ABSTRACT

One or a group of separably connected trucks are advanced by a speed regulated prime mover and support in sequence a roll of a soft curable organic polymeric conduit or trough in a compact lie flat condition, a device for extending the advancing conduit to an expanded state, an arrangement for heating or otherwise treating the expanded tube or trough to effect the hardening of the advancing article and guide means for leading the at least partially hardened expanded article from the trailing end of the apparatus in synchronism with the apparatus advance. The heating and curing or the expanded tube is effected by passing the expanded tube through chambers where it is sprayed with hot liquids which are recirculated through a heating unit.

4 Claims, 3 Drawing Figures
EXPANDING, HARDENING, AND PLACING APPARATUS FOR PREFORMED PIPE

REFERENCE TO OTHER APPLICATIONS

This application is a continuation-in-part of U.S. patent application Ser. No. 206,006 filed Dec. 8, 1971 now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates generally to the improvement in the laying of a large conduit trough or other article and it relates particularly to an improved method and apparatus for the automatic expansion and hardening of conduit and the laying of the conduit in a continuous manner.

The use of large diameter rigid conduit is a very common expedient and is applied to such situations as the drainage of sewage and water, irrigation, the distribution of water and the like. The conventional procedure for producing and laying and burying such pipe or trough possess numerous drawbacks and disadvantages. The conduits are usually precast in a rigid state in relatively short lengths and these are then transported to the desired site laid and joined end to end in trenches and are then covered. It is apparent that the above procedure is expensive and highly time consuming and otherwise leaves much to be desired.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide an improved conduit or trough forming and handling apparatus.

Another object of the present invention is to provide an improved apparatus for the continuous laying of large diameter conduit of very long lengths.

Still another object of the present invention is to provide an improved apparatus for storing large conduit in a compact state and expanding and hardening the conduit attendant to the laying thereof.

A further object of the present invention is to provide an apparatus of the above nature characterized by its reliability, ruggedness, and high versatility and adaptability.

The above and other objects of the present invention will become apparent from a reading of the following description taken in conjunction with the accompanying drawing which illustrates a preferred embodiment thereof.

In a sense the present invention contemplates the provision of a pipe laying apparatus comprising a vehicle, a storage of a hardenable lay flat conduit trough or other long article mounted on said vehicle, means for extending article from said storage to affluently expanded state, means for advancing the article with the advance of said vehicle and discharging it at the trailing end of said vehicle, and means for hardening said conduit during its advance along said vehicle.

The apparatus in its preferred form includes one or a plurality of trucks coupled end to end at least one of the trucks being self driven. The lay flat pipe is formed of a hardenable, synthetic polymeric resin or other material for example one having a heat actuated cross linking catalyst, and is wound in its lay flat condition on a reel rotatably supported on the leading truck. The next truck supports a liquid furnace heat exchange unit, a circulating pump and a truck propelling motor such as a diesel engine, the next truck supports a pair of longitudinally spaced spheres within the expanded conduit and limited against longitudinal movement by an external toroid between the spheres. The expanded tube while maintained in its expanded state advances through successive chambers where it is sprayed with hot liquid or other fluid which is recirculated through the heater and the thus hardened and cured tube passes over roller guides into a preformed ditch wherein it assumes its final rigid state.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an elevational view of an apparatus embodying the present invention, and

FIG. 2 is a view similar to FIG. 1 of another embodiment thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1 of the drawings which illustrate a preferred embodiment of the present invention the forming and hardening equipment has a wagon referred to by the numeral 1 provided with wheels 2 on which are arranged a reel, a feeder device 4, an expanding device 5, and a hardening and forming mechanism 9.

The reel is provided with flanges on both sides of the winding axle, and a roll 3 of a soft tubular body hardenable by after treatment is wound on the reel in a flat form. The feeder device is for feeding a flatly formed body and provided with magnetic force for fixing the expanding device 5. The expanding device 5 is for expanding the flat soft tubular body and possesses magnetism. The expanding device 5 is provided with a shaft 7 extending backwards and with forming devices 8 and 8' immediately behind the expanding device and at the outlet of the hardening and forming mechanism described later, thereby maintaining the form of running tubular body in a desired shape. Following the expanding device is arranged the hardening mechanism 9 for hardening the soft tubular body, which contains a spraying mechanism 9' and receiving container 9" for spraying medium such as oil, water, or hot blast and hardens the soft tubular body possessed of a potentially hardenable nature by circulating medium for spraying with the aid of laid pipe 10, a fluid transferring device 11 and a medium container 12. The fluid transferring device 11 is for returning medium having finished hardening operation and has sufficient delivery pressure to develop pressure necessary for making effective the spraying of medium. The medium container 12 has a medium supply inlet and a device for controlling arbitrarily the temperature of medium as circumstances demand.

The potentially hardenable soft body does harden due to quantitative or qualitative change of the contained plasticizer, and hardening by reducing a certain amount of plasticizer by oil and the like is most easy. In another case, it is possible that thermosetting plasticizer is contained and hardening is effected by heating. The properly effected tubular body, after fully hardened, is laid in the trench behind the wagon 1 by way of rollers 15 which are provided for proper sliding. It should be noted that the aforesaid mechanism, of course, can be designed properly unless the object of this invention is transgressed and such modifications are included in the claim of the present invention.
When hard pipe is laid underground employing the equipment of the present invention explained above, a trench is first excavated by a trencher, and subsequently a wound soft body is unwound from the reel and expanded by the expanding device, then passed through the hardening mechanism for hardening, and finally laid in the trench after running on roller portion of the apparatus which are connected with the reel by a leading wheel mounted truck or carriage which supports a pair of transversely spaced upright brackets having a spindle shaft journalled thereto. Wound on the spindle shaft is a compact spool of relatively soft conduit which is in a flat condition, it being noted that conduit may be a trough or other article. The conduit is of the type which hardens to a rigid state upon being heated and advantageously is formed of a synthetic organic polymeric resin having a heat actuatable cross linking agent, thermosetting initiator or catalyst as described in detail, for example in co-pending patent application Ser. No. 181,146 filed Sept. 16, 1971 now abandoned and Ser. No. 205,278, filed Dec. 6, 1971, or may be formed of any other suitable hardenable material.

A second carriage is coupled to carriage and supports a prime mover, for example, a diesel engine which is coupled by way of an adjustable speed transmission to the traction wheels of carriage. Also mounted on carriage is a heat exchange furnace or other heating unit to which is fed by a pump.

A conduit expansion unit is mounted on the next carriage which is coupled to the carriage and includes a chamber having longitudinally aligned leading inlet and trailing outlet openings, the collapsed conduit entering the inlet opening and being guided by a pair of vertically spaced rolls and leaving through the outlet opening. A pair of longitudinally spaced conduit expanding toroids or spheres surrounding the expanded conduit between spheres having an inside diameter slightly less than the outside diameters of spheres.

On the following two carriages which are intercoupled and coupled to carriage are treating or curing tanks respectively the tanks having longitudinally aligned openings through which the expanded conduit advances. Located at the top interior of tanks respectively which are connected with pipes and associated tubing to the outlet of the liquid heating unit. The bottoms of tanks are connected by pipes and associated piping to the outlet of pump where the effluent water or liquid from tanks is recirculated through heat unit back to the drip pans and. A suitably supported motor extends from sphere coaxially through expanded conduit in tanks and is provided with longitudinally spaced circular forming units.

Extending downwardly and rearwardly from the bottom edge of trailing tank opening is a suitably supported guide member provided along its top with freely rotatable guide rolls. The side wall of the hardened or cured conduit as it traverses the guide is engaged by a sensing unit for detecting the hardness, temperature or other parameter of conduit and controls, through any suitable inverse feedback network, one of the operating parameters such as the advancing speed of the apparatus as affected by the drive assembly and, or the temperature of the treating liquid as controlled by heater unit or the speed of pump or the like.

In the normal operation of the apparatus described above the soft flexible conduit is withdrawn from the reel with the advance of the apparatus by drive.
67 and as the soft conduit traverses the expansion unit 71 it is extended to its fully expanded circular cross sec-
tion by the internal spheres 74.

The soft expanded conduit then traverses tanks 81 and 81’ where it is heated by the hot liquid for example a hydrocarbonol. falling thereon from drip pans 85 and 85’ to a temperature to effect the curing and hardening of the conduit 51 due to the activating of the cross link-
ing agent or catalyst or in any other manner as described above. The at least partially hardened conduit is directed by guide member 92 into a preformed trench where it assumes its final shape and position and because of the latent heat therein continues to harden to its final rigid state. By adjusting the sensitivity of sensor 93 and its control parameters as related to the composition of the conduit its interim and final rigidity properties may be controlled.

In a specific example of the present process the appa-
ratus was advanced at 30 mhr and the soft conduit had an inside diameter of 200 mm, a wall thickness of 3.5 mm and a length of 100 meters and a hardness of 20°C of shore D–250. The advancing expanded pipe was treated with a hydrocarbon oil at 170°C and the hardness of the final rigid conduit at 20°C was shore D 82.

While there have been described and illustrated pre-
ferred embodiments of the present invention, it is ap-
parent that numerous alterations, omissions and addi-
tions may be made without departing from the spirit thereof. For example an automatic trench digger may be coupled carriage 84 so that the trench in which the conduit is laid is automatically dug with the propulsion of the apparatus and the handling and laying of the con-
duit.

I claim:

1. A pipe laying apparatus comprising a vehicle, means mounted on said vehicle for storing in a compact longitudinally withdrawable condition a storage of a lay flat conduit formed of a heat hardenable polymeric resin composition, means on said vehicle for extending conduit from said storage to a fully expanded state, means for rearwardly advancing said expanded conduit with the advance of said vehicle and discharging it in situ, at the trailing end of said vehicle, said extending means including a freely mounted expanding form positioned to be within said advancing conduit, means for restricting the longitudinal rearward advance of said form, and means on said vehicle for heating said ex-

panded conduit whereby to effect its hardening during its rearward advance along said vehicle.

2. The apparatus of claim 1 wherein said heating means comprises a chamber through which said ex-

panded conduit advances, a plurality of nozzles direct-
ing a stream of hot fluid onto said advancing conduit, a heating device and means for recirculating the efflu-

cent fluid through said heating device back to said no-
zles.

3. The apparatus of claim 1 including a prime mover for advancing said vehicle.

4. The apparatus of claim 1 wherein said storing means comprises a reel mounted on said vehicle, said lay flat conduit being wound on said reel.