

# PATENT SPECIFICATION

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## COMPLETE SPECIFICATION

### Heat Sealed Thermoplastic Tubes and Method of Manufacture thereof

We, WATERMAN PEN COMPANY INC., a Corporation organized under the laws of the State of New York, United States of America, of 1, De Forest Street, Seymour, Connecticut, United States of America, 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 heat sealed thermoplastic tubes and especially, but not exclusively, to ink cartridges for fountain pens consisting of a sealed thermoplastic tube arranged to be inserted in the barrel of a pen equipped with a piercing element whereby, when the barrel is tightened up, the element pierces the cartridge and the pen is ready for use.

The object of the invention is to provide an improved method for sealing an end of a thermoplastic tube, particularly one end of an ink cartridge after filling and so to provide a cartridge which is conveniently and effectively sealed and which can be handled freely without danger of leakage.

According to the invention, a method of sealing the open end of a tube of thermoplastic material comprises the steps of applying to said end a closure disk of thermoplastic material compatible with the material of the tube and a metal cap arranged to embrace the end portion of the tube and the closure disk, and welding the disc to the end of the tube by applying heat to the cap.

The invention also includes a tube of thermoplastic material having one end sealed according to the above method and also such a tube when its other end is closed and the tube is a fountain pen ink cartridge.

The invention will be described by way of example as applied to an ink cartridge and with reference to the accompanying

drawings, in which:—

Figure 1 is a side elevation of a cartridge tube,

Figure 2 is a longitudinal section of the tube of Figure 1 after the pre-forming step.

Figure 3 is an enlarged fragmentary sectional view illustrating the pre-formed end of the tube and associated elements ready for weld sealing,

Figure 4 is an enlarged fragmentary sectional view illustrating the operation of welding the closure disk to the tube, and

Figure 5 is an enlarged fragmentary section illustrating a modification.

Referring to Figures 1 to 4, what for convenience will be referred to as the body of the cartridge consists of an extruded tube 1 of polyethylene or similar thermoplastic material, closed at its lower end 2. The lower end portion and its method of manufacture form no part of the present invention.

The cartridge body is first pre-formed as indicated in Figure 2, as by a heated die, to provide an end portion 3 of reduced diameter merging at shoulder 4 into the body portion proper, this reduced end portion being designed to be sealed by a closure disk welded to the tube end and the entire sealed end preferably enclosed within a metal protecting cap.

During the sealing, care has to be taken to avoid undue softening and distortion of the tube and also to avoid over-heating the ink in the cartridge and the metal protecting cap is especially formed to serve the additional function of transferring appropriately applied heat to effect the welding of the plastic elements, without overheating the cartridge as a whole or its contents.

The closure disk is preferably a flat, circular piece 5 of polyethylene or other thermoplastic material compatible with that of the tube 1 (see Figure 3), of a diameter slightly larger than that of the re-

(Price 3s. 6d.)

Price 25p

duced end 3 of the body tube. The peripheral portion of the disk is arranged to abut a complementary peripheral portion of the tube end and to be welded to it.

5 The enclosing cap 6 is slightly tapered or at least flared towards its open end, and, in this preferred form, is provided with a plurality of circumferentially spaced indentations 7 (conveniently of triangular form).  
10 The closure disk is preferably seated in the closed end of the cap before the latter is indented.

When the tube has been filled with ink and the cap and disk are applied over the  
15 open end of the tube body (see Figure 3) the indented cap portions 7 grip and tend to dig into the tube wall and serve also to space the remainder of the skirt of the cap from the tube.

20 The cartridge is now ready for sealing and for this purpose a hot plate 8 or the like is applied to the rim of the cap as illustrated in Figure 4 and slight pressure is applied. Aluminium or copper are suitable for the cap material and a temperature  
25 of the order of 400°F. The heat transmitted by the cap serves to melt the plastic around the periphery of the disk and at the end of the tube wall and, as the cap is  
30 moved down to its sealing position with the cap skirt engaging the tube shoulder, the abutting portions of the disk and tube are effectively welded together in the zone  
35 marked 9, which forms a slightly enlarged head on the tube end.

The flared shape of the cap not only facilitates its application to the tube but also permits the escape of otherwise entrapped  
40 air; and the limited contact between the cap and tube provided by the indented portions 7 minimizes the transmission of heat to the plastic other than where the weld is to be made. In addition, of course, the indented  
45 portions tend to lock the cap to the tube end before the weld zone. After sealing, a cold plate or cold air blast may be applied to the welded zone to freeze the plastic and cool the cap.

In the modification illustrated in Figure 5  
50 the sealing disk 10 is shown provided with an upturned flange 11 designed to seat within the open end of the reduced neck 12 of the cartridge tube and to be welded to it by the application of heat to the periphery  
55 of the similarly shaped cap 13.

It will be recognized that the described filling and sealing of the cartridges may conveniently be carried out by an endless conveyor method, the cartridges being moved  
60 from stage to stage for the successive operations of pre-forming, filling, capping, sealing, cooling, and discharge.

*What we claim is:—*

1. A method of sealing an open end of a tube of thermoplastic material, comprising the steps of applying to said end a closure disk of thermoplastic material compatible with the material of the tube and a metal cap arranged to embrace the end portion of the tube and the closure disk, and welding the disk to the end of the tube by applying heat to the cap.

2. A method as claimed in Claim 1 wherein the heat is applied to the peripheral portion of the cap only.

3. A method as claimed in Claim 1 or Claim 2, wherein, before welding, the closure disk has a larger diameter than the open end of the tube.

4. A method as claimed in any preceding claim wherein, prior to the application of the disk and the cap to the tube, the tube is formed with a shoulder adjacent to its open end and the portion of the tube between the shoulder and said open end is reduced in diameter relatively to the body of the tube.

5. A tube of thermoplastic material having one end sealed by a method according to any preceding claim.

6. A tube of thermoplastic material having one end sealed by the method according to Claim 4 wherein the metal cap is provided with a depending skirt which embraces the end of the tube and abuts against the shoulder.

7. A tube as claimed in Claim 5 or Claim 6, wherein the metal cap has a flared skirt.

8. A tube as claimed in Claim 6 or Claim 7, wherein the skirt of the metal cap is provided with a plurality of circumferentially spaced indented portions in gripping engagement with the end portion of the tube.

9. A tube according to any of claims 5 to 8 wherein the other end of the tube is closed and the tube is arranged to function as a fountain pen ink cartridge.

10. A fountain pen ink cartridge substantially as hereinbefore described with reference to Figures 1 to 4 of the accompanying drawings.

11. A fountain pen ink cartridge substantially as hereinbefore described with reference to Figure 5 of the accompanying drawings.

A. M. & Wm. CLARK,  
Chartered Patent Agents,  
Quality House,  
5-9, Quality Court,  
Chancery Lane,  
London, W.C.2.

FIG. 1.

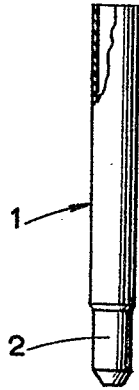


FIG. 2.

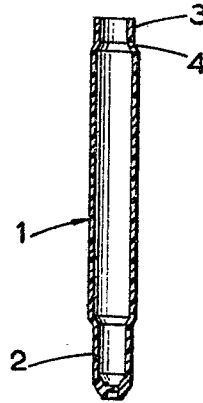


FIG. 3.

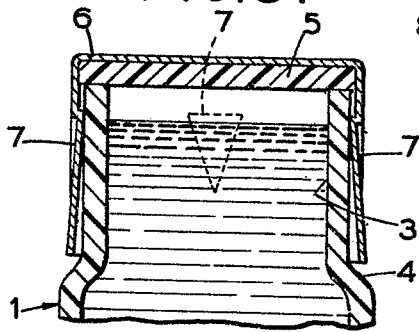


FIG. 4.

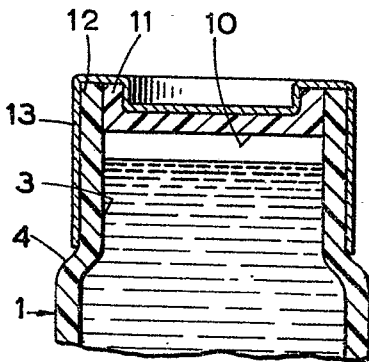
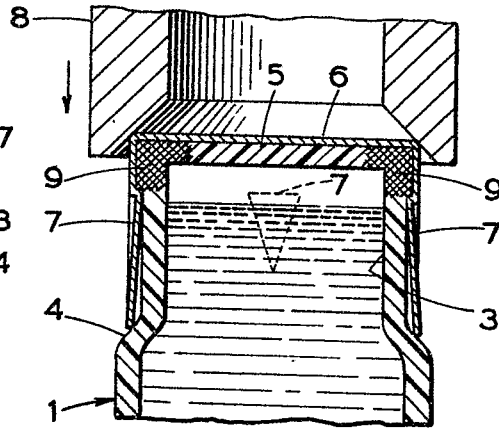


FIG. 5.