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[33] Japan
[31] 42/83859;
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[54] **APPARATUS FOR CONTINUOUSLY FORMING
PLASTIC-COATED METALLIC TUBINGS**
1 Claim, 11 Drawing Figs.

[52] U.S. Cl. 228/5,
29/527.1, 117/96, 118/629, 228/13, 228/19
[51] Int. Cl. B23k 1/20
[50] Field of Search..... 228/5, 13,
19; 29/527.1, 527.2; 117/75, 93.4, 96, 97, 127;
118/621, 622, 629

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ABSTRACT: An apparatus for continuously manufacturing metallic tubings having a plastic coating thereon. The apparatus is adapted to form a long extending metallic tube initially from a metal strip and then, to apply the plastic coating to inner and outer surfaces of the long extending tube or either one of them as desired while the tube is transported to output side of the apparatus, where such tube already coated is sheared into a standard length of the tubings, all in a continuous manner. The apparatus contains all necessary treating means for respective operations as a unit assembly, so that the respective operations are successively carried out with respect to the long uninterrupted tube, and the coated tubings of standard length are continuously produced.

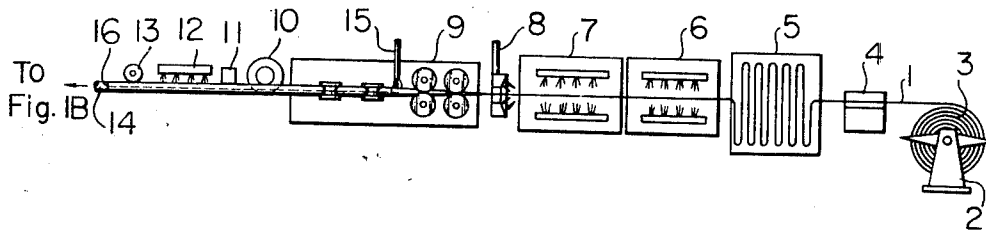


Fig. 1A

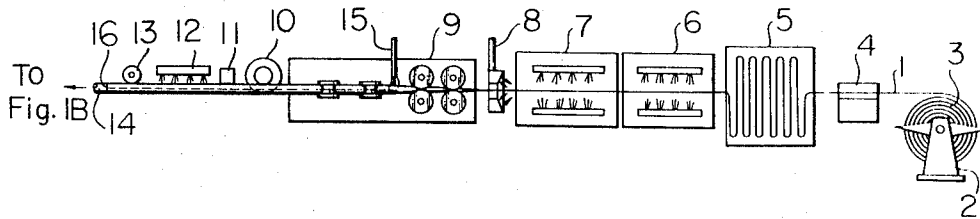


Fig. 1B

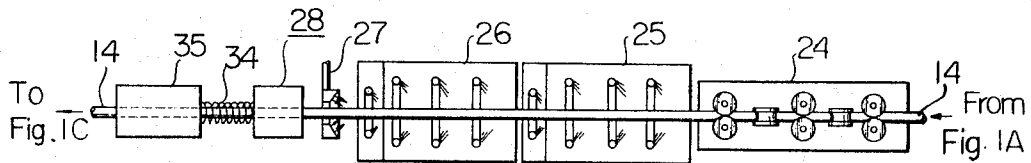
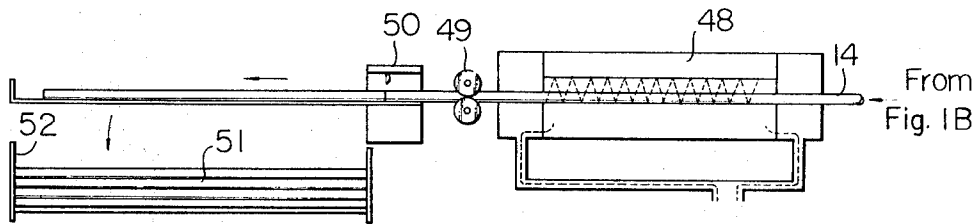


Fig. 1C



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Fig. 2

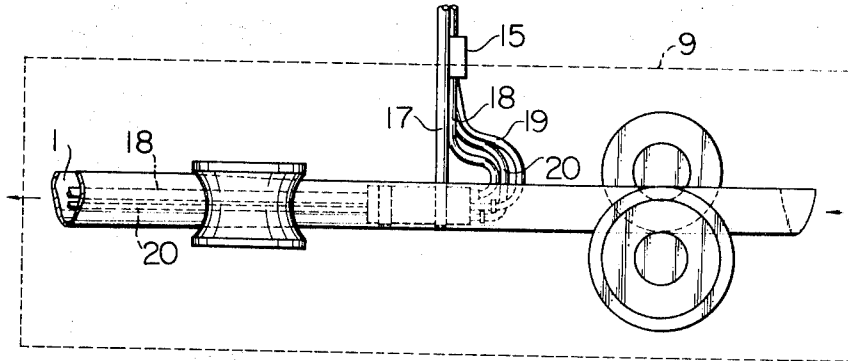


Fig. 3

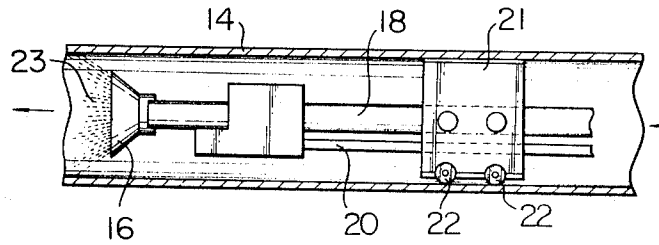
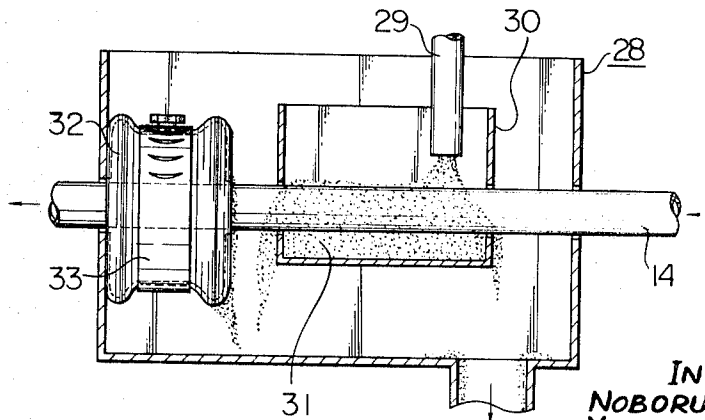


Fig. 4



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Fig. 5

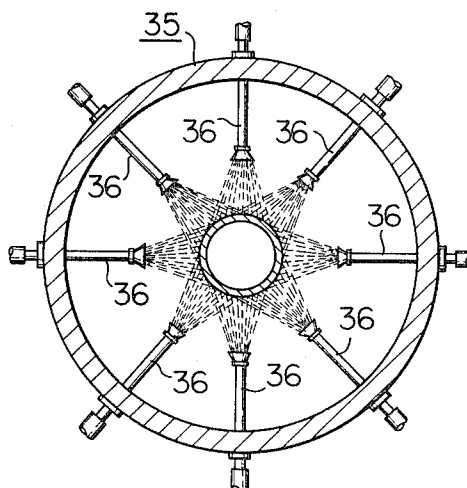
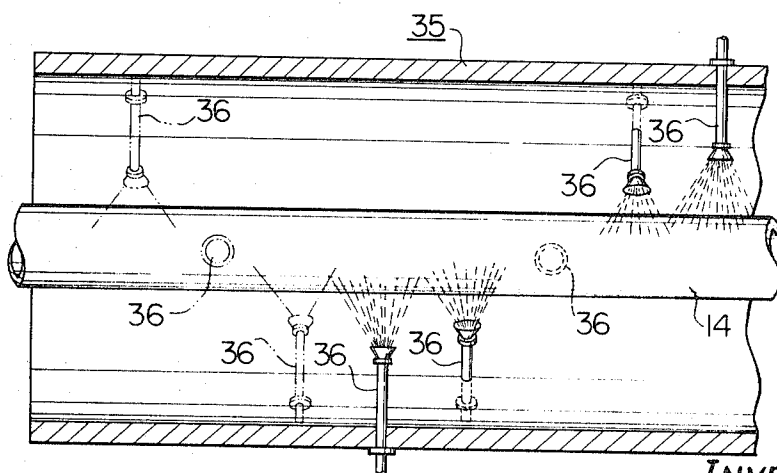


Fig. 6



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Fig. 7

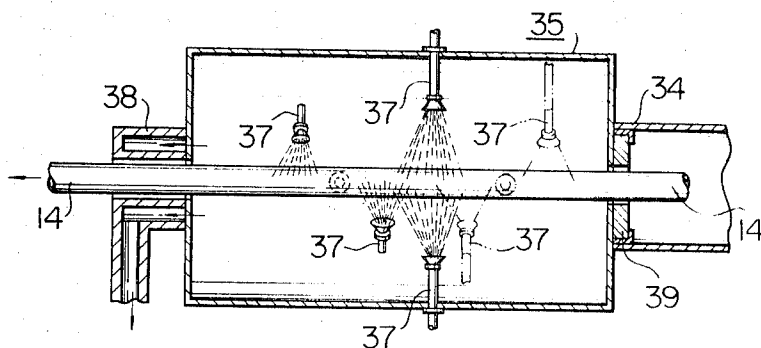


Fig. 8

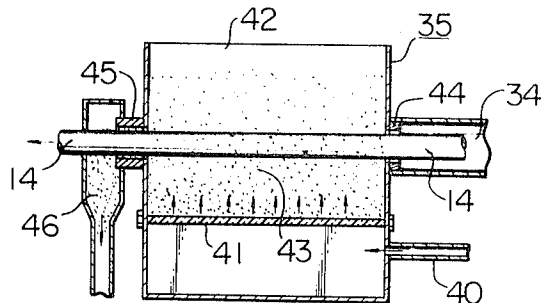
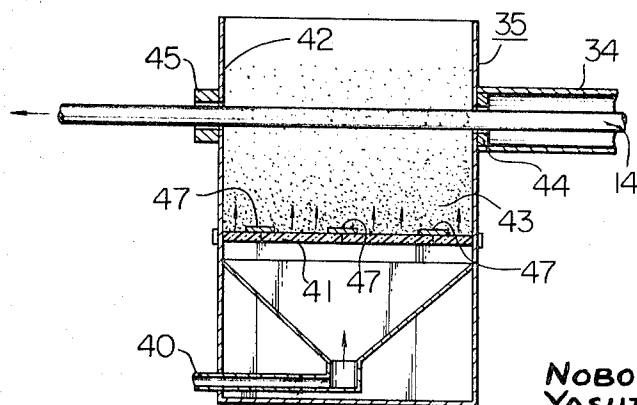


Fig. 9



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APPARATUS FOR CONTINUOUSLY FORMING PLASTIC-COATED METALLIC TUBINGS

This invention relates generally to an apparatus for forming metallic tubings which are coated with a plastic or synthetic resin film and, more particularly, to an improved apparatus which is adapted to form the metallic tubings and to apply a plastic or synthetic resin coating to both or any of inner and outer surfaces of the tubings in a continuous manner.

Heretofore, in manufacturing metallic tubes to which the plastic coating is applied, metallic tubes have been first manufactured and, then, the tubes without having the coating have been further treated so as to be provided with such coating thereon. Thus, it has been necessary to effect the extra work of moving the tubes to be coated, which are cut in a standard length, from the foregoing stop of manufacturing the tubes to the next step of applying the plastic coating thereto. Further, due to the fact that the plastic coating applying step has been carried out after the material tubes are cut in the standard length, a jig for securely holding such standard length of tubes has been always required. The attaching and detaching operations of such jig have occupied a long period of time required for the whole manufacturing operation and, besides, it has been unable to apply the coating to portions where the jigs in the form of, for example, chucks are holding the tubes to be coated. These inconveniences have been defects of conventional apparatuses of the type referred to in the above.

The present invention has been suggested to eliminate the above defects of conventional apparatuses.

It is, therefore, a principal object of the present invention to provide an apparatus which enables manufacture with a high efficiency the metallic tubings having the plastic coating in a continuous manner, by combining a device for forming continuously the tubes from a striplike metallic material with a device for applying successively the plastic coating to the tubes formed.

Further objects and advantages of the present invention will become apparent from the following disclosures made in detail with reference to the accompanying drawings, wherein:

FIGS. 1A, 1B, and 1C schematically show, in conjunction with each other, a whole line of the apparatus of the present invention as continuously forming a tube from a strip metallic material and successively applying the plastic coating to the tube step by step.

FIGS. 2 and 3 are fragmentary side views partly in section of an equipment for coating inner surface of the tube, as employed in the apparatus of FIG. 1.

FIG. 4 is a fragmentary side view partly in section of an equipment for preparing outer surface of the tube for the coating thereof as employed in the apparatus of FIG. 1.

FIGS. 5 and 6 show fragmentarily an exemplary equipment for coating outer surface of the tube as employed in the apparatus of FIG. 1, the former in a cross section and the latter in a side view partly in section.

FIG. 7, 8 and 9 fragmentarily show the second, third and fourth embodiments, respectively, of the equipment for coating outer surface of the tube, as employed in the apparatus according to the present invention, in partly sectioned side views.

While the present invention will be described below with reference to certain preferred embodiments as illustrated, it should be understood that there is no intention to limit the invention to specific forms disclosed, but, on the contrary, the intention is to cover all modifications, alternative constructions and equivalents following within the spirit and scope of the invention.

Referring now to the drawings specifically in FIGS. 1A through 1C, 1 is a strip of a metallic material, 2 is a stand for rotatably mounting a reel 3 around which said strip metallic material 1 is wound, and the strip 1 is paid out from the reel 3 as unwound. The strip 1 paid out from the reel 3 is entered through an end welder 4 and through a strip accumulating station 5 into the first cleaning equipment 6. Said end welder 4 is to weldingly connect rear end of the strip already fed into the apparatus with forward end of a new strip to be successively

fed therein, so that the strip is continuously supplied to the apparatus. Further, the strip accumulating station 5 is provided in order that the strip 1 which comes from the end welder 4 is accumulatively stored in the station 5 with a certain amount of its length, so that even when the supply of the strip is interrupted by and end welding operation carried out at the welder 4, the strip 1 will be continuously fed to the succeeding equipments.

While the strip 1 is passed through the first cleaning equipment 6, any dirt and oils or fats on the strip will be removed therefrom. The strip 1 is then passed to a shot blaster 7. In this equipment, both surfaces of the strip 1 are made to be microscopically uneven in order to improve sticking effect of the coating to be applied thereto. The strip 1 passed through the shot blaster 7 is then fed through a first hot air dryer 8 to a tube forming device 9 so as to be rolled lengthwise and formed into a tubular form, after which the thus formed tubular strip is finished while passing through step by step a seam welder 10, a seam shaver 11, a water shower cooling station 12 and a seam brusher 13 so as to form a complete tube 14. In the present instance, the said seam welder 10 is to weldingly join both side edges of the strip with each other, which is now formed in a tubular form, the seam shaver 11 is to remove any undesirable unevenness at the seam produced during the seam welding operation, and the seam brusher 13 is to remove any oxidized layer around the seam produced during the welding operation.

In order to apply a plastic coating to the inner surface of the tube 14, as shown in FIGS. 2 and 3, an inner surface coating equipment 15 is provided in the tube forming device 9. The equipment 15 is slidably placed on the strip at the place where the latter is formed in a semicircular shape in section so that, at the same time, a powder gun nozzle 16 mounted at the forward end of said inner surface coating equipment 15 will be inserted into inside the tube 14 so as to be positioned at a place succeeding the said seam brusher 13. It should be here appreciated that the above inner surface coating equipment 15 may be of any conventional types of so-called electrostatic powder coating systems, which perform desired sticking effect of the coating, even from the view point of establishing a desired production effect or cost. Thus, in the particular embodiment as illustrated in FIGS. 2 and 3, an equipment of such electrostatic powder coating system is utilized here.

Further with reference to FIGS. 2 and 3, 17 is a gun supporter, 18 is a powder supplying hose, 19 is an air hose, 20 is a high-voltage cable, and 21 is a gun holder which is slidably engaged with the inner surface of the tube 14 through a plurality of insulating rollers 22 rotatably mounted on the holder. A powdery plastics 23 is made to jet from the powder gun nozzle 16. Since the nozzle 16 is positioned as previously mentioned inside the tube 14 at the portion where the tube 14 is passed through the seam welder 10, seam shaver 11, water shower cooling station 12 and seam brusher 13 and, thus, the tube 14 has been completely cooled, the powdery plastics 23 applied to the inner wall of tube 14 will never be burnt.

The tube 14 of which inner surface has been thus coated with the powdery plastics 23 is further transported to a set of sizing rolls 24, where the tube 14 is sized or formed into any of such desired shapes as a round tube or an angular tube. Then, the tube 14 is proceeded to a further step comprising a second cleaning equipment 25. While passing through the second cleaning equipment 25, any dirt and oils or fats on the outer surface of the tube 14 will be removed away. Any further oxidized layer produced on the outer surface at the time of the welding operation will be also removed away during passing through a further step comprising an acid spray station 26, so that a clean tube surface will be obtained (See FIG. 1B). Then, the tube 14 is proceeded through a second hot air dryer 27 to, optionally as desired, a preparing station 28 for the next coating. In the station 28, a primer treating is applied to the tube surface so that the sticking effect of the resin powder to the surface will be improved. An embodiment of such preparing station 28 for coating will be shown in FIG. 4.

Referring now to FIG. 4, 29 is an exhaust pipe for a treating liquid, 30 is a treating chamber, 31 is the treating liquid which is exhausted from the pipe 29 and 32 is a wiper made of, for example, a felt material, around which a steel belt 33 is wound. An excess amount of the liquid 31 attached to the outer surface of the tube 14 will be removed by means of the wiper 32 and the amount of such liquid attached will be adjusted by selectively winding or unwinding said steel belt 33. The tube 14 thus prepared with the priming treatment for the coating by means of the preparing station 28 is then forwarded a heater 34 (See FIG. 1B). Said heater 34 will promote drying-up of the primer material given at the station 28 and, at the same time, will be effective in establishing a preheating for applying the plastic coating to the outer surface of the tube 14. At the same time, also, due to this heating operation the powdery plastics 23 being attached to the inner surface of the tube by means of the foregoing inner surface coating equipment 15 will be made to fuse so that the plastic coating will be formed on the inner surface. Therefore, it would be required to employ such a type of the heater 34 that will heat the tube 14 in a shorter period of time up to a temperature above the melting point of the plastic material utilized but will prevent effectively the tube 14 from being overheated up to a degree where the plastic material might be burnt up, that will cause any gaseous substances produced at the time of fusion of the plastics to be easily dispersed away by heating the tube 14 from inside, and also that the dimensional size of the heater 34 will not become large. Thus, the most preferable type of the heater to be utilized as satisfying the above requirements will be an induction heater. It will be further preferable to carry out the heating operation of the tube 14 by means of the heater 34 in an atmosphere of such inert gas as, for example, a nitrogen gas, so that characteristics of the resin coating will not be deteriorated by the heat.

The tube 14 thus heated by the heater 34 is then transported to an outer surface coating equipment 35, with which a further plastic coating will be applied to the outer surface of the tube 14. As the equipment 35 for coating the outer surface, such various types of the equipment as follows will be suggested.

That is, any of an electrostatic powder coating system as illustrated in FIGS. 5 and 6, an air spray powder coating system as shown in FIG. 7, a fluidizing type dipping system as shown in FIG. 8, or a fluidizing type electrostatic coating system as shown in FIG. 9 may be utilized.

Referring now to FIGS. 5 and 6, 36 is an electrostatic powder coating guns, a plurality of which will be arranged radially around the tube 14 and respectively in a position spaced from each other in the axial direction of the tube 14. In order to cover the whole outer surface area of the tube 14 with the powdery plastics, without causing any pin-holes to be produced on the tube surface and, thus, a uniform coating film will be obtained thereon, it will be preferable to arrange a number of guns 36 radially around the whole periphery of the tube 14 and respectively in a spaced relation from each other in the forwarding direction of the tube so that respective guns 36 will not interfere with each other. By thus arranging a plurality of guns 36 radially around the periphery of the tube 14, it will be possible to make the amount of powdery plastics jetted out of respective one of such guns 36 to be small, so that the powdery plastics applied to the outer surface of the tube 14 will immediately be fused and, thus, an excellent plastic coating layer will be uniformly obtained.

Referring next to FIG. 7, 37 is a spray gun, 38 is a suction device for sucking an excess amount of the powder material, and 39 is an inlet seal member which is adapted to seal the inlet so that the powdery plastics will not disperse therefrom. As the tube 14 heated at the heater 34 passes through the air spray powder coating system 35 as illustrated in FIG. 7, the powdery plastics jetted out of the spray gun 37 will be applied to the outer surface of the tube and will be instantaneously fused thereon, so that a plastic coating will be formed on the surface. It should be appreciated that a plurality of the spray guns 37 will be arranged radially around the whole periphery

of the tube 14 and respectively in a spaced relation to each other in the axial direction of the tube 14, which arrangement is preferable for the same reason as in the aforementioned electrostatic powder coating system shown in FIGS. 5 and 6.

In FIG. 8 next, 40 is a pressure conduit, through which an air or inert gas under pressure will be supplied through a porous plate 41 into a fluidizing chamber 42 so that a layer of the powdery plastics 43 in the chamber 42 will be blown upwardly and, thus, fluidized. 44 is an inlet seal and 45 is an outlet seal. Said outlet seal 45 can not be brought into a direct contact with the tube surface to which the powdery plastic material is attached, but in order to prevent as much as possible any turbulent stream from occurring within the fluidizing chamber 42, the clearance between the tube surface and inner surface of the outlet seal 45 must be made small. Thus, it is preferable to form the outlet seal 45 with a cylindrical tube having a proper inner diameter. Any powdery material 43 leaking out of the outlet seal 45 will be collected by means of a collecting conduit 46. With the above arrangement, as the tube 14 heated at the heater 34 passes through the fluidized layer of the powdery plastics 43 within the chamber 42, the powder 43 will be made to attach to the outer surface of the heated tube 14 and, thus, instantaneously melted so that a plastic coating is applied to the tube 14.

The outer surface coating equipment as shown in FIG. 9 is a fluidized electrostatic powder coating equipment which is comprising a combination of the electrostatic powder coating system shown in FIGS. 5 and 6 with the fluidizing type immersion coating system shown in FIG. 8. In FIG. 9, 47 is an electrode and other elements correspond to those shown in FIG. 8. In the operation of this equipment, air or inert gas under pressure is supplied from the pressure conduit 40 into the fluidizing chamber 42 through the porous plate 41, thereby the layer of powdery plastics 43 will be blown upwardly and, thus, fluidized. Under these conditions, the powdery plastics 43 is brought into contact with the electrode 47 so as to have an electric charge. Thus, as the tube 14 heated at the heater 34 and earthed thereto passes through upper part of the fluidizing layer of the powdery plastics 43, the charged powder particles 43 will be attracted by the earthed tube 14 so as to adhere to the outer surface thereof. As soon as the powder 43 adheres to the tube 14, the powders 43 will be fused by the heat of tube 14 so as to form a plastic coating around the same.

After passing through the heater 34 and succeeding through the outer surface coating equipment 35, the powdery plastic has been applied to the inner and outer surfaces of the tube 14 in a melting state. Now, as the tube 14 proceeds to a succeeding cooling device 48 (See FIG. 1C), the resin film in the melting state will be cooled so as to set and, thus, to be secured to the both surfaces of the tube 14. Then, the tube 14 now completely coated with the plastic film is further transported through a set of guide rolls 49 to a traveling shears 50, where the long tube 14 will be sheared into a standard length as desired. Thus, a number of standard length tubings 15 of which both inner and outer surfaces are coated with the plastic film will be continuously stored in a storage carrier 52.

The apparatus for continuously forming the metallic tubes having plastic coatings thereon according to the present invention as disclosed in detail with reference to illustrative preferred embodiments, will show such remarkable effects as follows.

First of all, since the step of forming the tube in a continuous manner from a strip metallic material and the step of applying the plastic coating to such tube are combined into a single line system, the production of tubings having the plastic resin coating can be extremely increased. In manufacturing, heretofore, such tubings having the plastic coating thereon, material metallic tubes have been initially formed and, then, the tubes without being coated have been further treated in a separate step so as to be coated with the plastic film. According to the present invention, on the other hand, the extra working or operation of connecting these separate two steps which has been involved in such conventional apparatuses

having the defects as above has been effectively and completely eliminated. Comparing, further, with the case where the coating is applied to the tubings already cut into any standard length, the coating applying operation in the present invention can be effectively carried out with respect to a long continuous tube successively after such tube is formed, thereby the coating operation will never be interrupted and, thus, the production effect can be made very high.

Secondly, according to the present invention, since no jigs for holding the tube during the resin coating operation are required at all, the coating operation can be remarkably simplified. That is, it has been always required in conventional apparatuses to employ such jigs for holding the tube at the time of the coating operation, as the coating has been carried out separately after the tube was sheared into a standard length and, thus, it has been required to effect the attaching and detaching operations which have been time consuming. This defect has also involved such inconvenience that the plastic coating could not be applied to the portions of the tube where the jigs were holding the latter. On the other hand, according to the present invention, the coating operation can be effected with respect to a continuous long tubing during the tube forming step and, therefore, such time consuming attaching and detaching operations can be eliminated at all, thereby the coating operation can be much simplified.

Further, according to the present invention, it is possible to carry out the coating operation optionally for only one of the inner and outer surfaces of the tube and, yet, the tube manufacturing velocity of the apparatus will not be altered depending on particular one of the one-surface coating or both-surface coating carried out. Thus, a stable processing can be provided by the present invention.

Further according to the present invention, it is made possible to carry out any of or both of the inner surface coating and outer surface coating during the time when the tube is being formed. Thus, the time period from the inner surface coating to the succeeding outer surface coating can be made shorter.

Also, with the particular arrangement of the heater 34 as disclosed, both of the melting operation for the powdery plastics 23 applied to the inner surface of the tube 14 and the preheating operation of the tube 14 for the outer surface coating can be established by means of the single heater and, thus, the processing can be effectively shortened.

What we claim is:

1. Apparatus for continuously forming plastic coated metallic tubing comprising the combination of means for continuously supplying strip metal to be formed into continuous metal tubing, forming means for continuously forming said strip metal into continuous metal tubing including means for rolling the strip metal into tubular form and means for welding the longitudinal seam of the rolled tubular form, inside coating means operatively associated with said forming means and extending inside the rolled strip metal from a point where the strip metal is not completely rolled to a point where the strip metal is completely rolled and welded, said coating means including means for depositing a thermoplastic coating material on the inside wall of the rolled and welded strip metal, outside coating means for depositing a thermoplastic coating material on the outside wall of the metal tubing subsequent to the deposition of the coating material on the inside wall thereof, heating means disposed between said inside coating means and said outside coating means for heating said metal tubing so as to fuse said inside coating on the inside wall of the tubing while at the same time preheating the outside wall of the tubing for the subsequent outside coating step in a single heating operation and cooling means for cooling the coated metal tubing subsequent to the deposition of said coating material on the outside wall of the metal tubing, said heating means, outside coating means, said cooling means being adapted to avoid mechanical contact with said tubing so that said continuous tubing can be transported continuously from said heating means through said cooling means without any mechanical contact to interfere with said outside coating.

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