

Oct. 5, 1926.

1,602,165

H. PARKER

METHOD OF BENDING FIBER TUBES

Filed Sept. 18, 1924

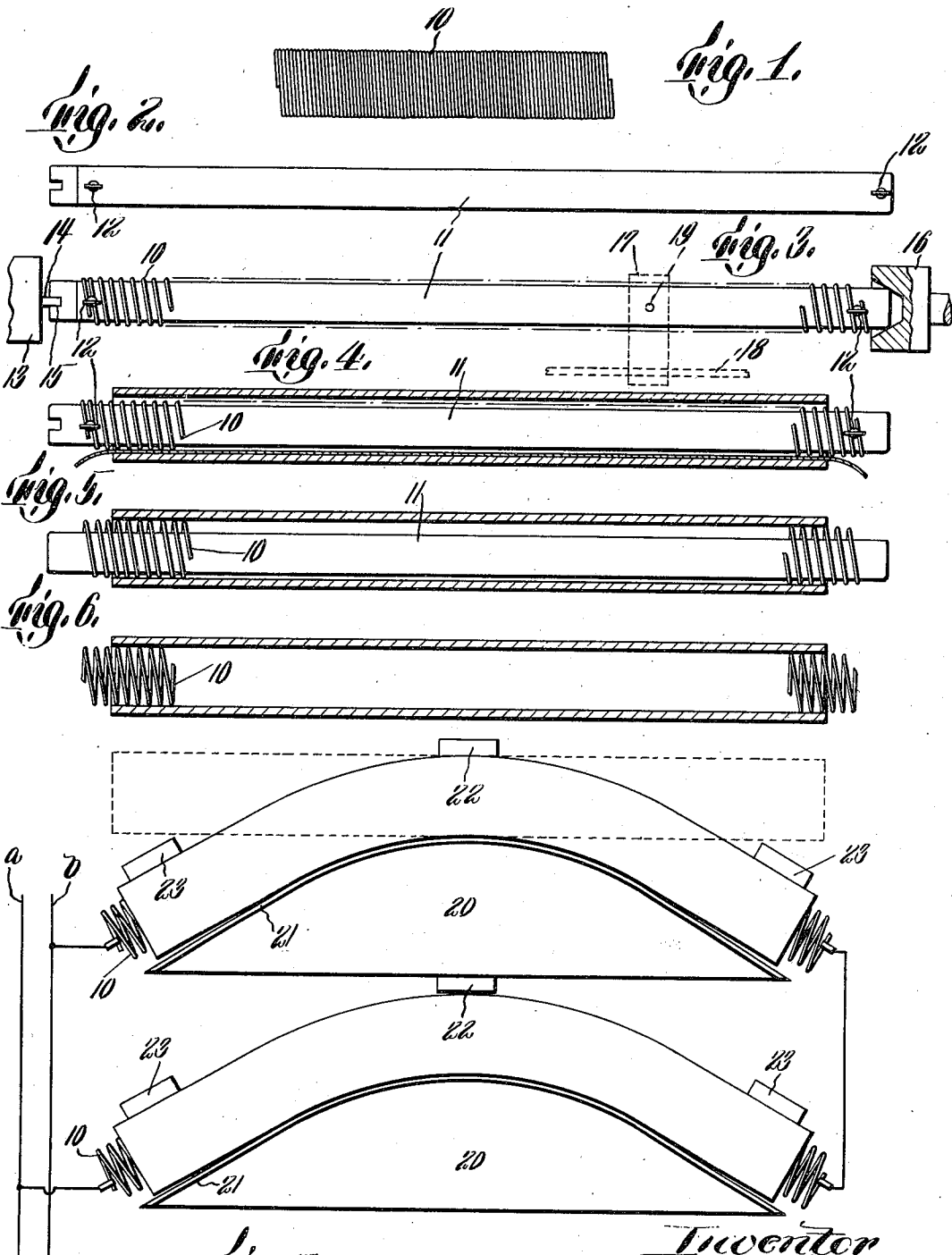


Fig. 7.

Inventor
Howard Parker
Attys

Patented Oct. 5, 1926.

1,602,165

UNITED STATES PATENT OFFICE.

HOWARD PARKER, OF BERLIN, NEW HAMPSHIRE, ASSIGNOR TO BROWN COMPANY,
OF BERLIN, NEW HAMPSHIRE, A CORPORATION OF MAINE.

METHOD OF BENDING FIBER TUBES.

Application filed September 18, 1924. Serial No. 733,390.

In the manufacture of fibrous tubes it is the custom to produce the same by winding upon a mandrel a wet web of fibrous pulp such as cellulose pulp,—the wet web of pulp being formed by a cylinder mold or other web-forming mechanism and being conveyed to the winding mandrel by any suitable form of conveying means. As a result of this operation, there is formed upon the mandrel a tube having a wall which is substantially homogeneous. When the winding operation is completed, the tube itself is moist and it is then ordinarily subjected to a drying operation by which the moisture is removed.

The present invention relates to a method of bending such fibrous tubes after the forming mandrel has been removed. This may be accomplished before the tube is permitted to dry, or if it is dried the tube may be moistened so as to condition it for the bending operation, for it is a prerequisite that the tube shall be in a condition to bend, and in a moist condition they bend best. A moist paper of fiber tube is easily collapsible since the walls thereof under these conditions possess little strength or resistance.

One of the problems which presented itself in the bending of such tubes is to prevent a malformation of the tube, and to maintain the circularity of the tube in cross-section. I have solved this problem by the use of a flexible form-maintaining device which may be inserted into the tube while the latter is rectilinear, and which itself may bend with the tube into an arc of any reasonable degree of curvature or into compound curves as may be desired. For the purpose I have discovered that a helical spring of sufficient length and strength may be employed for the reason that the spring may be so wound up as to reduce its diameter and thus to enable it to be inserted in the tube without damaging the tender wall thereof, and then released so that its convolutions or helices will exert an even pressure against the inner wall of the tube throughout its length. When the spring has thus been introduced into the tube, the tube may now be bent into any curve or compound curve without flattening the tube or disturbing the circular cross-section thereof.

On the accompanying drawing,—
Figure 1 illustrates more or less conven-

tionally a flexible internal pressure member which may be employed in carrying out my process.

Figure 2 represents an arbor or rod which I may employ for the purpose of winding the spring or pressure member so as to reduce its diameter and extend its length.

Figure 3 illustrates a method of winding the spring upon the arbor or rod so that it may be introduced into the tube which is to be bent.

Figure 4 illustrates the arbor with the spring thereon introduced into a tube and illustrates the employment of a flexible sheet of paper or other material which is introduced into the tube so that the insertion of the rod or arbor with the spring thereon will not injure the internal wall of the tube.

Figure 5 illustrates the next step in which the closely wound spring is released so that it may expand into contact with the wall of the tube.

Figure 6 illustrates the tube with the spring therein after the rod or arbor has been withdrawn.

Figure 7 shows several of the tubes after they have been bent against a form.

It is of course highly desirable in carrying out any process of bending a fiber tube while it is in a condition that may be bent, whether the wall be homogeneous or whether it consists of a plurality of more or less adhering laminations or convolutions, that the tender wall of the tube should not be scarred or injured either externally or internally. Consequently it is desirable to provide means by which the spring or internal flexible pressure device may be introduced into the tube without scraping or otherwise injuring the internal wall of the tube.

In the event that the tubes are formed of wet pulp upon a mandrel, the tubes are placed either on a plane surface or in a suitable shaped trough so that their axes will not be deflected and so that the mandrels may be withdrawn. I use as the pressure device a spring of suitable material, preferably spring steel in the form of a helix, which under normal conditions is less in length than the tube to be bent but of somewhat greater diameter than the tube. A spring of this character in its normal condition is shown in Figure 1. The spring, however, must be conditioned to be inserted

into the tube, and for this purpose I employ a rod or arbor 11 which is provided at each end with a wing screw or other equivalent device as indicated at 12. The spring is slipped on to this rod or arbor which is of relatively very much smaller diameter than the tube to be bent, and one end of the spring is secured to the arbor by one of the wing screws 12. The spring is now wound tightly about the arbor and at the same time is extended so that its coils or helices closely hug it and the other end of the spring is then secured to the arbor by the other wing screw 12. This may be done by hand, but if desired it may be accomplished by an instrumentality of the general character of an engine lathe. This machine or instrumentality usually is provided with a rotatable driving head 13 having a member 14 to engage a slot or notch 15 in the end of the arbor. The other end of the arbor is held in a rotatable tail center or head 16. A movable member 17 is adapted to slide along a guide 18 on the machine or instrumentality and may be provided with a pin or other member 19 to engage the coils or helices of the spring. As the arbor is rotated, the member 17 which engages the spring is caused to travel lengthwise of the arbor or rod so as to wind the spring closely about the arbor and at the same time to extend the spring longitudinally until its free end is secured by one of the wing screws 12. After the spring has thus been secured to the arbor, it is removed from the instrumentality and is now ready for insertion into a green or moist tube.

In Figure 4 I have shown one of the tubes in cross-section with the arbor or rod and the spring placed therein.

In order that the introduction of the spring into the tube may not injure it, I ordinarily employ a long strip of paper of suitable width, which is either partly wrapped about the tube and the spring, or else is first inserted into the tube before the introduction of the spring, so that injury to the wall of the tube is prevented. When the arbor and the spring are in place, the tube is rolled over to release the paper which is now pulled out of the tube, then the wing screws are removed and the spring is permitted to expand or unwind sufficiently so that its coils or convolutions bear with equal pressure along the entire length of the tube, as shown in Figure 5, whereupon the arbor is now withdrawn. The tube is now bent by placing it on the floor or upon some other flat surface upon which there is laid a form or template of the desired curvature. These templates may be made in any suitable or convenient manner. For example, I have shown a form which consists of a base 20 having an upstanding curved flange 21. The tube is laid upon the floor as shown in dotted lines in Figure 7, so that it is tangen-

tial to the curved portion of the template, and then the ends of the tube are pressed to cause the tube to assume the curvature of the flange 21. The tube is not resilient while it is moist, but, on the contrary, may be described as ductile in the sense that it may be bent into shape without any substantial tendency towards resuming its initial shape. After the tube has been thus bent, stops or holding devices such as indicated at 22, 23, may be placed upon the floor or support so as to rest against the tube and hold it against the curved flange of the template. I frequently use ordinary building bricks for this purpose. When the tubes are bent under the conditions as described, the spring offers substantially no resistance to the bending of the tubes, being easily bent therewith but at the same time preventing any cross-sectional distortion of the tubes. Ordinarily I hasten the drying of the tubes by arranging fans or blowers so that a constant stream of air is maintained over and in contact with the tubes. The stream of air may be heated if desired. The tubes dry in the form into which they are bent, after which the springs may be easily removed without danger of injuring the tubes. Inasmuch as the springs are formed of electrically-conducting material which is preferably more or less resistant to the passage of an electric current so that they will become heated thereby, the springs may be connected to conductors, which are in turn connected with a suitable source of electrical energy so that the springs become heated and hasten the drying of the tubes. I have indicated at *a* and *b* two electrical conductors forming a part of a circuit with which the springs of two tubes are illustrated as being connected in series. I do not, however, myself claim the process of drying the tubes by heating the springs, as this does not constitute my own invention.

What I claim is:—

1. A method such as herein described, which comprises bending a straight moist tube into the desired curvature while causing yielding outward pressure to be exerted uniformly against the internal surface of such tube, and then removing the moisture from said tube while it is subjected to such pressure.

2. A method such as herein described, which comprises winding a helical spring of greater diameter than the tube to be bent, so that its diameter is less than that of the tube, inserting such spring into a straight moist tube, permitting such spring to expand against the wall of said tube, then bending such tube, and permitting it to set in a rigid state.

3. A method such as herein described, which comprises winding a helical spring of greater diameter than the tube to be bent, so that its diameter is less than that of the

tube, inserting such spring into a straight moist tube, permitting such spring to expand against the wall of said tube, then bending such tube, and then drying said tube while the spring is in place.

4. A method such as herein described, which comprises winding a helical spring of greater diameter than the tube to be bent, so that its diameter is less than that of the tube, introducing into a tube while the tube is in a plastic condition a protector for the internal surface thereof, and also said wound spring, permitting such spring to expand against the internal wall of said tube, then bending such tube, and causing such tube to set and harden in its bent condition.

5. A method such as herein described, which comprises winding a helical spring of greater diameter than the tube to be bent, so that its diameter is less than that of the tube, introducing into a tube while the tube is in a plastic condition a protector for the internal surface thereof, and also said

wound spring, then removing said protector, permitting such spring to expand against the internal wall of said tube, then bending such tube, and causing said tube to set in a bent, rigid state.

6. A process such as herein described, which comprises winding a helical spring about an arbor, inserting such spring and arbor into a tube while the tube is plastic, permitting the spring to expand against the internal wall of said tube, removing said arbor, then bending said spring into the desired curvature, and causing the tube to set in its bent, rigid condition.

7. A method such as herein described, which comprises inserting a flexible, form-maintaining device into a straight, temporarily plastic tube, bending the tube to the desired curvature, and causing said tube to set substantially rigidly while said device is in place.

In testimony whereof I have affixed my signature.

HOWARD PARKER.