterior wall of the tubing is adjustable for regulating the flow of the fluid.

12. A finish die for drawing plastic tubing as set forth in claim 11 in which the closure means for distributing the fluid comprises a plurality of discharge openings with one passage on opposite sides of the vertical axis.

13. A finish die for drawing plastic tubing comprising a tubular casing, a bushing mounting fitted to each of the opposite ends of the casing and spaced apart, a bushing slidably fitted within each of the bushing mountings and provided with an annular groove between annular end flanges, and passages formed in the bushing connecting the annular groove therein with passages leading to the exterior of the casing.

14. A finish die as set forth in claim 13 in which the bushings are axially slidable within the mounting and held therein by the tubing being drawn through the die.

15. A finish die for drawing plastic tubing comprising a casing in which a supply of cooling fluid is adapted to be contained and through which the tube is to be drawn, and a finish die bushing mounted in said casing in position to be submerged in the cooling fluid, said die bushing being provided with an annular groove between tube finishing annular flanges and said bushing having a passage leading to the annular groove for applying a cooling fluid to the exterior wall of the tube drawn through the die.

16. A finish die as set forth in claim 15 in which the die bushing is mounted in opposite ends of the casing.

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REFERENCES CITED

The following references are of record in the file of this patent:

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