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INTERNALLY COOLED MANDREL

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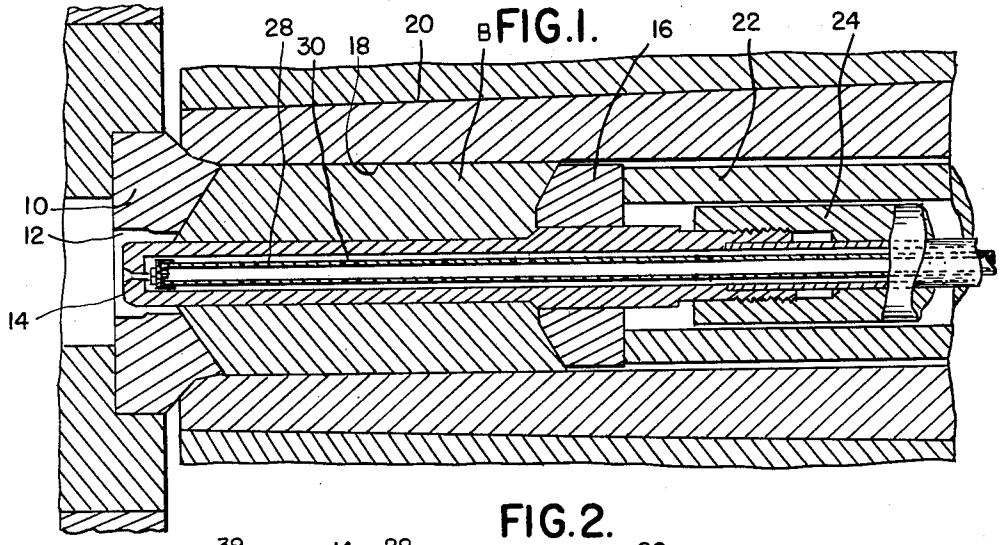


FIG. 1.

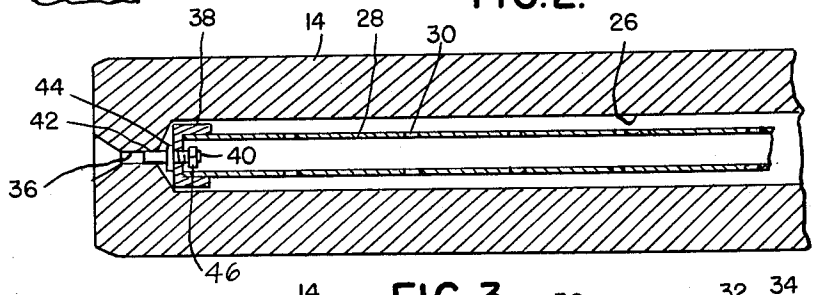


FIG. 2.

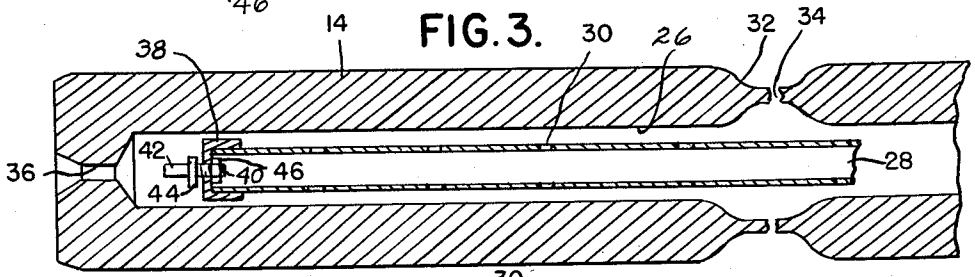


FIG. 3.

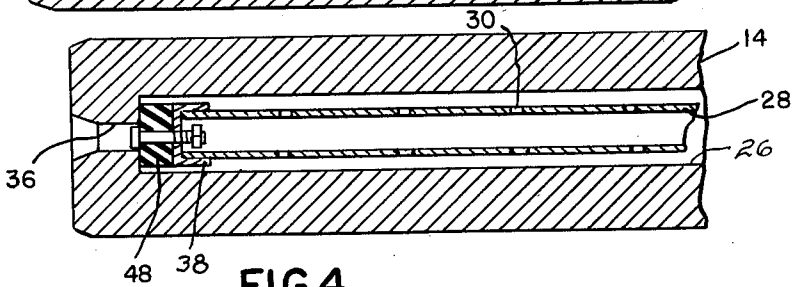


FIG. 4.

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INTERNALLY COOLED MANDREL

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5 Claims. (Cl. 207—16)

The present invention relates to an internally cooled mandrel, and more particularly to an internally cooled mandrel for use in tube extrusion provided with pressure relief means.

It is an object of the present invention to provide a mandrel for use in extruding tube having a coolant passage therein including means normally closing the outer end of the passage and means responsive to elongation of the mandrel for opening the valve to relieve pressure in the event of failure of the mandrel.

More specifically, it is an object of the present invention to provide an internally cooled mandrel for use in tube extrusion having an elongated passage extending longitudinally thereof and terminating in a reduced opening at the outer end of the mandrel, a coolant tube extending longitudinally of the passage, a plug in said opening, and means connecting the outer end of said tube and said plug operable to withdraw the plug from the opening upon elongation of the mandrel.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a fragmentary sectional view showing the relationship of die, mandrel, and associated structure employed in extruding tubing.

Figure 2 is an enlarged longitudinal sectional view showing the outer end of the mandrel in operating condition.

Figure 3 is a sectional view similar to Figure 2 showing the relationship of parts just prior to failure of the mandrel.

Figure 4 is a fragmentary axial sectional view of a modified form of pressure relief construction.

Referring now to the drawings, there is illustrated a die **10** having a circular opening **12** therethrough in which is positioned the outer end of a mandrel **14**. An annular pressure head **16** is received within the circular opening **18** of a container **20** and is engaged by the outer end of a tubular stem **22**. Received between the die **10** and the pressure head **16** is a billet B of the material of which the tube is formed. The billet B is heated to the appropriate temperature, is placed within the container and is pierced by forward movement of the mandrel **14** which is accomplished by moving the mandrel holder **24** forwardly by suitable means such for example as a hydraulic cylinder.

After the billet B has been pierced the stem **22** is advanced to force the pressure head to the left as seen in Figure 1, and the material of the billet B is extruded through the annular space between the opening **12** in the die and the outer surface of the mandrel **14**. Since the billet B is heated and since heavy frictional resistance is encountered, there is a tendency for the parts and particularly the mandrel, to become very hot. As disclosed in prior Patent 2,698,683, cooling means have been provided for the mandrel and these means comprise

a longitudinally extending passage **26** in which is provided a conduit or spray tube **28**. The spray tube has distributed longitudinally thereof ports **30**. Liquid coolant such as water, is introduced into the inner end of the spray tube **28** and escapes into the annular space between the spray tube and the passage **26**. This serves to carry away a substantial amount of heat generated during the extrusion process and permits re-use of the mandrel to pierce another billet as soon as the preceding billet has been completely extruded.

The extrusion operation necessarily involves substantial tensile stresses on the mandrel **14** due to the drag of the metal of billet B as it is extruded through the die **10**, and thus the mandrel occasionally fails in use.

When the mandrel **14** breaks, the broken end is frictionally retained in the previously extruded portions of the tube which is travelling at a faster rate of speed than the metal surrounding the end of the broken mandrel. Thus, when the mandrel breaks, solid rod is extruded behind the previously extruded tube portions, completely sealing the rear end of the water passage **26**. Water may thus be sealed in the partially extruded tube since the outer portion of the mandrel has separated from the inner portion and is frictionally retained in the interior of the partially extruded tube. Thus water, converted to steam by reason of the intense heat developed by the operations, results in dangerously high pressures within the sealed tube portions. As a result of the pressure, the extruded tube portion may rupture or the broken off end of the mandrel may be propelled from the partially extruded tube at high velocity, causing danger of personal injury or property damage.

The failure of the mandrel is normally in tension and results in separation of the mandrel. This failure in its preliminary stage results in necking down of the mandrel as illustrated at **32** in Figure 3, before actual rupture takes place, as indicated at **34**. Accordingly, as the preliminary phase of mandrel failure, there is an elongation of the mandrel.

In accordance with the present invention this elongation of the mandrel which precedes rupture thereof is employed to control operation of pressure relief means. As best seen in Figures 2 and 3, the outer end of the passage **26** terminates in a reduced port or opening **36**. The outer end of the spray tube **28** is closed by a cup **38** which is apertured to receive the stem **40** of a plug valve **42**, the valve having an annular shoulder **44** intermediate its ends. The inner end of the stem is threaded for the reception of a nut **46**. Under normal operating conditions the plug valve **42** is located within the opening **36** and operates as an effective closure for the opening. However, during operation if the mandrel **14** starts to fail, it will neck down as indicated at **32** and prior to actual rupture will elongate to an extent which withdraws the valve portion **42** from the opening **36**. This provides a relief passage which prevents the building up of steam pressure and avoids the difficulties previously mentioned.

Instead of employing the metal plug valve **42** as best seen in Figures 2 and 3, it is possible to employ a valve of the type shown at **48** in Figure 4. The valve **48** may be formed of rubber or similar material and is adapted to overlie the opening **36** rather than to enter into it as is the case of the valve plug **42**. This valve is thus yieldable and like valve **42** will maintain the opening closed during slight relative elongation of the mandrel.

The drawings and the foregoing specification constitute a description of the improved internally cooled mandrel in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What we claim as our invention is:

1. An internally cooled mandrel for use in tube extrusion and subjected in use to tensile stresses and having a longitudinally extending passage terminating in an opening at the outer end thereof, means for supplying cooling liquid to said passage, a valve normally closing said opening, and means in said passage responsive to elongation of said mandrel for opening said valve.

2. An internally cooled mandrel for use in tube extrusion and subjected in use to tensile stresses and having a longitudinally extending passage terminating in an opening at the outer end thereof, means for supplying cooling liquid to said passage, an elongated support member in said passage having its inner end fixed and its outer end free for relative movement in the end of said passage adjacent the outer end of said mandrel, a valve normally closing said opening, said valve being carried by the free end of said member, whereby upon elongation of said mandrel under the tensile stress applied thereto, said valve opens to provide for escape of cooling liquid.

3. An internally cooled mandrel for use in tube extrusion and subjected in use to tensile stresses and having a longitudinally extending passage terminating in an opening at the outer end thereof, means for supplying cooling liquid to said passage, comprising an elongated

conduit extending longitudinally of said passage having its inner end fixed and its outer end free for relative movement in the end of said passage adjacent the free end of said mandrel, said conduit having ports for the escape of cooling liquid into said passage, a valve normally closing said opening, said valve being carried by the free end of said conduit, whereupon upon elongation of said mandrel under the tensile stress applied thereo, said valve opens to provide for escape of cooling liquid.

4. A mandrel as defined in claim 3 in which said valve comprises a closure member movable in sealing relation in said opening and adapted to be withdrawn therefrom to release cooling liquid from said mandrel.

5. A mandrel as defined in claim 3 in which said valve comprises a yieldable member overlying the inner end of the opening in the outer end of said mandrel, and slightly expansible to maintain said opening closed during slight elongation of said mandrel.

References Cited in the file of this patent

UNITED STATES PATENTS

1,374,369	Earl	Apr. 12, 1921
1,989,948	Singer	Feb. 5, 1935
2,385,574	Hyprath	Sept. 25, 1945
2,698,683	Martin et al.	Jan. 4, 1955