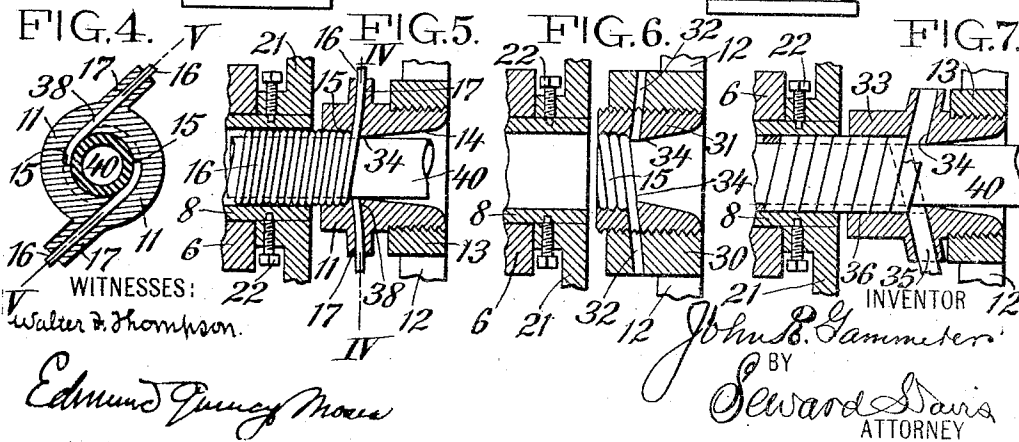
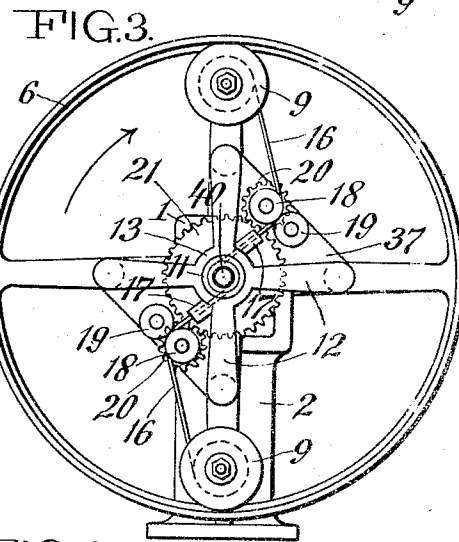
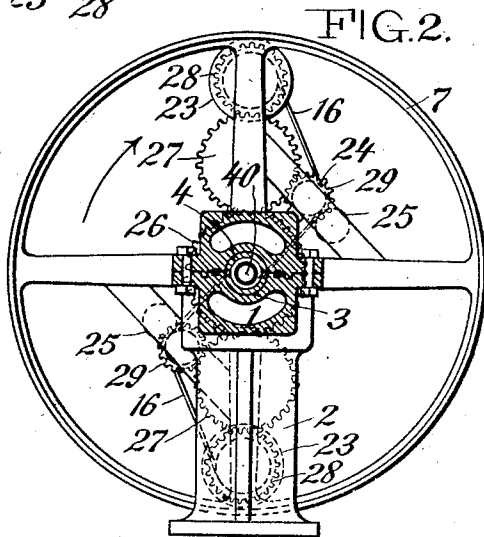
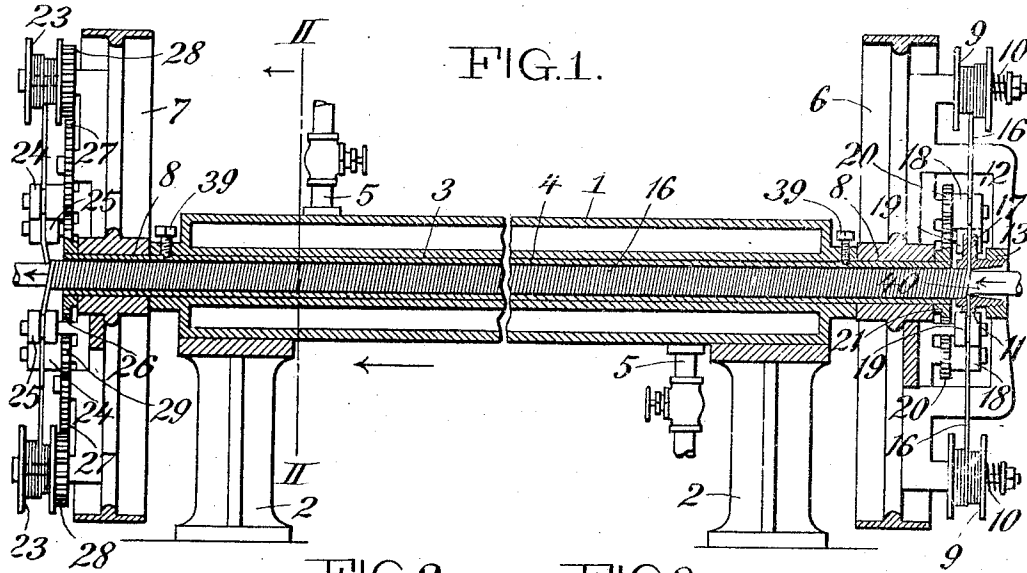


J. R. GAMMETER.  
ART OF VULCANIZING.  
APPLICATION FILED MAY 15, 1908.

1,004,865.

Patented Oct. 3, 1911.



# UNITED STATES PATENT OFFICE.

JOHN R. GAMMETER, OF AKRON, OHIO, ASSIGNOR TO B. F. GOODRICH COMPANY, OF AKRON, OHIO, A CORPORATION OF OHIO.

## ART OF VULCANIZING.

1,004,865.

Specification of Letters Patent.

Patented Oct. 3, 1911.

Application filed May 15, 1908. Serial No. 433,005.

*To all whom it may concern:*

Be it known that I, JOHN R. GAMMETER, a citizen of the United States, and a resident of the city of Akron, county of Summit, and State of Ohio, have invented certain new and useful Improvements in the Art of Vulcanizing, (Case F,) of which the following is a specification.

This invention relates to improvements in the art or method of vulcanizing, especially adapted to the vulcanization of elongated articles such as hose or tubing.

More particularly it relates to the vulcanization of articles of such character as a continuous process in a manner somewhat similar to that described in my former applications Serial No. 374,686 filed May 20, 1907, and Serial No. 379,831 filed June 20, 1907, since issued as patents numbered 906,215 and 906,489, respectively.

An apparatus for carrying out the improved method forming the subject of this application, is described and claimed in a companion application Serial No. 428,483 filed April 22, 1908, issued March 2, 1909, as Patent Number 913,720 and is also described in this case for purposes of illustration and explanation.

Before my inventions, the usual mode of vulcanizing hose, solid rubber tires, belting or other articles of elongated form, was either to vulcanize the articles in straight molds of such length as could be easily handled, in which case the lengths produced were necessarily quite limited, or in the case of small hose or tubing, to vulcanize it in coiled form. The latter method, however, has the objection that the tubing is given a permanent curve or set by being vulcanized while coiled, which makes the hose, when in use, inconvenient to handle and of diminished durability. My present invention avoids the defects of both of these methods.

In the accompanying drawing forming part of this specification, Figure 1 is a longitudinal vertical section through a vulcanizing machine by which my invention may be practiced. Fig. 2 is a transverse section of the machine on the line II—II of Fig. 1. Fig. 3 is an end elevation of the machine looking at the winding end thereof. Fig. 4 is a transverse section, and Fig. 5, a longitudinal section through the coiling die; Fig. 4 being taken upon the line IV—IV of

Fig. 5, and showing the hose in section, and Fig. 5 being taken on line V—V of Fig. 4, showing a portion of the guide tube with the fixed gear attached thereto, and showing a portion of the hose and mold in elevation. Fig. 6 is a view similar to Fig. 5 of a slightly modified construction, the hose and mold being omitted. Fig. 7 is a view similar to Fig. 5 of another modified form.

Referring to the drawings in detail, 1 is a vulcanizer supported on pedestals 2 and provided with a central longitudinal chamber or channel 3 through which preferably extends a guide tube 4. This guide tube may, however, be dispensed with and the interior surface of the chamber be itself used as a guide tube. The vulcanizer is preferably divided longitudinally into two sections, which may be separated to permit the introduction or removal of the guide tube. In the preferred form of my machine, each of these sections is made hollow and provided with suitable means, as a pipe 5 for the introduction of steam thereto to serve as a heating medium. Any other arrangement for heating the chamber or guide tube may, however, be resorted to. The hose 40, or other article to be vulcanized, is designed to be passed through the chamber in the vulcanizer continuously or substantially continuously, and at such a rate that it will be subjected to heat for a sufficient length of time to properly vulcanize it, so that upon its exit from the chamber it will be in a finished state.

For the purpose of supporting and molding the uncured hose and for feeding it through the heating chamber, I spirally wind upon the hose just before it enters the chamber one or more bands which may be either round or flat wires, or strips of other suitable material. These wires being wound closely and compactly about the hose, form a casing or mold therefor. They completely incase the hose during its passage through the heating chamber, and upon its emergence therefrom, may be unwound, leaving the hose fully vulcanized and needing no further support. I have devised a particular machine for the purpose of winding these wires about the hose and unwinding them therefrom, though it is perfectly possible to use the wires in the way which

I have described without this apparatus, as the wires may be wound by other devices or by hand. In this apparatus, I provide a winding pulley 6 at the entrance to the vulcanizing chamber and an unwinding pulley 7 at its exit. These pulleys are driven by belts about their peripheries, or in other suitable manner, and are mounted concentrically with the axis of the channel through the vulcanizer upon hollow journals so that the hose may be passed through the journals and through the vulcanizing chamber. Where I use a separate guide tube in the chamber, I prefer to extend this at each end beyond the chamber, as at 8, 8, to form these journals. The winding pulley carries one or more spools or reels 9 from which the wires forming the mold are drawn. These reels are preferably provided with some frictional tension device, such as the springs 10 pressing upon washers, to prevent them from running too fast, and allowing the wire to become tangled. To cause the wire to take the proper coiled formation without cutting the soft uncured rubber of the hose, I preferably pass it through a coiling die 11, which surrounds the hose. This coiling die 11 is shown most clearly in Figs. 4 and 5, and consists of a sleeve carried by fingers 12, which project from the spokes or other portions of the winding pulley. These fingers preferably unite at their inner ends in a ring 13, which may be threaded on the inside and into which a portion of the coiling die 11 screws. Any other means of attaching the die to the fingers may be used, or the separate die may be entirely dispensed with and the ring 13 itself be shaped to form a die. I prefer, however, the separate die as shown, as a new one may then be inserted to replace one which has become worn. The coiling die or sleeve is formed with a tapered mouth 14 adapted to guide the entering hose and with an enlarged and internally threaded portion 15, which receives the winding wires 16, and causes them to coil into spiral form. The wires enter the die through suitable apertures 38. For the purpose of feeding the wires from the reels or spools 9 through the apertures 38, and for forcing them to assume the coiled formation and to lie close to the screw threaded inner surface of the die, I provide a pair of rolls 18 and 19 carried by a suitable part of the winding pulley, as a web 37, which grip the wire frictionally. One of these rolls 18 is positively driven by a gear 20, which meshes with a fixed gear 21, preferably carried upon the end of the journal 8 projecting beyond the winding pulley, and secured thereto by set screws 22, or in any other suitable manner. The wire is sufficiently stiff to be forced or pushed by the feeding rolls into the coiling die and coiled therein.

The feeding rolls are driven at a slightly greater peripheral speed than that at which the wire is taken up by the hose, whereby they tend to feed or push the wire forward into the die, but they are adjusted so that they will not positively grip the wire, but will slip upon the same before the wire will buckle. In order to enable the wire to sustain the pressure necessary to force it into the die, the feeding rolls may be placed close to the apertures in the die, so as to leave as short a length as possible of the portion of the wire under compression, unsupported. Where a little space separates the rolls and the die, as in the form shown in the drawings, the requisite lateral support may be obtained by providing the die with tubular extensions 17. The coiling die 11 also serves the purpose of feeding the incased hose through the vulcanizing chamber, for as it revolves with the winding pulley, its threaded portion 15 acts as a revolving nut upon the coiled wires 16 surrounding the hose and screws, or feeds the hose forward. The hose is preferably inflated before being passed through the machine to give it more rigidity, and to cause it to expand tightly within the wire winding. The walls of the hose are thus subjected to compression which causes the layers of rubber and fabric to properly adhere.

I usually make the tubing of a little larger diameter than the size which I intend to give it when vulcanized, and then reduce it to its final size by winding it tightly with the wires or bands. This produces a more compact product. The increase in diameter due to the inflation, may be sufficient without actually making a larger diameter.

The unwinding mechanism is practically the reverse of the winding. The pulley 7 is provided with reels or spools 23 for receiving the unwound wire which is fed to them between rolls 24 and 25. A fixed gear 26 similar to the gear 21 is mounted upon the projecting end of the journal 8, or in any other suitable manner, and with it meshes a gear 27 journaled upon the unwinding pulley, which in turn meshes with a gear 28, which drives the spool or reel 23, also with a gear 29 which drives the roll 24. No die is necessary at the unwinding of the device, but the wires pass directly from the hose through the feed rolls and to the positively driven reels.

In Fig. 6, I have shown a slightly modified construction of the die-holding ring and die, the ring being marked 30 and the die 31. In this case the wire passes through an aperture 32 extending through both the ring and the die. No extensions are necessary as the parts of the apertures 32 in the ring 30 take their place.

Fig. 7 shows a die 33 constructed to coil flat bands 35 around the hose in place of

the round wires. The operation is substantially the same, the bore of the die, however, not being threaded, but being provided with a cylindrical enlargement 36 to hold the coils. The end wall of this enlargement forms an abutment 34 against which the bands 35 react to force the hose and casing forward. There is a sort of screw action between the last coil of the bands forming the casing and the abutment. A similar die to this might be used with the round wires, that is, the screw threaded portion 15 is not necessary in the forms of Figs. 5 and 6, as long as the dies are formed with the abutments 34.

The method of vulcanization with, and of operation of, my apparatus, in the curing, for example, of rubber hose, which is here chosen for illustration, is as follows: The hose 40 is fed into the machine from a storage reel (not shown), or the machine may be placed adjacent to the tubing machine from which the hose may be fed directly into the vulcanizer. As the hose advances through the revolving coiling die, the wires are rapidly and evenly coiled about the hose, tightly grip it. The revolving coiling die through the screw action above described causes the coils of wire and the hose to slowly advance through the vulcanizing chamber at a speed so proportioned to the length and temperature of the chamber that complete vulcanization of the hose will have taken place when it reaches the exit. As the hose emerges, the wires are unwound by the unwinding device, and the hose in finished state, is reeled up ready for shipment. The spools or reels 9 are of such size as to hold a very considerable quantity of wire so that the machine may be run for a long time without the necessity of changing spools. The spools 23 may be made interchangeable with the spools 9, so that when the wire is entirely reeled thereon, they may be placed on the winding pulley, though usually, I find it more desirable to reel the wire from the spools 23 through a straightening device and on to spools 9. The apparatus for doing this, however, forms no part of my present invention, and I have not, therefore, shown or described it herein. It will be seen that as the pulleys 6 and 7 revolve, the gears 20 and 27 carried thereby by which mesh with the gears 21 and 26, respectively, fixed to the ends of the guide tube 4, which in turn is secured from revolving, in any suitable manner as by the set screws 39, will be positively driven for the purposes already set forth. The inner diameter of the guide tube 4 should be of sufficient size to permit the incased hose to freely pass therethrough. In fact, there need be no guide tube throughout the length of the chamber as long as some suitable

means of supporting the incased hose, is provided.

In describing my method, I have referred to a particular apparatus which I have found well adapted for practicing it, but I do not wish to be limited to the use of such apparatus as any devices by which the necessary steps in the process may be carried out, will suffice. I may even wrap the bands about the hose or other article by hand and push or pull the wrapped article through the vulcanizer. I may use one, three or more bands instead of two as shown. The hose may be inflated or not as is found desirable, and any suitable substance may be used as the inflating medium.

Having thus described my invention, I claim:

1. The method of vulcanizing which consists in wrapping a band spirally about the article to be vulcanized, and simultaneously feeding the wrapped portion of the article through a vulcanizer.

2. The method of vulcanizing which consists in wrapping a band spirally about the article to be vulcanized, simultaneously feeding the wrapped portion of the article through a vulcanizer, and unwrapping the band from the portion of the article which has passed through the vulcanizer.

3. The method of vulcanizing which consists in simultaneously wrapping a band about an article to be vulcanized, advancing the wrapped portion of the article through a vulcanizer, and unwrapping the band from the vulcanized portion of the article.

4. The method of vulcanizing tubing which consists in inflating the tubing, wrapping a band spirally about the tubing, and simultaneously feeding the wrapped portion of the tubing while inflated through a vulcanizer.

5. The method of vulcanizing which consists in spirally winding a band upon the article to be vulcanized and feeding the wound portions of the article through a vulcanizing chamber at the same rate that the band is applied.

6. The method of vulcanizing an article of great length which consists in progressively winding a band about the article, and simultaneously pushing the article through a vulcanizer from the charging side thereof.

7. The method of vulcanizing an article of elongated form which consists in wrapping a band spirally about the article while maintaining the point of application of the band to the article in a fixed plane transverse to the article, whereby the article is caused to longitudinally advance, and simultaneously subjecting the wrapped portion of the article to vulcanizing action.

8. The method of vulcanizing which consists in wrapping a band spirally about the article to be vulcanized with sufficient ten-

sion to reduce the cross-section of the article, and simultaneously vulcanizing the wrapped portion of the article.

5 9. The method of vulcanizing tubing which consists in inflating the tubing, wrapping a band spirally about the tubing with sufficient tension to reduce its diameter, and simultaneously feeding the wrapped portion of the tubing through a vulcanizer.

10 10. The method of vulcanizing which consists in wrapping a plurality of bands spirally about an article to be vulcanized, and simultaneously vulcanizing the wrapped portion of the article.

5 11. The method of vulcanizing which consists in independently causing a band to as-

sume a coiled form, wrapping the same about an article to be vulcanized, and simultaneously vulcanizing the wrapped portion of the article.

12. The method of vulcanization of rubber articles in lengths consisting in continuously wrapping the uncured stock with a spirally-wound mold of flexible material and synchronously advancing the inclosed stock into and through a vulcanizing chamber. 20 25

JOHN R. GAMMETER.

Witnesses:

JAMES D. TEW,  
WALTER K. MEANS.