W. R. SEIGLE.

PULP TUBE MACHINE.

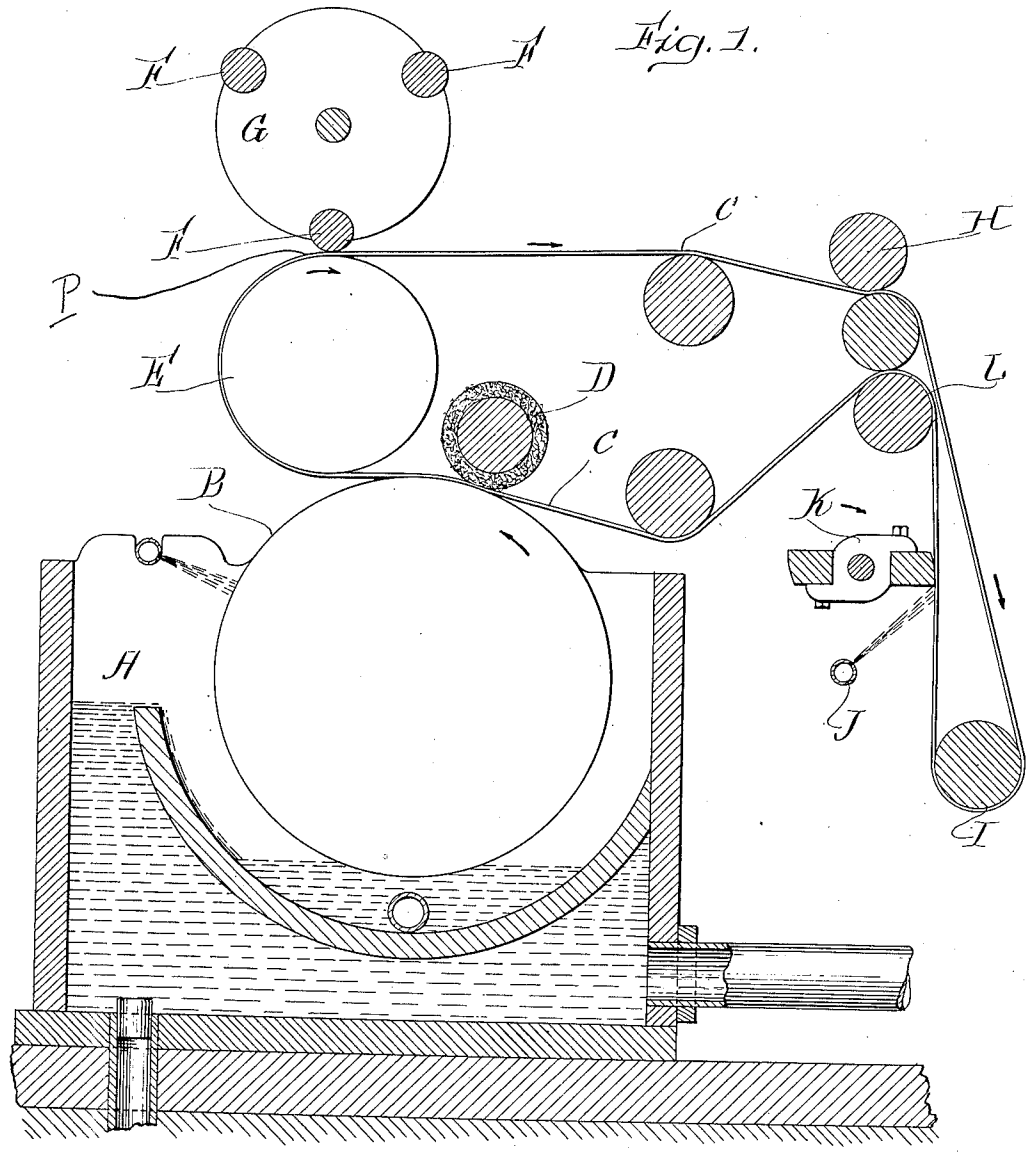
APPLICATION FILED JAN. 4, 1911.

1,037,670.

Patented Sept. 3, 1912.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 3.

Fig. 2.

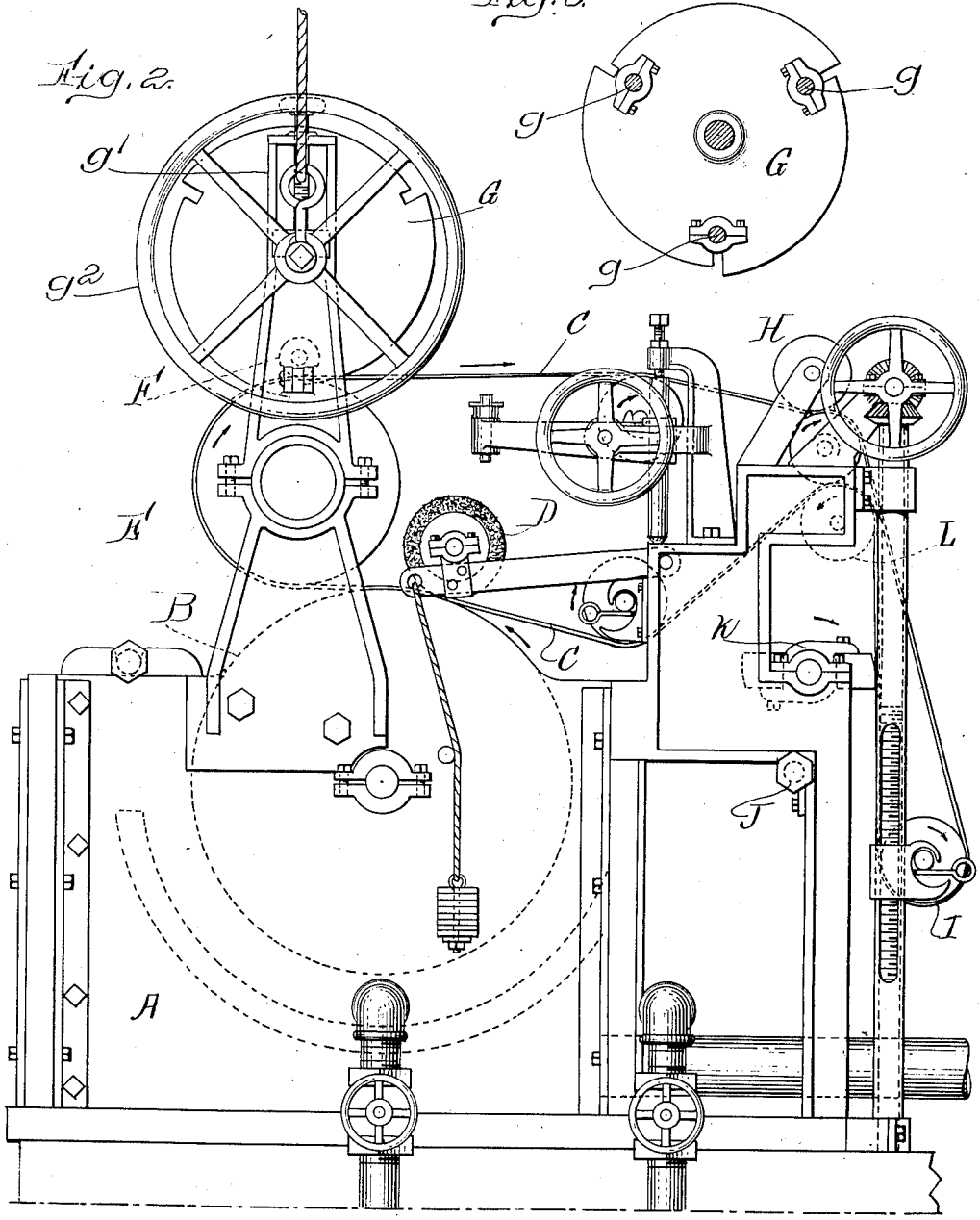

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Fig. 4.

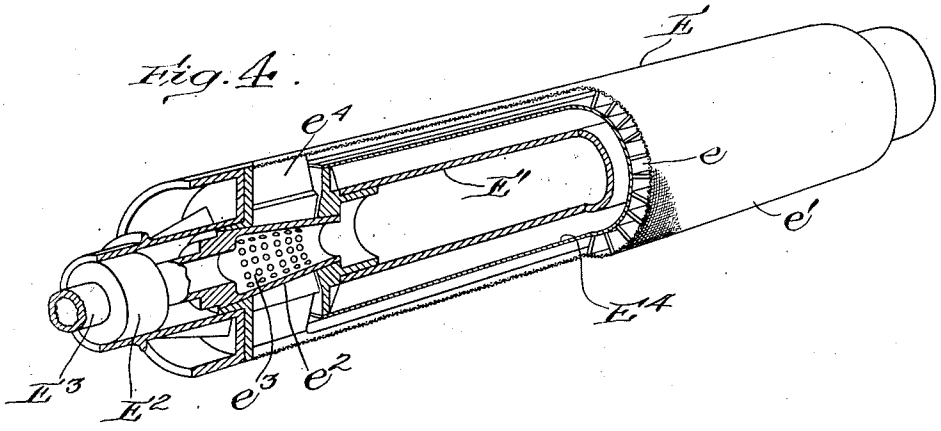
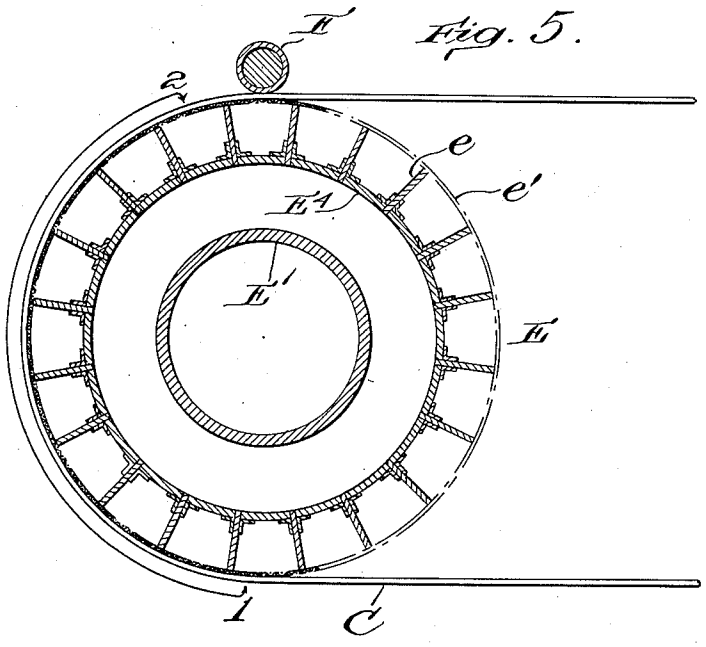


Fig. 5.



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UNITED STATES PATENT OFFICE.

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PULP-TUBE MACHINE.

1,037,670. Specification of Letters Patent. Patented Sept. 3, 1912.

Application filed January 4, 1911. Serial No. 600,795.

To all whom it may concern:

Be it known that I, WILLIAM R. SEIGLE, a citizen of the United States, and resident of Nashua, in the county of Hillsboro and State of New Hampshire, have invented new and useful Improvements in Pulp-Tube Machines, of which the following is a specification.

My invention relates to the manufacture of wound paper tubes; has for its object the production of paper tubes of greater density, strength, regularity of form and thickness of wall than have heretofore been produced by the winding method, and consists in a new and improved machine by which such paper tubes may be manufactured.

A method heretofore employed for the manufacture of wound paper tubes involves the formation of a thin web of pulp or paper on a rotating mold-cylinder, the transfer of this web to a heavily felted couch roll, in which a slight vacuum is maintained, and finally the transfer of the web from the felted roll to a metal form or mandrel which rests on and rotates in contact with, the felted roll. A machine for making paper tubes in this manner is shown in Bradley's United States Patent No. 799,628, and typifies what I am informed has been the heretofore preferred practice in the manufacture of such tubes. While large quantities of paper tubes have been made on machines of the Bradley type, they do not possess the qualities of strength, density, and regularity, in as high a degree as is desirable. Many uses await a paper tube which possesses these qualities in a greater degree than heretofore obtained. In order to couch the web of the paper from the mold-cylinder, a heavily felted couch roll is required. The machines of the Bradley type employ such couch rolls. But a heavily felted couch roll does not offer an advantageous resisting surface from which to wind a paper tube. Among other conditions a hard mandrel-pressure resisting surface is needed to secure desired density in a paper tube, and the roll which is felted heavily enough to work well as a couch roll, is too heavily felted to serve as an advantageous resisting surface for the winding operation performed on and by a tube-mandrel. Moreover, the conditions maintained or maintainable in such a machine as that described in the Bradley patent are inconsistent with the removal of water from the paper web to a degree which is favorable, and in practice necessary, to the obtainment of high density in the tube which is the product of the machine. Only a very slight vacuum can be maintained in the couch roll of a Bradley machine, because any considerable reduction in pressure in the roll would cause the web to adhere to the couch roll instead of winding off on the mandrel. Thus, in the Bradley machine the high water-content of the paper web and the depth of the felt on the couch roll, contribute to a condition in which tubes cannot be wound under substantial pressure.

To form a wound paper tube of high density and consequently superior strength, the paper web should contain a low percentage of water, as contrasted with conditions heretofore prevailing say about 70%. It should not be superficially dry, else the successive convolutions will not properly incorporate themselves into an integral mass and the tube will show laminations. The web, containing a reduced proportion of water, yet moist on its surface may be wound under an effectively applied pressure, of at least 10 pounds to the lineal inch. Under proper conditions, a pressure considerably greater than 10 pounds to the inch can be applied in my machine, producing a very dense paper tube. This demands a fairly hard, unyielding surface from which to wind the tube, and on which to exert the pressure which insures the proper building up of the tube.

In order to transfer a paper web from the web forming devices,—represented by a mold-cylinder,—I employ a web carrier of comparatively thin, close textured, porous material, which of itself would not adequately couch a paper web from a mold roll, and at the desired couching point I back this web carrier with a heavily felted couch roll, which, though it does not come in contact with the web forming surface, yet performs its couching function through the thin web carrier, which at the couching point derives from the heavily felted roll the needful capacity to pick up and transfer to itself a paper web. This thin web-carrier, resting on and supported by a suitable hard metal surface, constitutes a firm resistant abutment on which to exert mandrel pressure in winding a tube. In order to extract water from the paper web on the web carrier, the supporting roll is made as a sectional suction

roll, such as is shown and described in Parker's United States Patent No. 747,643, and the water-reducing suction is caused to operate through the web carrier on the paper web to a point close to but short of the bearing of the tube winding mandrel on the carrier, so as to enable the mandrel to pick up the paper web, which it could not do with certainty if the web were under strong suction at the winding-off line.

An example of a machine operating upon the above stated principles is illustrated in the drawings hereto annexed in which:

Figure 1 is a diagrammatic representation of a tube-winding machine, in elevation; Fig. 2 shows the machine more in mechanical detail, the frame thereof being in part omitted, the better to view the representation of working parts; Fig. 3 represents one of the mandrel frame heads in elevation, with its shaft, and the mandrel trunnions in section; Fig. 4 shows the sectional suction roll in perspective, partly broken away; and Fig. 5 shows the sectional suction roll in cross section, with the web-carrier and mandrel.

The paper film is initially formed upon a rotary mold B which rotates in the tank A. This mold is preferably built upon the sectional principle like the Parker rolls shown in Parker's United States Patent No. 747,632, so as to bring suction to bear upon the paper web until it approaches close to the point where it is couched off. At or before this point the suction is released from the mold segments so as to make it certain that the suction will not interfere with the removal of the web from the mold. The web is removed from the mold in the machine shown in the drawings by being couched onto a traveling belt C composed of quite thin felt, this belt being held to the mold by means of a heavily felted couch roll D. This heavily felted roll, being pressed against the rotary mold with the thin felt carrier between, imparts its characteristic couching capacity to the thin felt, which for the purpose is practically one with the heavy felt backing of the couch roll D. Without such a heavily felted roll, the web carrier C could hardly be capable of couching off the paper web. From the couch roll the felt belt or web carrier, which is endless, proceeds to and around the suction roll E, under the scavenger rolls at H, to and over a take up guide roll I, past the sprinkler pipe J and swabber K, thence to and over a guide roll L then to the couch roll D again. The thinness of the web carrying belt C enables the mandrel F to bear upon the paper web almost as though the hard surface of the roll E were in immediate contact with the mandrel F. I consider it preferable to couch from the mold on to a thin felt carrier from which the paper web will be removed in order to form a tube, rather than to couch to a couch roll and operate the mandrel in contact with the couch roll as shown in the machine of the aforesaid Bradley patent. The pressure with which the tube forming mandrel in my machine bears upon the web carrier would render a heavy felt couch roll unsuitable for the purpose. The effect of a heavily felted couch roll is obtained by backing the felt belt with the couch roll D of which the felt is of suitable thickness.

The suction roll E is a sectional roll like the Parker roll divided longitudinally by partitions into a number of segmental compartments from each of which the air may be exhausted independently of the others. The exhaust ports are so arranged that those compartments of the roll E which are under suction are preferably only those which lie in the arc of contact between the felt belt C and the roll surface E and moreover the suction sector must terminate so that the suction shall be released before the web arrives at the tube mandrel F, or at all events shall so diminish as not to interfere with the stripping of the paper web from the felt belt to the mandrel or to the tube in course of formation on the mandrel.

The tube mandrel F is secured in bearings which allow it to rotate in the end members of the mandrel frame G. This frame is provided with trunnions *g* which have vertical play in a channel or groove formed in the machine frame so that when the tube mandrel at F is brought down to the point where it bears upon the belt C and the suction roll E the entire weight of the mandrel frame is sustained by the suction roll. This weight may be increased or diminished by adding or subtracting weights and for most purposes should be so determined that the mandrel frame F shall bear upon the paper web which is sustained by the felt belt and suction roll with a pressure of at least 10 pounds to the lineal inch along the mandrel. The mandrel frame G will preferably be provided with several sets of bearings for tube mandrels so that when one tube has been wound the frame may be rotated so as to bring a new mandrel into contact with the paper web and start the formation of a new tube. I have found by observation and experiment that the suction exerted upon the felt belt by the sectional roll E should be released close to but short of the point of bearing between the mandrel and the web. Thus the point marked P in Fig. 1 indicates about the place where the suction on the paper web should be released. By maintaining a vacuum of from 15 to 17 inches (mercury) in the exhaust roll segments the water content of the paper web will be reduced to about 70% and the paper with the water content thus reduced is sufficiently firm to sustain the

mandrel pressure (from 10 pounds to the lineal inch upward) which is required to form a pulp tube of desirably high density. At the same time by maintaining this suction near to but short of the point where the tube is formed on the mandrel, the mandrel pressure will squeeze out a little water from the paper and possibly also from the felt belt, so that a narrow film of water can sometimes be detected on the paper just before it is wound upon the tube. This water occasionally runs back on the paper but almost immediately reaches a spot where the relatively high vacuum is in operation and is there sucked through and out of the paper web. Thus while the water content is low enough to insure sufficient strength to sustain the rolling pressure, the web itself is not allowed to become superficially too dry at the critical point, namely where the web is rolled upon itself in convolutions upon the mandrel; and by this means undesirable lamination is avoided. If the sectional roll be so adjusted that the effective suction area extends under the winding line on the mandrel the suction will prevent the web from perfectly stripping off its carrier on to the mandrel or tube, unless the suction be so reduced that the water content of the web rises to a percentage inconsistent with the maintenance of mandrel pressure high enough to form a dense tube.

The structure and operation of the sectional suction roll is illustrated in Figs. 4 and 5 where the roll, generally designated by E, is shown, comprising a cylinder E^4 furnished with radial partitions e, the whole being covered with a pervious clothing e'. An inner tubular shaft E′ extends from end to end of the roll. The roll is mounted to turn upon two conical perforated heads e^2 of which only one is shown in Fig. 4. These conical heads are fixed in position and provided with holes e^3 which cover a predetermined portion of the conical heads e^2. The bearing is supplemented by a cylindrical collar E^2 through which passes an exhaust pipe E^3.

Surrounding the perforated heads e^2 and incorporated in the structure of the roll E there are a number of radial partitions e^4, the spaces between which communicate with the holes e^3, and also with the spaces between the radial partitions e. The structure of the roll and its support is the same at each end except that the farther end from that shown in Fig. 4 has no exhaust pipe such as E^3, the center tube E′ serving to equalize the exhaust at the two ends of the roll.

Assuming that the predetermined extent of the surface of the conical bearing E^2 occupied by the apertures e^2 extends over an arc corresponding to the curved line from 1 to 2 in Fig. 5, when the exhaust apparatus (not shown) is put in operation to exhaust the interior of the roll, a partial vacuum is produced in the conical bearing E^2 at either end and in the pipe E′. As the spaces between the radial partitions e^4 come in succession into communication with the holes e^2 these spaces and consequently the communicating spaces between the partitions e are exhausted so long as such spaces are in communication with the holes e^2; thus the exhaust is operative upon the carrier C and the web of paper thereon, during transit through the arc represented by the line 1—2 (Fig. 5), the said exhaust is released at a point such as 2 which is near but just short of the line of contact between the paper web and the mandrel F. The hard mandrel F exerts pressure upon a surface nearly as hard and unyielding as itself, namely, the thin felt belt on the metallic suction roll E, and may be made to exert such pressure as will form a dense highly compact paper tube. The abstraction of water should be carried as nearly as practicable to a minimum, that is to say, to a content which will suffice, and barely suffice, to integrate the successively wound convolutions of paper web, under the specific pressure applied. The scavenger roll H serves to remove from the carrier any short lengths of paper web which may continue on the carrier by reason of the momentary interruption of the tube formation when one mandrel is substituted for another after the completion of a tube. On stripping the pulp tubes from the mandrels after their formation in the manner above described it will be found that upon drying they shrink very little, if at all, in diameter. They may be made much thicker than heretofore; it is practicable to wind tubes in this manner having a thickness of wall of one inch or more.

The principle on which my improved machine operates may be summarily stated as follows: The thin web of fibers which constitutes the paper-film must be couched off the mold roll uniformly and without fracture; effective couching requires a heavily felted couch roll. In order to form a dense tube by winding such a web on a mandrel the winding pressure must be exerted on a surface which is harder than that of a couch roll, and, moreover, the water content of the paper web should be reduced so that the predetermined winding-pressure shall not be destructive of the integrity of the web. By employing a web-carrier which is interposed between a heavily felted and therefore effective couch roll and the mold cylinder, and between a water-reducing roll and the winding mandrel, successively, the thin web-carrier allows the water-reducing roll to perform its function as a firm winding abutment, substantially as if the mandrel and water-reducing roll were directly in

contact. Or, in other words, the relatively thin web carrier partakes of the functionally effective physical characteristics of the couch roll and winding abutment roll, in succession. While in transit over the water-reducing roll, the excess of water is removed from the paper web, preferably by suction, which is relaxed in time to permit the web to leave the carrier to be wound on the mandrel.

What I claim and desire to secure by Letters Patent is:

1. In a machine for forming wound paper tubes, the combination of a mold cylinder, an endless web-carrier of relatively thin porous material, a couch roll covered with relatively thick yielding material, bearing on the web-carrier and pressing the same against the mold cylinder, a segmental suction roll over which the web-carrier passes, and a tube mandrel, bearing on the web-carrier and supported therethrough by the segmental suction roll, the suction devices of the segmental suction roll being arranged to maintain vacuum within the web-carrier up to a point near to but short of the line of bearing of the mandrel on said web-carrier.

2. In a machine for forming wound paper tubes, the combination of a mold cylinder, an endless web-carrier of relatively thin porous material, a couch roll covered with relatively thick yielding material, bearing on the web-carrier and pressing the same against the mold cylinder, a support for the web-carrier, a tube mandrel bearing on the web-carrier and supported therethrough by said support, and water-abstracting means, operative on the web upon the carrier up to a point near to but short of the line of bearing of the mandrel on said web-carrier.

3. In a machine for forming wound paper tubes, the combination of a mold cylinder, an endless web-carrier of relatively thin felt, a heavily felted couch roll backing the web-carrier and holding it against the mold cylinder, a segmental suction roll over which the web-carrier passes, and a tube mandrel, bearing on the web-carrier and supported therethrough by the segmental suction roll, the suction devices of the suction roll being arranged to maintain a vacuum within the web-carrier up to a point near to but short of the line of bearing of the mandrel on the web-carrier.

4. In a machine for forming wound paper tubes, the combination of a mold cylinder, a couch roll to couch a paper-web from the mold-cylinder, a hard-surfaced roll, a tube mandrel bearing against the resistance of the hard-surfaced roll, and a web-carrier movable between the couch roll and the mold cylinder and between the hard-surfaced roll and the mandrel, said carrier being so thin as to partake of the physical characteristics of the couch roll and hard-surfaced roll, and means to abstract water from the web on its carrier in its transit from the couch roll to the tube winding mandrel.

5. In a machine for forming wound paper tubes, the combination of a mold cylinder, a couch roll to couch a paper-web from the mold cylinder, a hard-surfaced segmental suction-roll, a tube mandrel bearing against the resistance of the hard-surfaced segmental suction roll, and an endless web-carrier passing between the mold cylinder and couch roll and the segmental suction roll and mandrel, said carrier being so thin as to partake of the physical characteristics of the couch roll and sectional suction roll, the suction devices of the suction roll being arranged to maintain suction on the web-carrier up to a point near to but short of the line of bearing of the mandrel on the web-carrier.

Signed by me at Boston, Massachusetts, this 30th day of December, 1910.

WILLIAM R. SEIGLE.

Witnesses:
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CHARLES D. WOODBERRY.