APPARATUS FOR IMPREGNATING AND COATING STRANDED BODIES

Inventor: Roy Tomlinson, Manchester, England

Assignee: Connollys (Blackley) Ltd., Manchester, England

Filed: Nov. 29, 1971

Appl. No.: 202,934

Abstract

In order to coat and fill the interstices between the elements of an elongated flexible body, for instance a multi-conductor cable core, formed by stranding or bunching a plurality of the elements together, the body is impregnated and coated with a filling material by passing it into a bath of filling material, in a liquid state, through an inlet die, through the liquid in the bath, and then out of the bath through an outlet die. The dies are wholly situated below the level of the liquid and are maintained at a temperature such that there is no substantial leakage of the liquid from the bath therethrough while the body is passing continuously through the bath. Preferably the dies are each mounted at the free end of a metal tube projecting from the wall of the bath and are maintained at the said temperature by means of external cooling fins on the tubes.

11 Claims, 3 Drawing Figures
APPARATUS FOR IMPREGNATING AND COATING STRANDED BODIES

This is a division of application Ser. No. 8,298 filed Feb. 3, 1970, now U.S. Pat. No. 3,672,974.

This invention relates to a method of and apparatus for coating and filling the interstices between the elements of an elongated flexible body, formed by strand- ing or bunching a plurality of the elements together, with a waterproof material (hereinafter referred to as "the filling material") that will not readily drain from the body under normal conditions of temperature and pressure and that will permit relative sliding movement of the elements over one another during bending of the flexible body. Each element may comprise a single elongated flexible member or two or more such members stranded together.

The filling material is a material that is a liquid at a temperature above normal ambient temperature and sets to a viscous or solid state at ambient temperature.

Examples of the material are:

a. Mixtures of whiting and castor oil
b. Microcrystalline petroleum waxes
c. Mixtures of microcrystalline petroleum waxes and oils, for instance petroleum jelly
d. Low molecular weight, high Melt Flow Index polyethylene of a semi-solid or grease-like nature
e. Mixtures of petroleum jelly, microcrystalline petroleum waxes, polyethylene, polyisobutylene and aluminum stearate
f. Mixtures containing cumerone indene resins
g. A blend of two or more of filling materials (a) to (f).

The invention is concerned especially but not exclusively with the manufacture of the so-called "fully-filled telecommunication cable" comprising a multiplicity of plastics insulated conductors enclosed within a waterproof sheath, with the interstices between the conductors and between the conductors and the sheath substantially fully-filled from end to end of a cable length with the filling material.

The method in accordance with the invention comprises impregnating and coating the body with the filling material by passing it into a bath of filling material, in a liquid state, through an inlet die wholly situated below the level of the liquid, through the liquid in the bath, and then out of the bath through an outlet die wholly situated below the level of the liquid, the dies being maintained at a temperature such that there is no substantial leakage of the liquid from the bath throughout while the body is passing continuously through the bath. It will be appreciated that when the body is stationary in the bath for a period of time long enough for its temperature to increase to a value approximating to that of the bath, the relationship between the temperature of the part of the body in the die and the die temperature may be such that the filling material in the die is at a temperature above its setting point and some leakage may take place.

The inlet die is preferably a closing die by which the bunch or strand of elements or an outer layer thereof is formed and the aperture of the outlet die is preferably slightly greater in cross-section than, although of the same shape as, that of the inlet die. This allows the bunch or strand of elements to expand or bird-cage in the bath after it has passed through the inlet die to cause the liquid to be drawn into its interstices and ensure that the liquid drawn in in this way is not wholly forced out from the strand or bunch when it passes through the outlet die of greater cross-sectional area.

When as is normal the dies are of circular cross-section, a suitable difference in diameter between the inlet and outlet dies is ten thousandths of an inch. It will be appreciated, however, that this value will vary in accordance with the overall size of the strand or bunch and with the size of the individual elements, e.g., single insulated conductors or twinned pairs, from which the strand or bunch is built up.

It has been found that the simplest way of maintaining the inlet and outlet dies at an appropriate temperature is to mount each of them at the free end of a metal tube projecting from the wall of the bath and to increase the heat loss from these tubes by means of external cooling fins. In the manufacture of plastics insulated telecommunication cable, solid metal dies can be used and these can conveniently be split dies fitting into the ends of such tubes.

When manufacturing such a cable on a conventional stranding or bunching machine, a bath provided with inlet and outlet dies can be mounted on the outlet side of each stranding or bunching head, the inlet die acting as the closing die for the preceeding stranding or bunching head. Where the first stranded or bunched layer of single or twin conductors is laid up round a preformed core (e.g., a twin) this core can be passed through a first bath before it enters the first stranding or bunching head, so that it is itself impregnated and coated with the filling material.

When the cable is coated and impregnated, layer by layer, in this way, the liquid in each bath can be at atmospheric pressure but when more than one layer or the whole of a stranded or bunched core consisting of a multiplicity of insulated conductors is to be impregnated and coated by simultaneously by passing through a single bath, it may be desirable to maintain the liquid in the bath under a pressure above atmospheric. In this latter circumstance and in other circumstances it may be found necessary to lower the temperature of the dies by forced cooling, e.g., by means of a water bath, instead of relying on natural cooling.

Each bath is preferably associated with and supplied with liquid filling material from a separate reservoir which is conveniently part of a single container which is divided by a partition to form both the reservoir and the coating and impregnating baths. When such a divided container is used, it is preferably lagged overall and, if necessary, heated to maintain the filling material at the desired temperature. To enable the liquid to pass from the reservoir into the bath, the partition is preferably provided with one or more valve controlled apertures below the level of the body passing through the bath and each valve or valves is preferably linked with the driving means for passing the cable or other flexible body through the bath in such a way that the driving means cannot be energised unless the valve is open.

In order that the invention may be more fully understood and readily put into practice a description will now be given, by way of example, of our preferred plant for making multi-core plastics insulated telephone cables, with reference to the accompanying drawings in which:

FIG. 1 is a sectional end elevation of a bath having inlet and outlet dies and forming part of a divided container,
3,811,406

FIG. 2 is a sectional side elevation of the divided container, and
FIG. 3 is a diagram of the lay-out of the plant.

The container 1 shown in FIGS. 1 and 2 has an outer thermal insulating wall 2 and an inner wall 3 which form the boundary walls of a chamber 4 filled with oil that can be heated by means of an immersion heater 5. The container 1 is divided transversely by a partition 6 to form a bath 7 and a reservoir 8, each of which, when the container is in use, will contain filling material such as petroleum jelly which is maintained in a liquid state by the heated oil jacket.

Projecting from opposite sides of the bath 7 are a pair of metal tubes 9 and 10. A split solid metal inlet die 11, which can also serve as the closing die for a preceding stranding head, fits into the free end of the tube 9 and a split solid metal outlet die 12, having an aperture of slightly greater diameter than that of the inlet die 11, fits into the free end of the tube 10. The tubes 9 and 10 are provided with external radially extending cooling fins 14 which serve to maintain the dies 11 and 12 at a temperature such that there is no substantial leakage of the liquid filling material through the dies during continuous passage of a cable core C through the bath 7.

In the lower part of the partition 6 at a position such that it will lie below the level of a core passing through the bath 7 is a valve-controlled aperture 15 which provides free flow of liquid filling material from the reservoir 8 into the bath. The valve of the valve-controlled aperture 15 is linked with a cam 16 which engages a roller 17 of a micro-switch controlling the power supply to the machine (not shown) drawing the core through the bath 7 in such a way that the machine cannot be energised unless this valve is open. A pump 18 is provided for pumping liquid filling material from the bath 7 back into the reservoir 8 when required. Thermo-couples 19 are connected to a control device which automatically disconnects the power supply to the machine drawing the core through the bath 7 when the liquid filling material reaches a predetermined maximum or minimum temperature.

Filling material in liquid form is fed into the reservoir 8 through a thermally insulated pipe 21 via a supply control valve 22 controlled through a pneumatic actuator 23 by three floats 24, 25 and 26 located at different depths in the reservoir. Float 24 causes the control valve 22 to close when the level of the liquid filling material in the reservoir 8 is at the maximum required and float 25 causes the control valve to open when the level of the liquid is at the minimum required. The third float 26 is provided for controlling a relay which automatically disconnects the power supply to the machine drawing the core through the bath 7 when the level of liquid filling material in the reservoir 8 falls to a dangerous level, i.e., to a level just above the upper surface of the core passing through the bath. To avoid the possibility that, in the event of the valve-controlled aperture 15 becoming inadvertently blocked, the core might continue to be drawn through the bath 7 when the level of the liquid filling medium in the bath has fallen below the upper surface of the core, alternatively the float 26 may be located in the bath 7 or an additional float may be provided in this bath for this purpose.

In the plant shown in FIG. 3 multi-core plastics insulated telephone cables are made by the conventional stranding process employing two stranding machines 27, each having a plurality of stranding heads, and a bunching machine 28 having a plurality of bunching heads. Each machine is provided with apparatus for foating and filling with a filling material the interstices between the plastics insulated conductors of the cable core under manufacture. Two thermostatically heated, lagged storage tanks 31 containing liquid filling material are connected in parallel in a ring main 32 whose piping 33 is heated and lagged and liquid filling material is pumped around the ring main by pumps 34. Valves 35 are provided for disconnecting a storage tank 31 or pump 34 from the ring main if desired. At spaced locations around the ring main are spur pipes 36 controlled by valves 37 and each connected to a heated and lagged manifold 38, one manifold for each cable making machine.

Each stranding machine 27 is of conventional form and includes a plurality of stranding heads 41, a haul-off capstan 42 and a take-up drum 43. The bunching machine 28 includes an input bobbin stand 44, a plurality of bunching heads 45, a whipping head 46, a haul-off capstan 47 and a take-up drum 48. Located on the outlet side of each stranding head 41 in the stranding machines and on the outlet side of each bunching head 45 in the bunching machine is a divided container 1 as described in FIGS. 1 and 2, the reservoir 8 of each container being fed with liquid filling material from its associated manifold 38 through the lagged pipe 21.

In the place of the ring main 32 if desired each manifold 38 may be connected by a heated supply pipe directly to a storage tank and the liquid filling material may be supplied from the storage tank to the reservoir by a gravity feed or by an appropriate pump.

During the loading of a stranding or bunching machine, the impregnating baths 7 are emptied by pumping the liquid from these baths into their respective reservoirs 8, with the valves of the valve controlled apertures 15 connecting the reservoirs to the baths closed; on completion of the loading operation these valves are opened to refill the impregnating baths before the machine is started. To facilitate loading, the metal tubes 9 and 10 projecting from the baths 7 on which the inlet and outlet dies 11 and 12 are carried are preferably of considerably larger internal diameter than that of the die apertures so that they accept a pulling hauser and a connector between such a hauser and the cores being fed through the machine during threading up, the dies being finally placed in a position after threading up is completed.

A principal advantage of the method and apparatus is in accordance with the invention is that recirculation or re-use of excess filling material can be avoided, with the consequence that when (as is usual) the filling material is petroleum jelly there is less risk of degradation of the material.

Another advantage is that the apparatus can readily be reset for the use of filling materials of different set points. Once the thermostats controlling the heating of the supply tank, supply pipes, reservoirs and impregnating baths have been set, the apparatus is self-metering, provided that the dies are appropriately cooled. For example it has been found that for a petroleum jelly with a drop point of about 53°C, an appropriate liquid temperature is 65°C and adequate cooling of the dies is obtained by mounting them on finned metal tubes about 75 mm (3 ins) long.
It is to be understood that in the following Claims the expression "stranding" is intended to include the operation referred to hereinbefore as "bunching" and the term "a strand" includes "a bunch."

I claim:

1. Apparatus for coating and filling the interstices between the elements of an elongated flexible body, formed by stranding a plurality of the elements together, which apparatus comprises a bath; a metal tube projecting from the wall of the bath; an inlet die mounted at the free end of the tube through which a body can be passed into the bath; a second metal tube projecting from the wall of the bath; and an outlet die mounted at the free end of the second tube through which the body can be passed out of the bath; the dies being so located as to lie wholly below the level of liquid filling material when contained in the bath, and external cooling fins on the part of each tube projecting from the wall of the bath for maintaining the dies at a temperature such that there will be no substantial leakage of liquid from the bath therethrough while the body is passing continuously through the bath.

2. Apparatus as claimed in claim 1, wherein the bath is associated with a separate reservoir for the liquid filling material and means is provided for transferring liquid from the reservoir to the bath.

3. Apparatus as claimed in claim 2, wherein the reservoir is provided with a supply valve operable by a float controlling a relay for automatically disconnecting the power supply to driving means passing the body through the bath when the level of liquid in the bath falls to just above the upper surface of the body.

4. Apparatus as claimed in claim 1, wherein the bath and its associated reservoir constitute parts of a single container which is divided by a partition.

5. Apparatus as claimed in claim 4, wherein the divided container is lagged overall and is provided with heating means for maintaining filling material in the reservoir at the desired temperature.

6. Apparatus as claimed in claim 4, wherein the partition of the divided container is provided with at least one valve controlled aperture so located as to be below the level of a body passing through the bath to enable the liquid to pass from the reservoir into the bath.

7. Apparatus as claimed in claim 6, wherein the valve is linked with driving means for passing the body through the bath in such a way that the driving means cannot be energised unless the valve is open.

8. Apparatus as claimed in claim 1, wherein the dies are split solid metal dies which fit into the free ends of the tubes.

9. Apparatus as claimed in claim 1, wherein the aperture of the outlet die is slightly greater in cross-section than, and is of the same shape as, that of the inlet die.

10. For use in the manufacture of an elongated flexible body in the form of a plurality of plastics insulated conductors stranded together to constitute a telecommunication cable core by a stranding process employing a stranding machine having a plurality of stranding heads, apparatus for coating and filling the interstices between the plastics insulated conductors of the cable core, which apparatus comprises a plurality of baths each associated with and located on the outlet side of a stranding head; each of which baths has a metal tube projecting from the wall of the bath, an inlet die mounted at the free end of the tube through which a core can be passed into the bath, a second metal tube projecting from the wall of the bath and an outlet die mounted at the free end of the second tube through which the core can be passed out of the bath, the dies being so located as to lie wholly below the level of liquid filling material when contained in the bath; external cooling fins on the part of each tube projecting from the wall of the bath for maintaining the dies at a temperature such that there will be no substantial leakage of liquid from the bath therethrough while the core is passing continuously through the bath; a plurality of reservoirs, each associated with a bath for supplying thereto liquid filling material; and a supply tank common to the plurality of reservoirs for supplying liquid filling material to the reservoirs.

II. For use in the manufacture of an elongated flexible body in the form of a plurality of plastics insulated conductors stranded together to constitute a telecommunication cable core by a stranding process employing a plurality of stranding machines each having a plurality of stranding heads, plant comprising a plurality of apparatus for coating and filling the interstices between the plastics insulated conductors of a cable core, each of which apparatus is associated with a stranding machine and comprises a plurality of baths each associated with and located on the outlet side of a stranding head; each of which baths has a metal tube projecting from the wall of the bath, an inlet die mounted at the free end of the tube through which a core can be passed into the bath, a second metal tube projecting from the wall of the bath and an outlet die mounted at the free end of the second tube through which the core can be passed out of the bath, the dies being so located as to lie wholly below the level of liquid filling material when contained in the bath; external cooling fins on the part of each tube projecting from the wall of the bath for maintaining the dies at a temperature such that there will be no substantial leakage of liquid from the bath therethrough while the core is passing continuously through the bath; a plurality of reservoirs, each associated with a bath for supplying thereto liquid filling material; a plurality of heated manifolds each connected to the plurality of reservoirs of the coating and filling apparatus of a stranding machine, a heated ring main to which the plurality of heated manifolds are connected, and a supply tank connected to the ring main for supplying liquid filling material to the manifolds.

* * * * *