April 18, 1950 F. V. COLLINS 2,504,500

TUBE FORMING APPARATUS

Filed March 2, 1946

Fig. 1

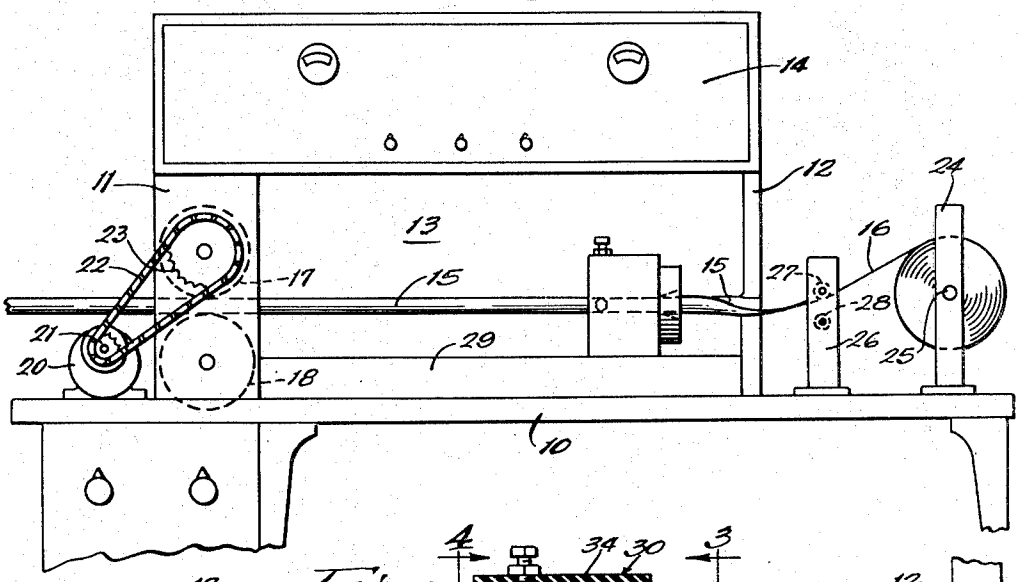


Fig. 2

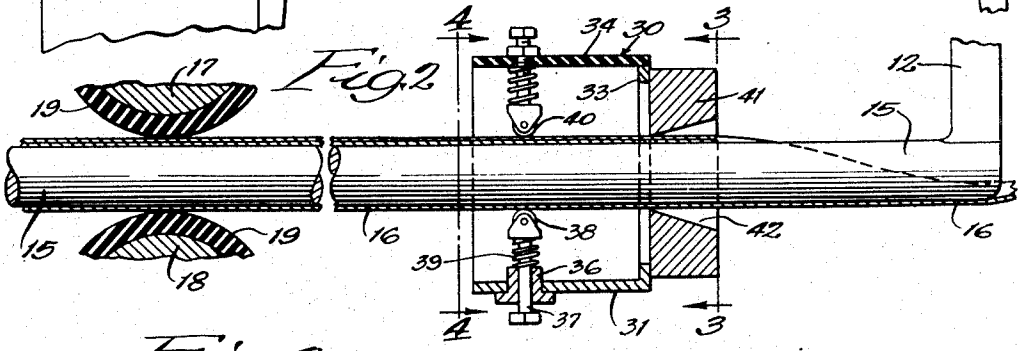


Fig. 3

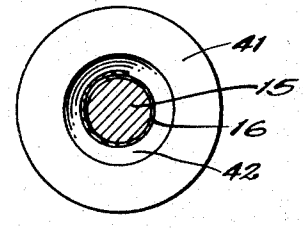


Fig. 4

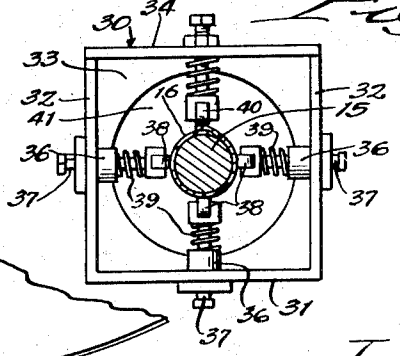
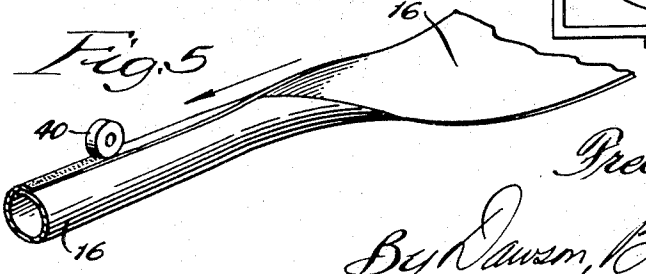


Fig. 5



Inventor:
Fred V. Collins,
By Dawson, Booth & Spangenberg,
Attorneys.

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TUBE FORMING APPARATUS

Fred V. Collins, Des Plaines, Ill., assignor to William F. Stahl, Chicago, Ill.

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1 Claim. (Cl. 154—42)

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This invention relates to a tube forming apparatus and method, and is particularly useful in the forming of tubes from fusible flat stock.

It is common practice today to form tubes from plastic material such as cellulose acetate, vinyl acetate, and from a variety of other materials in the factory and to ship the tubes thus formed, with suitable reinforcing or protecting members, to the point where they are to be used. The resultant product is bulky, fragile and expensive to ship. At the destination, considerable space is required for storing.

An object of the present invention is to provide a simple apparatus and method which may be employed at the point of destination, where the tubes are to be used, for forming tubes from flat stock and as the tubes are needed. A further object is to provide an apparatus and a method for forming tubes directly from flat stock supported upon a reel so that a large quantity of tubes can be formed rapidly from a relatively small and compact roll of flat web stock. Yet another object is to provide means whereby high frequency radio waves may be employed for the sealing of a tube formed continuously from flat stock in an effective manner. Other specific objects and advantages will appear as the specification proceeds.

The invention is illustrated, in a preferred embodiment, by the accompanying drawing, in which—

Figure 1 is a broken side view in elevation of apparatus embodying my invention; Fig. 2, an enlarged longitudinal sectional view of the mandrel and the electronic foot; Fig. 3, a transverse sectional view, the section being taken as indicated at line 3 of Fig. 2; Fig. 4, a transverse sectional view, the section being taken as indicated at line 4 of Fig. 2; and, Fig. 5, a perspective or diagrammatic view of the web as it is formed into a tube and united by fusing.

In the illustration given, 10 designates a frame which may be of any suitable type or construction. Upon the frame 10 is mounted on one side a standard 11 and on the other side a support or tail-stock 12. Between the members 11 and 12 and to the rear thereof is an apron or shield 13 of thin metal. If desired, the web or shield 13 may be omitted. Supported by the members 11 and 12 is a radio frequency generator 14 which may be of any suitable type or construction. The radio frequency generator is not claimed per se herein and, therefore, is not described in detail.

I prefer to employ a mandrel 15 as a means for supporting the web when it is formed into a tube. The mandrel 15 is preferably supported

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by the tail-stock member 12 or formed integrally therewith, a slot being formed at 13 in the tail-stock 12 to permit the web 16 to pass therethrough. It will be understood that any suitable means may be provided for suspending or supporting mandrel 15 so that the lower portion of the mandrel at the rear will be open for contact with the web 16 as it is fed forwardly to enclose the mandrel.

The forward end of mandrel 15 extends between two rollers 17 and 18 which are preferably provided with a resilient sleeve 19 of rubber or other suitable material. One or both of the wheels 17 and 18 may be driven to feed the material 16, now in tubular form, along the mandrel 15. In the illustration given, a motor 20 is shown, supported by frame 10 and driving a sprocket 21. A chain 22 connects sprocket 21 with a sprocket 23 fixed on the shaft of wheel 17. Wheel 17 may be equipped with a gear meshing with a gear (not shown) fixed to wheel 18 for simultaneously driving wheel 18. It is preferred to have wheels 17 and 18 synchronized in their rotation.

Mounted upon frame 10 is a reel rack 24 supporting a shaft 25 carrying the roll of flat material 16. A guide rack 26, equipped with rollers 27 and 28, is supported just forwardly of the rack 24 and serves to guide the web 16 toward the bottom of the mandrel 15.

Mounted upon a platform 29, carried by the frame 10, is an electronic housing member 30 which comprises the bottom wall 31, side walls 32 and rear frame 33. Such walls may be formed of steel or other suitable material. The top wall 34 is preferably formed of a non-conducting material such as polystyrene, etc. The bottom and side walls are each equipped with a sleeve member 36 providing a guide for a stem 37 which is equipped at its top with a roller 38. A spring 39 normally urges the roller inwardly toward the mandrel.

Extending through the top wall 34 and terminating at a point just above the mandrel 15 is a roller 40 forming an electronic foot. The roller 40 engages the web 16 and to hold the overlapping sides thereof together during the action of the high frequency radio waves in the fusing operation. It will be understood that the electronic shoe 40 is connected with the radio frequency generator 14.

At the rear of the housing 30 is a funnel block or tube-forming guide 41. The guide 41 is provided with a forwardly and inwardly inclined opening 42 which guides the forwardly moving web 16 so as to form a tube as it enters the hous-

ing 30. I have found that satisfactory results are obtained when the member 41 is employed merely as a floating guide, resting freely upon the material 16 as it is fed forwardly upon mandrel 15. Figure 5 illustrates the gradual change in the form of the flat material 16 as it is fed forwardly to form the tube illustrated and with the sides of the material in overlapping relation.

The web or flat stock 16 may be formed of any suitable material which is responsive to the action of high frequency radio waves and tends to fuse together portions of the web when brought into overlapping relation. The types of material thus responsive to such action are well known. Examples may be given as cellulose acetate, vinyl acetate or vinyl chloride (co-polymer).

Operation

In the operation of the device, a roll of the material 16 may be placed upon the reel or shaft 26 so as to feed forwardly through the guide rack 26 and to envelop the bottom portion of the mandrel 15. The advancing web is formed into a complete tube within the funnel block or guide 41 so that side portions of the material 16 overlap each other, as illustrated best in Fig. 5. The tube thus formed is held firmly in tubular shape by the pressure rollers 38 in housing 30 and the electronic foot 40 is effective in forming a straight fusion seam through the overlapping parts under the influence of high frequency radio waves. By "overlapping" I mean any structure in which the opposite sides of the tube, after the formation of the tube, lie against each other and are thus available for union through fusing.

A relatively wide range of frequencies may be employed in bringing about the fusion operation, depending upon the type of material being united, its thickness, power factor and dielectric strength, etc. I have used frequencies of 200 megacycles effectively in the uniting of cellulose acetate, vinyl acetate, etc., in the usual tube thicknesses. The effect of the high frequency radio waves is to bring about an internal change in the web so that a fusion occurs between the overlapping or adjacent walls, thus forming an integral seam or merging of the walls.

The operation is continuous, with flat material being fed under and then over the mandrel and the finished tube being drawn off the opposite end of the mandrel under the pull exerted by the resilient tread of wheels 17 and 18.

The apparatus is extremely simple and compact and may be set up at the place of use with the result that flat stock is usable to produce the tubes as they are needed.

While I have described a mandrel as a suitable means for supporting the tube, it will be understood that the tube may be formed without a mandrel and by other means, while, at the same time, providing the overlapping edges, which may be fused together.

While in the foregoing description, I have set forth one mode or method for employing the invention and have described the structure in great detail, it will be understood that such details may be varied widely by those skilled in the art without departing from the spirit of my invention.

I claim:

Apparatus for forming a tube from a fusible flat plastic sheet comprising an electrically conducting mandrel, guide means for directing said plastic sheet toward the mandrel and for wrapping the same longitudinally therearound to form a tube having a seam formed by overlapped edges of the sheet, a multi-sided frame surrounding the mandrel, a rotary, spring-urged contact electrode carried on one side of said frame and adapted to press on the lapped seam of the plastic tube, a plurality of spring-urged pressure rollers supported by said frame in spaced-apart positions on the periphery thereof operative to urge the plastic sheet into a tightly lapped position around the mandrel, a generator of radio-frequency electrical energy, and transmission line means for connecting the output of the generator to the contact electrode and the mandrel to impress a high-frequency electric field therebetween to fuse and integrate the lapped seam.

FRED V. COLLINS.

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