Jan. 5, 1937. A. LUTZ 2,066,991

MANUFACTURING PAPER TUBES AND PIPES AND THE LIKE

Filed Aug. 20, 1931 2 Sheets-Sheet 1

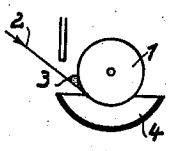


Fig. 1.

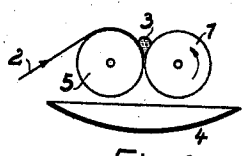


Fig. 2.

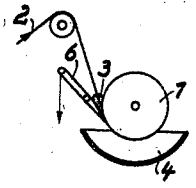
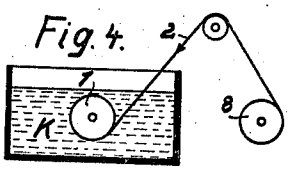


Fig. 3.



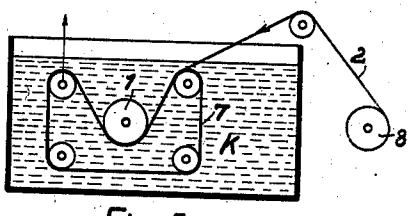


Fig. 5.

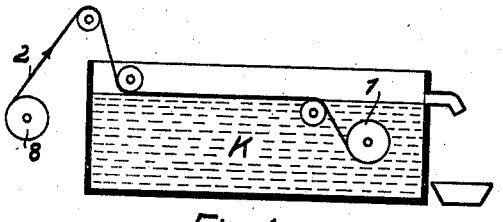
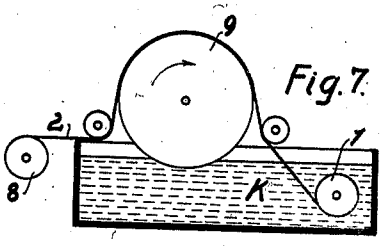
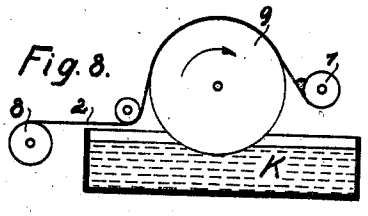
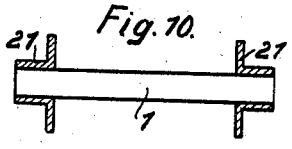
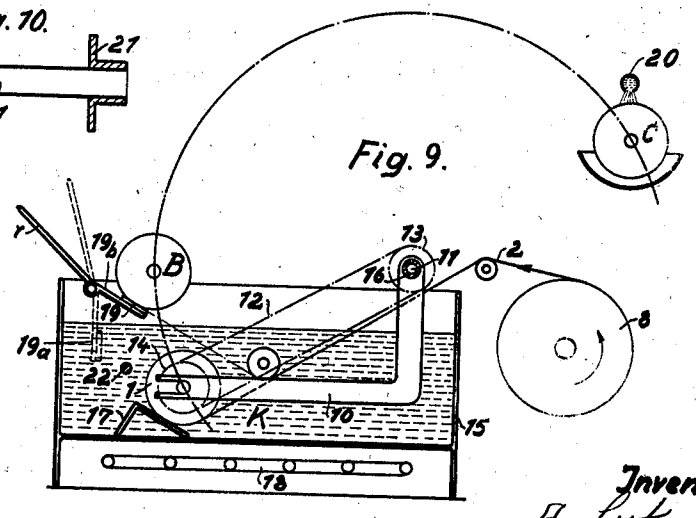


Fig. 6.









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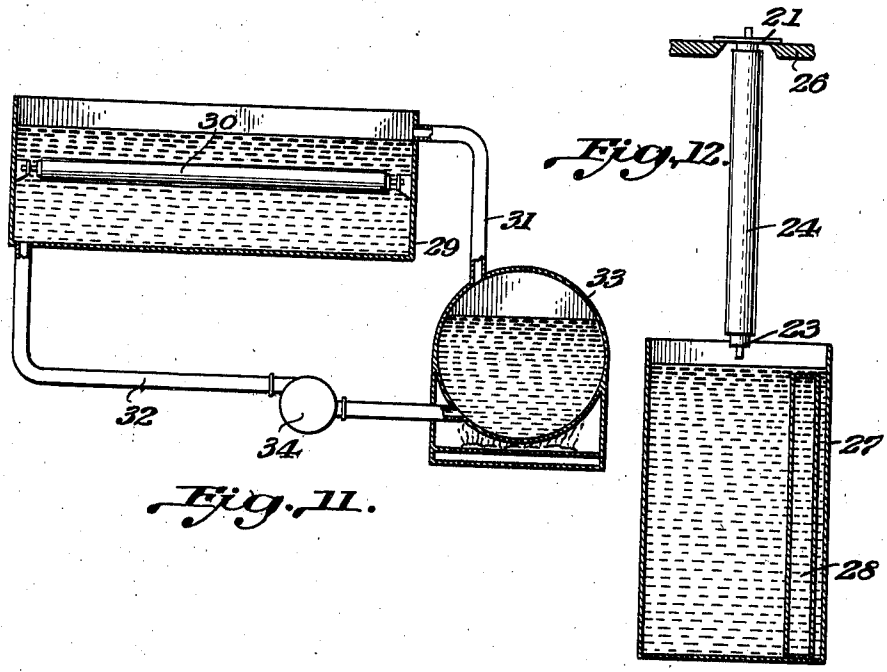
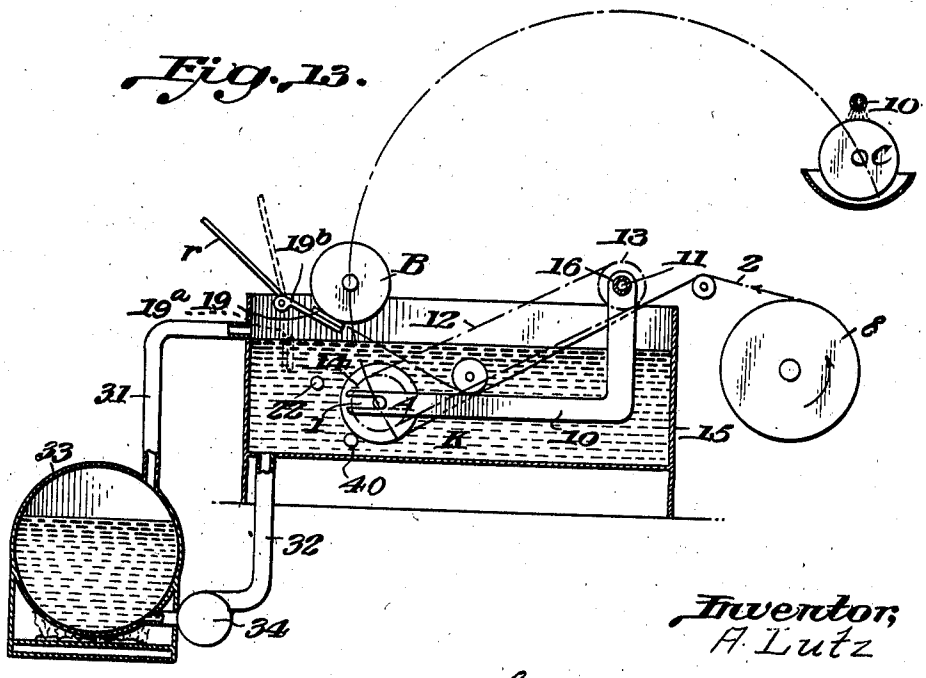


Fig. 12.

Fig. 11.

Fig. 13.



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UNITED STATES PATENT OFFICE

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MANUFACTURING PAPER TUBES AND PIPES AND THE LIKE

Alfred Lutz, Bredereiche (Uckermark), Germany

Application August 20, 1931, Serial No. 558,396
In Germany January 10, 1930

7 Claims. (Cl. 93—81)

This invention has reference to the manufacture of pipes and tubes made of paper, textile fabric, fibres, fibre-fleece, metal films or foils and the like and it is intended to devise means of obtaining a more satisfactory and more durable product than generally obtainable heretofore and to otherwise improve the method of manufacture. In the making of the tubes or pipes of the kind referred to the paper or the like is provided on one side thereof with an adhesive, such as glue or the like, and it is then wound upon a mandrel. With the method of manufacture heretofore in use it has not been possible however to manufacture pipes or tubes which are capable of answering all requirements as regards firmness and impermeability, so that such tubes, as heretofore manufactured could not be used as substitutes for metal tubes, and in particular for steel tubes and the like.

Now, in accordance with this invention, adhesives are used which are adapted for solidification by cooling, and there is the additional feature that during the winding up of the material upon the mandrel the cooling of the adhesive, or at least of the outer already wound up layers is prevented or reduced, which object may for instance be accomplished by keeping the temperature of the adhesive at the moment of the engagement of the material with the mandrel sufficiently high so as to obtain an absolutely reliable union of the two superimposed layers. By this means tubes and pipes are produced possessing the firmness and impermeability of metal pipes. The cooling off of the wound up material may be prevented or reduced for instance by directly heating the point at which the web and the wound-up coil are to be united, this heating being effected for instance by gas lamps disposed at a suitable distance, or by the use of a blast of hot air or by electric heating bodies. The web of paper or the like with the adhesive applied thereto may also be caused to pass over heating surfaces which extend up to the point of union. In accordance with a preferred embodiment heated scrapers or the like may be caused to move upon the coil of wound material directly before the point of union or the point of engagement of the web with the coil.

In the accompanying drawings:

Figures 1 to 3 and 8 represent diagrammatically the method for preventing chilling of the adhesive during the winding operation by holding an excess of hot liquid adhesive between the paper to be wound and the mandrel.

Figs. 4 to 7 represent diagrammatically the method for preventing chilling of the adhesive by holding the mandrel submerged in the hot liquid adhesive.

Fig. 9 is a diagrammatic view of an apparatus for carrying out the method according to the invention.

Fig. 10 is a detail section of a special form of mandrel.

Fig. 11 is a diagrammatic view of an apparatus for heating and circulating the adhesive.

Fig. 12 is a diagrammatic view illustrating the treatment of the aggregate during drawing it off from the mandrel.

Fig. 13 is a diagram of a modification of the apparatus for carrying out the method.

In accordance with the embodiment illustrated in Fig. 1 of the drawings the hot adhesive may be introduced into the angle formed by the roll or coil of wound material and the web fed thereto so that the adhesive may collect in this angle in shape of a lump 3. The mandrel is represented at 1 and the web is indicated at 2. The excess of adhesive which flows off laterally may be received in a trough or a gutter 4 and after having been heated, may be led back to the point of engagement. The regulation of the thickness of the layer of adhesive material is effected by the temperature of the adhesive and by the tension of the web 2 while it is being fed to the wound-up roll or coil 1.

In accordance with the arrangement shown in Fig. 2 of the drawings the pressure of the roller 5 against the mandrel 1 is utilized, the roller 5 being heated if desired. Instead of a roller 5 a scraper 6 may be used which is forced against the mandrel 1 by spring pressure or by the action of a weight and which may be heated if required. The upward extension of the lump of material 3 may be regulated by suitable laterally disposed guards not shown in the drawings. A particularly favorable means of keeping the adhesive hot comprises the carrying out of the winding operation wholly or in part below the surface of the bath of adhesive. Sometimes it is sufficient to immerse the mandrel completely into the adhesive liquor, as indicated in Fig. 4. In this manner the formation of cavities or air bubbles in the wound-up roll is sure to be prevented and the impregnation of the web of paper or the like with the adhesive and consequently the production of a dense and homogeneous mass is facilitated.

With a view of regulating the thickness of the layer of adhesive one or more rotating counter-pressure rollers or relatively stationary scrapers as described in the following with reference to

Figures 9 and 13 are caused to bear upon the roll or coil formed by the winding-up of the web upon the mandrel, the scrapers or the like which may be manufactured from elastic material such as sheets of steel, rubber bars, brass-wire brushes, roller brushes and the like being forced towards the roll of material by weighted levers, springs, screw spindles or the like. Another possibility for the regulation of the thickness of the adhesive layer and for the purpose of imparting a very dense structure to the material is afforded by providing means for causing the moving web to be forced against the mandrel 1 by means of an auxiliary web 7 of metal wire cloth which is passed around the mandrel with adjustable tension (Fig. 5).

After the winding-up has been finished and the roll is removed from the bath of adhesive the same rollers or scrapers may be used to remove the exterior excess of the adhesive and to smoothen the surface of the mandrel which is preferably kept immersed in the adhesive liquor, when not in use, for the purpose of being kept warm. The action of the stripping rollers is further increased by causing their outer periphery to slide along the wound-up roll, which may for instance be effected by a braking action on the pivoting trunnions thereof or by pinion wheels with different numbers of teeth disposed upon the shafts of the two rollers. The same action may also be produced by the auxiliary web 7 in accordance with the arrangement with Fig. 5.

In order to prevent the cooling of the first layer applied upon the mandrel, particularly at the beginning of the winding operation, so as to produce absolute smoothness and dense condition of the inner surface of the paper tube or the like the winding mandrel is heated before the beginning of the winding operation either by heating with gas, steam or by immersion in a hot liquid. By this means the additional favorable result is produced that the mandrel which has been expanded by the heating contracts by the reduction of temperature, so that the removal of the finished pipe or tube from the mandrel is facilitated. The same object may be accomplished by applying black soap or the like or an emulsion of oils or fats to the mandrel before the winding commences. Pure fats or oils have been found to be unsuitable for the purpose, inasmuch as they fail to yield the necessary amount of friction during winding in order to be sure of carrying the paper material or the like with them. On the other hand the substances first mentioned possess a sufficient degree of lubricating properties to allow of the withdrawal of the tube or pipe from the mandrel. In a preferred embodiment the winding mandrel with or without the previous application of a layer of soap is completely immersed into the bath of adhesive, so that it is correspondingly heated after which the paper or the like is wound thereon. In this manner an envelope of adhesive, for instance of asphaltum, is produced upon the mandrel which imparts a smooth interior surface to the finished pipe and increases the resistance of the pipe against moisture, which purpose could otherwise only be obtained by a complicated, time-consuming and consequently expensive subsequent treatment of the interior surface of the pipe.

In accordance with the different uses of the wound material different kinds of auxiliary articles may be included within the windings, such as for instance wire, bands of iron, threads of textile fabric, ribbons, textile material, metal films and sheets, films of cellulose, fleece of fibres, loose fibres, wood of any suitable shape and condition, longitudinally extending rods, metal tubes, tubes of concrete, glass, porcelain, clay, stoneware, coupling and connecting means and the like. As an addition to the adhesive such substances may be used which will impart the necessary safety against a change of form by heat to the wound body obtained with the aid of pitch, asphaltum or the like; of such substances I may mention sulphur, resin, gypsum, hydraulic cement, magnesia, lime, sand, kaoline, clay, soot, ground pumice stone, asbestos, so-called slag wool, powdered asbestos, coke powder and similar substances. The employment of materials of this kind presents considerable difficulties in view of the fact that the wrapping-up of the materials mentioned will cause the formation of air-bubbles which interfere with the uniform structure of the wound-up body and will unfavorably influence its mechanical properties and its resistance. In accordance with this invention special means of manufacture are provided if such kinds of material are used in order to produce absolutely dense winding bodies which are free from bubbles and possess a high degree of firmness, density and cohesion against gases and a high capacity of resistance against water, acids, alkalis, salt water or the like.

The rolled or wound bodies obtained by this invention are initially more or less plastic and their shape may be changed to a high degree by pulling, compressing, rolling or by a displacement of the layers of material. It will be noticed in particular that in the winding of paper within a hot and molten mass of adhesive a considerable amount of heat is stored in the winding body by which means it becomes possible to alter the shape of the tube even after having removed it from the mandrel, so that for instance the cylindrical shape is changed into a square shape by the withdrawal from the mandrel. In accordance herewith the pipe may be rolled flat or may be cut open, so as to obtain herefrom flat plates. By this means the pipes may be bent or curved and nozzle-shaped or flange-like enlargements may be produced at the ends of the pipes or tubes for instance by the displacement of the layers with relation to each other and threads or grooves may be obtained by pressing, or the ends may be connected with flanges, nozzles, coupling means and the like by rolling or screwing operation. If necessary these operations may be carried out within the hot bath of adhesive or a bath of hot water. If it is desired to dispense with this kind of subsequent treatment for the production of flanges, nozzles, sleeves and the like I make use of a winding mandrel which possesses a relatively larger cross section for a part of its length. For the purpose of obtaining pipes or tubes of any suitable cross sectional shape correspondingly formed winding mandrels are used. By stamping, punching, jolting and thickening, drawing and pressing operations and the like objects of different kind, such as for instance vessels and containers and articles for the electric industry or tightening rings for pipes and tubes and the like may be manufactured from the still plastic wound-up body.

Aside from the dissolved or fused adhesives already referred to binding agents of hydraulic nature may likewise be used for the purposes of this invention such as for instance gypsum, magnesia, hydraulic cement and the like, for in-

stance for the purpose of manufacturing hollow bodies or plates, slabs, tiles and the like for building purposes which are particularly distinguished by their low weight, firmness, elasticity, thermic insulation, minimizing of acoustic conductivity, facility of treatment, absence of inflammability and other important advantages.

For the finished winding product it is of importance that, after the winding operation has been finished, the rotation of the mandrel is continued, until the wound article by cooling with air, water or by other means has become sufficiently cooled and hardened to allow of its being withdrawn from the mandrel. If the rotation is discontinued, before the proper time has been reached, a portion of the adhesive will gravitate downwards and sag and the pipe will deviate from the round shape.

In the manufacture of pipes and tubes in accordance with the method of this invention and particularly in the winding of the web upon a mandrel which has been immersed into the bath of adhesive matter some difficulties will occasionally present themselves in the course of manufacture. Sometimes such a volume of foam is suddenly developed that the adhesive flows over the walls of its container; or the finished product assumes a porous condition and presents bubbles in cross section, or on the other hand the pipe or tube manufactured according to the invention which is absolutely round, when the winding is terminated has frequently been found to be disfigured by assuming sharp waves or undulatory ribs extending in parallelism to the axis of the pipe, while the pipe is undergoing the cooling treatment upon the mandrel. Another difficulty is presented by the fact that the adhesive does not enter the paper or the like, or does not sufficiently adhere thereto. Now, it has been ascertained that these difficulties may be overcome by removing those constituents from the adhesive employed which are apt to produce vapors or gases or an increase of volume, that is to say particularly the moisture, the air and low boiling tar oils. Care should also be taken that the liberated constituents, such as for instance water or air, are not given an opporunity of reentering the paper or fabric before effecting the winding thereof.

In order to avoid these difficulties I may for instance proceed in such a way that the paper or the other material of the web, before being allowed to enter the bath of adhesive agent, is highly heated which may be effected by passing it over drying drums or through suitable agents, such as molten sulphur, low melting metal alloys and the like. By employing a preliminary treatment with a bath of sulphur in combination with the use of pitch or bitumen as an adhesive agent the additional advantage of hardening the adhesive is produced, so that the resistance of the pipe against a change of the original round shape is increased, so as to obviate the possibility of the pipe assuming an irregular, unround cross section.

In accordance with a further feature of this invention the difficulties due to the existence of humidity and air in the materials to be used may be eliminated by heating the adhesive, for instance the pitch, to such a temperature that it does not only give off the lower boiling constituents, but that it will also vaporize the moisture contained in the paper or the like which is passed therethrough, while any enclosed air is sufficiently expanded to cause a portion thereof to escape.

In Figs. 6 to 8 of the drawings there are shown diagrammatically and by way of exemplification some methods of procedure for applying the coating of adhesive to both sides of the web or paper or the like at different times. In the arrangement according to Fig. 6 the web or paper which is run off from the roll 8 floats, so to speak, upon the bath of adhesive K the level of which is kept constant by an overflow or in any other manner. Before allowing the web to be wound upon the mandrel 1 which is completely immersed into the bath of adhesive K, the other side of the web 2 is wetted with the adhesive.

The arrangement according to Fig. 7 shows a heated cylinder 9 the bottom part of which is immersed in a bath of adhesive K so that the cylinder will take up a certain amount of adhesive in its rotation. Over the cylinder 9 the web of paper or the like 2 which is unwound from the roll 8 is allowed to move. By the engagement of the web 2 with the adhesive which is retained upon the heated cylinder 9 the moisture is evaporated from the paper and is free to escape from the free exposed upper surface of the web, while the hot, thinly liquid adhesive enters the paper from below and forces out the air. The impregnation of the other side of the web of paper or the like is effected by submerging the web in the bath of adhesive K before allowing it to be wound upon the mandrel 1. The heated cylinder 9 and the winding mandrel 1 may also be arranged in such a manner that, as shown in Fig. 8, they will form a pocket or a gutter similar to the showing of Fig. 2, said pocket receiving the amount of adhesive necessary for the wetting of the other side of the web of paper or the like. The excess of adhesive flows back into the bath K.

The mode of operation in connection with an immersed winding mandrel 1 is shown diagrammatically for instance in Fig. 9 of the drawings. The winding mandrel 1 is journalled at the ends of two brackets or arms 10 of somewhat rectangular shape. The other end of the arms 10 is rockingly mounted upon a shaft 11, so that the winding mandrel 1 may be rocked in succession, so as to assume the three operating positions A, B, C. The driving of the winding mandrel during all of these three working positions is for instance effected by means of a chain 12 and sprocket wheels 13, 14 of which the wheel 13 is driven by the shaft 11. This shaft is journalled in a tube 16 which is disposed on both sides of a tank 15 for the bath of adhesive K. Around this tube 16 the rocking of the supporting arms 10 for the winding mandrel 1 is effected. In the winding operation the mandrel 1 by its weight bears upon the scraper or stripping plate 17 which is composed of a piece of angle iron and is rigidly secured in the tank 15. The pressure of the wound-up material upon the stripping plate 17 may be correspondingly increased by weighting the supporting arms 10. Instead of the scraper or stripping means 17 rollers may be employed which are either stationary or partake in the movement, but in this case with a smaller velocity than the web of paper as will be described hereinafter. By means of chains operatively connected to the supporting arms 10 and engaging sprocket wheels disposed at the ceiling of the room and not shown in the drawings the supporting arm is rocked successively into the positions B and C. The heating of the tank 15 is effected for instance by a gas burner 18 so that the temperature of the bath of

adhesive K may be regulated at any time. As soon as the winding mandrel 1 in the position A has taken up a sufficient amount of layers of the web of paper 2 it is rocked into the position B, the web of paper or the like is cut off crosswise, and a scraper or stripping means 19 is rocked from the position 19a into the position 19b by means of the lever r rockingly disposed on the tank, so that the scraper or stripping means will be forced against the coil of layers produced upon the mandrel. After the excess of adhesive has been wiped off in this manner the stripper 19 is caused to drop back into the position 19a and the mandrel with the coil of windings thereon is rocked into the position C. In this position the coil or roll of windings is preliminarily cooled by sprinkling tubes 20 whereupon the final cooling is effected in a tank filled with water.

The cooling of the coil before removing it from the mandrel produces the advantage that the wound-up coil retains its shape. The completely cooled wound-up coil or roll has however been found to present the difficulty that it can only be removed from the mandrel with a great amount of trouble or not at all, while the withdrawal of the wound article does not present any trouble at all, if it has not been cooled altogether or the cooling has been restricted to the surface only or if the article is heated from the side of the mandrel. It is evidently of importance that the adhesive is kept as liquid as possible upon the mandrel so that it will operate as a lubricant when pulled off therefrom. Now, in order to avoid the loss of shape of the wound-up article in the drawing off operation the article or coil is directly pushed from its supporting mandrel upon another mandrel of smaller diameter which is lubricated with oil or fat and from which the coil may be easily pushed off after thorough cooling. By this means there is the additional advantage that tensional strains in the wound material are avoided which are otherwise liable to occur upon the larger mandrel by the prevention of shrinking. Moreover, by a corresponding configuration of the second mandrel it is possible to impart variations of shape of different kinds to the wound coil, while it is still in the hot condition. Thus it is possible by this means to, for instance, impart a quadrangular or square shape to the wound-up coil or roll or to produce threads thereon by impression or to provide it at one end with a collar-like or sleeve-like enlargement, while the other end is reduced in diameter; or according to a modification the wound article may be bent or it may be given a conical configuration or its diameter may be enlarged by an interior overpressure or by centrifugal treatment of the layers of paper or the like. In this procedure the enlargement of diameter is restricted by an exterior mould into which the wound article is introduced. In case the wound article has already been cooled off before it is introduced into the exterior mould, so much that the layers will not admit of a displacement with relation to each other, this difficulty may be overcome by the introduction of a hot liquid into the wound coil, and this liquid may serve as a means of enlarging the wound article by hydraulic pressure or by centrifugal action. At the same time however the absorption of the adhesive by the paper is assisted and the structure of the wall is rendered denser, while the wound article is provided with an interior coating which consists for instance of bitumen or pitch and which is perfectly dense and smooth. Particularly by the employment of bitumen or of coal tar pitch a perfectly smooth interior thin coat may be obtained, which reduces the frictional loss in such pipe conduits and prevents the deposit of crusts.

For the purpose of facilitating the withdrawal of the winding mandrel from the paper tube or the like and for guiding the web during the winding operation I may make use of flanged rings 21 (Fig. 10) which are slidingly disposed upon the mandrel and in such a manner that a certain space is insured between them which corresponds to the width of the web of paper to be wound up. Any interstices between the front ends of the wound article and the flanges 21 are filled by the adhesive agent, so that the flange upon the withdrawal of the pipe will bear fully upon the front end surface of the wound material. A further advantage of the two flanged rings 21 is presented by the fact that the mandrel with the wound article supported thereon after having been removed from the supporting brackets 10 may be laid upon a table, so that the flanges act as supports and the wound article which is still in the soft condition is protected against injury from pressure.

In order to prevent disforming of the finished roll of comparatively soft condition from the mandrel in the withdrawing operation or thereafter and to avoid unintentional detaching of the roll from the mandrel, the following procedure may be resorted to. The winding mandrel is heated before the rolling operation is commenced to such a temperature that, as above pointed out, any appreciable amounts of heat are not withdrawn from the inner layers of the wall of the tube during and after the winding operation and up to the time of withdrawal of the mandrel. It is also of advantage to coat the hot mandrel with a layer of the fused adhesive material before the winding is commenced. This coating and simultaneous heating is effected in a very simple manner by immersing the uncoated winding mandrel into the liquid adhesive material. In order to provide for as uniform a coating as possible of the winding mandrel a few layers of paper or the like are wound upon the layer of adhesive which is deposited upon the mandrel. Then the movement of the web of paper is interrupted and the coated mandrel is rotated for some time within and in contact with the arrested portions of paper. By this means the smoothening and equalizing of the layer of adhesive surrounding the winding mandrel will be produced and the first layer will be caused to completely hug the surface of the mandrel.

Now, if after this equalizing and smoothening action the interruption of movement of the paper would cease and the winding operation itself would be proceeded with, a tube would be obtained, the interior layers of which would not be coated with the adhesive. In view thereof it is preferable to unwind the layers of paper which have been utilized for the equalizing operation down to one winding layer only. This operation is preferably effected outside of the bath of adhesive material in order to facilitate watching the operation. Then the winding mandrel is again immersed with the material still adhering thereto, whereupon the normal winding operation is commenced. After the finished roll has been cooled from the outside in the manner above described it is placed vertical together with the mandrel, which may be effected in the manner illustrated in Fig. 12 of the drawings by suspending the mandrel 23 with the tube or roll 24 from

a support or abutment 26 by means of flanges 21, the parts being thus held in position above a container 27 charged with a cooling medium.

As a result of the special preliminary treatment of the mandrel before the winding operation the tube 24 will slip off the mandrel by a very slight pulling action, and very often even by the mere action of gravity and will be thereby introduced into the cooling agent. The sudden immersion of the wound, but still soft tube into the cooling liquid effects an immediate and uniform cooling thereof, and there is the advantage that the soft tube in the vertical position is not subject to any forces which are liable to produce deviation from the round section or other deformations. The lower end of the tube sliding off from the mandrel is supported on the bottom of the cooling container and the upward pressure of the cooling liquid is sufficient to prevent any deformation of the end of the tube which rests upon the bottom of the container 27. The position of the tube after slipping off from the mandrel is indicated at 28 in Fig. 12.

Instead of operating the winding mandrel according to Fig. 9 by means of chains it is obvious that pinions, conical wheels or worm wheels may be used. The chain drive has the advantage, however, that it occupies the least amount of space. The immersion of these driving wheels in the adhesive, in molten asphaltum for instance, has not produced any disturbances of any kind whatever. Between the paper roll 8 and the winding mandrel 1 any of the means above described may be inserted for the purpose of applying the adhesive agent to one side of the web.

The mounting of the web on the mandrel and the beginning of the winding is very much simplified by the fact that, after the winding operation is finished, the web of paper or the like is not cut off at the paper roll 8 but in the vicinity of or upon the winding mandrel itself, while that end of the web which is to constitute the beginning of the next coil is allowed to drop into the adhesive. This end places itself upon a transverse rod provided in the tank 15 (Fig. 9) and is placed upon the new mandrel by means of broad tongs, pincers or the like, after the mandrels have been exchanged. Without this provision the end of the web which is impregnated with the adhesive would become solidified or hardened and would then not become smoothly engaged with the mandrel or it would be necessary to pass that end of the web which has been cut off near the roll 8 and has thus far remained dry, through the hot adhesive agent before it is applied to the mandrel.

In the method and arrangement according to Fig. 9 of the drawing the tank 15 containing the adhesive agent is heated directly by the gas burner 18. It may sometimes be of advantage to effect the heating of the adhesive in a special container and to make provision for a continuous circulation of the adhesive between the supply of liquid adhesive and the boiler. A form of execution of the invention is embodied in the exemplification shown in Fig. 11 of the drawings. The tank 29 for the bath of adhesive and for the reception of the winding mandrel 30 is connected by the pipe conduits 31 and 32 to a boiler 33 heated in any suitable manner. The arrangement is preferably such, that one of the two pipes, the overflow pipe 31 for instance, constitutes the overflow for the tank 29 and is connected to the upper part of the boiler 33, while the other pipe connects the lower part of the boiler to the bottom of the tank 29. This latter pipe conduit 32 contains a pump 34 by means of which the fused adhesive is forced in a continuous current from the boiler 33 and into the tank 29, while the excess of the liquid adhesive flows back through the pipe 31 into the boiler 33.

By means of the constant circulation of the adhesive in the winding tank 29 an approximately equal temperature is insured in all parts of the tank and the formation of a solid film which would interfere with the winding operation is thereby prevented. If in the embodiment described and shown the boiler 33 is situated at a lower level than the winding tank 29 there is the possibility of rapidly emptying the contents of the winding tank 29 into the boiler 33. This is a point of advantage both when the emptying of the tank is actually intended as well as for the purpose of preventing solidification of the adhesive in the winding tank 29 in case of disturbance of operation or lack of attention of the operator.

The heating and circulating arrangement shown in Fig. 11 may also be applied to the form of the apparatus shown in Fig. 9. Such a combination of the two arrangements is shown in Fig. 13 wherein the above described parts are identified by the same reference characters.

Fig. 13 also illustrates the use of a stripping roller 40 in place of the angular plate 17 shown in Fig. 9.

The method and instrumentalities for the production of tubular articles according to this invention, and hereinbefore described and illustrated in various embodiments by way of exemplification may be used for the manufacture of pipes and tubes wound in the ordinary manner and in the rectangular direction with relation to the axis thereof or it may also be successfully employed for the manufacture of spirally wound pipes or tubes.

It should also be pointed out that the invention is not limited to the particular embodiments herein described and illustrated by way of exemplification, but it should be understood that its principles will admit of modifications and changes in accordance with varying uses and applications and without thereby deviating from the spirit of the invention, as expressed in the appended claims.

I claim:—

1. The method of producing tubes of flexible stratified thin material on a mandrel, comprising fabric and the like, which consists in winding such material upon itself in admixture with thermoplastic solidifiable adhesives to form manually adhering layers, heating the adhesive, and preventing chilling of the adhesive during the winding operation by holding the mandrel submerged into the hot liquid adhesive.

2. The method of producing tubes of sheets of fabric and the like, which comprises winding a web of fabric and the like in contacting layers and at a high temperature upon a mandrel and in admixture with heated solidifiable thermoplastic adhesive, rotating said mandrel during the winding, and continuing the rotation for some time after the winding is finished, and at the same time cooling the wound stratified roll produced and detaching it from the mandrel.

3. The method of producing tubular articles from thin sheets of fabric and of similar material, which comprises winding a web of said material at a high temperature in contacting layers upon a mandrel in admixture with heated, solidifiable thermoplastic adhesive, and submitting the roll

produced to centrifugal action, thereby enlarging said roll, and detaching it from the mandrel.

4. In the art of producing tubular stratified articles from thin, sheet-like material, a container for fluid, solidifiable thermoplastic adhesive, a winding mandrel, immersed in said supply and supported in the tank, means to vary the level of the adhesive in the tank, driving means for the mandrel, inserted in the adhesive, heating means for the tank, and guiding means for a web of said material.

5. The method of producing tubular articles from sheets of fabric and similar material, which comprises winding a web of such material in superimposed layers and in admixture and in contact with heated solidifiable thermoplastic adhesive upon a mandrel to form mutually adhering layers, removing the wound aggregate from the mandrel and keeping the temperature sufficiently elevated during winding and removal to cause the thermoplastic material to remain liquid in the immediate vicinity of the mandrel to enable the separation of the wound aggregate from the mandrel the thermoplastic adhesive acting as a lubricant.

6. The method of producing tubular articles from sheets of flexible fabric and similar material, which comprises winding a web of such material in superimposed layers and in admixture and in contact with heated liquefied thermoplastic adhesive upon a mandrel and heating said mandrel from the inside and cooling the aggregate produced from the outside and detaching the mandrel from said aggregate.

7. In the art of producing tubular stratified articles from thin, sheet-like material a container for fluid, solidifiable thermoplastic adhesive, a winding mandrel, immersed in said supply and supported in the tank, means to lower the level of the adhesive in the tank, driving means for the mandrel, inserted in the adhesive, heating means for the tank, guiding means for a web of said material, and heated means for removing the excess of adhesive on the article produced and for ironing it.

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