No. 652,868. Patented July 3, 1900.

J. H. & E. L. WHITE.

APPARATUS FOR MAKING PAPER TUBES.

(Application filed May 16, 1900.)

(No Model.) 3 Sheets—Sheet 1.

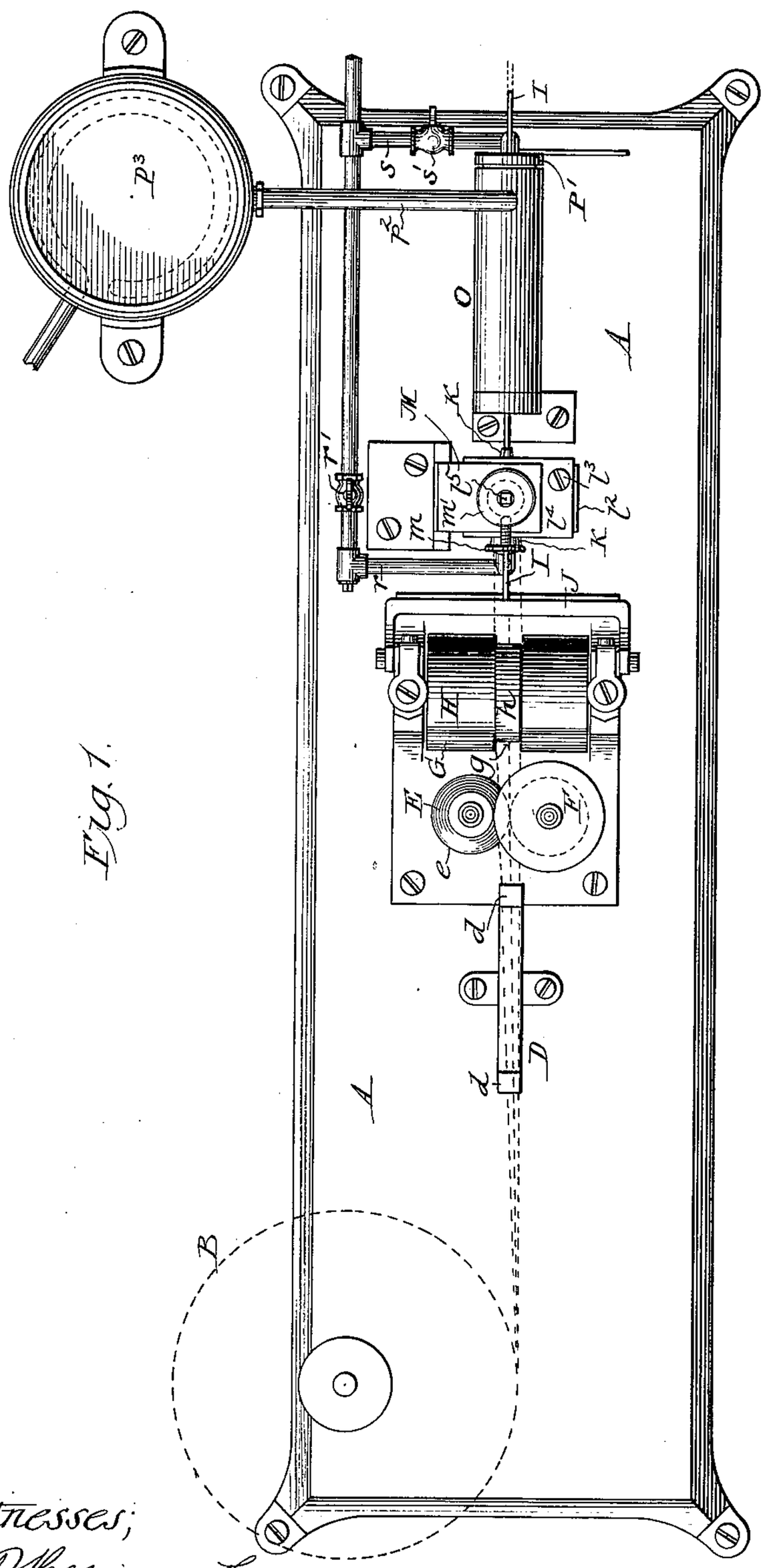

Fig. 1.

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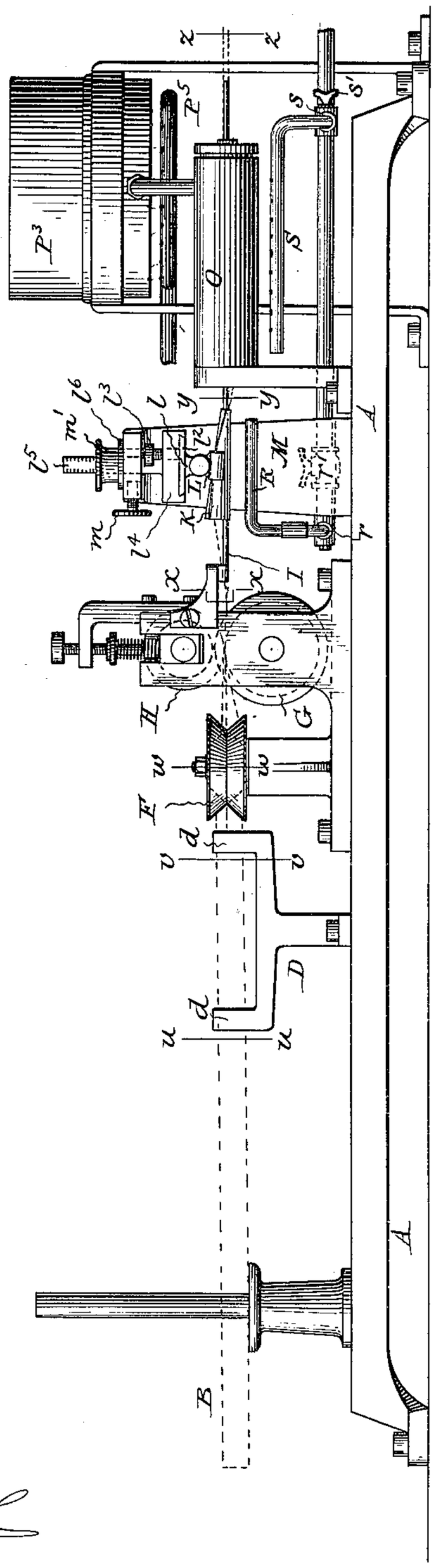

Fig. 12.

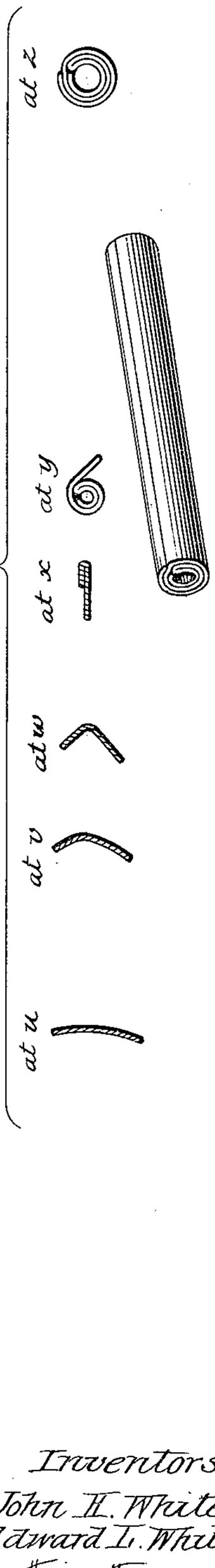

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Fig. 3.

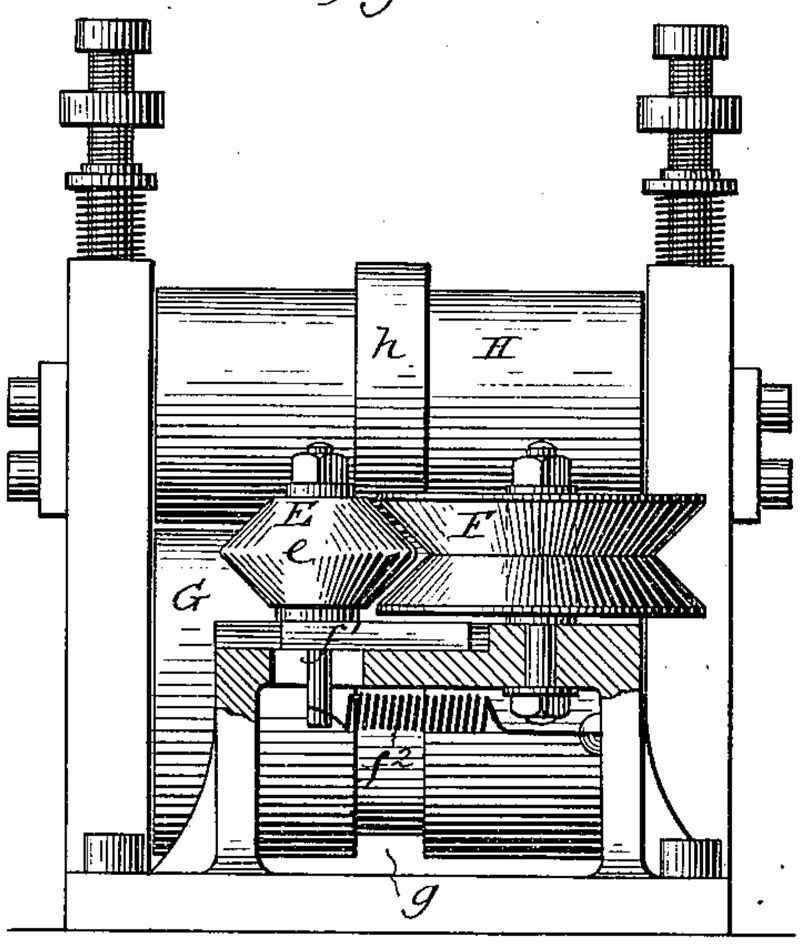


Fig. 4.

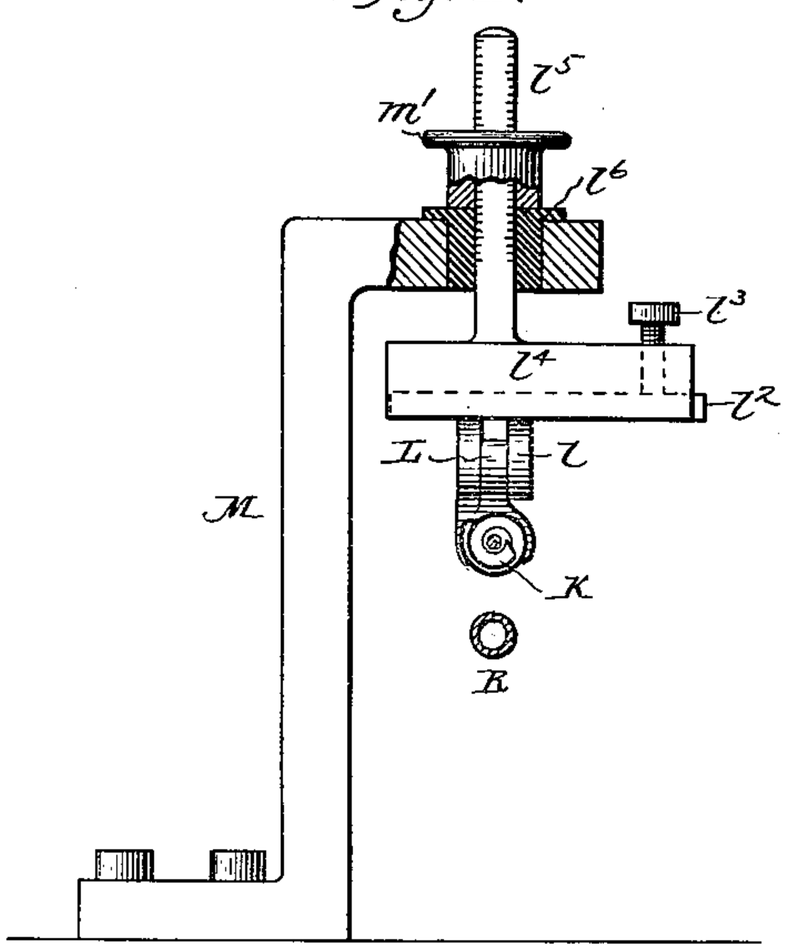


Fig. 5.

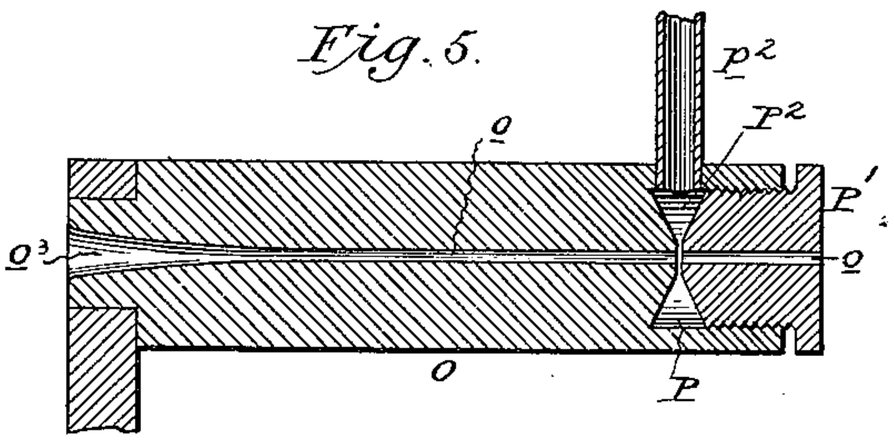


Fig. 6.

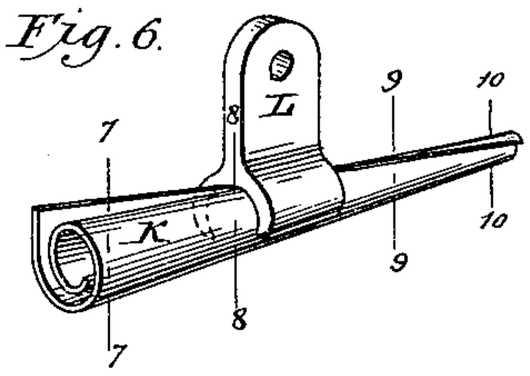


Fig. 7.

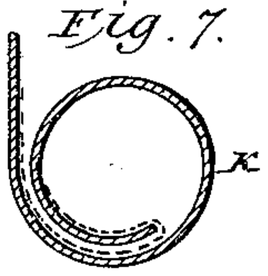


Fig. 8.

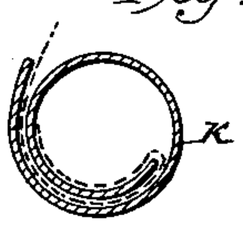


Fig. 11.

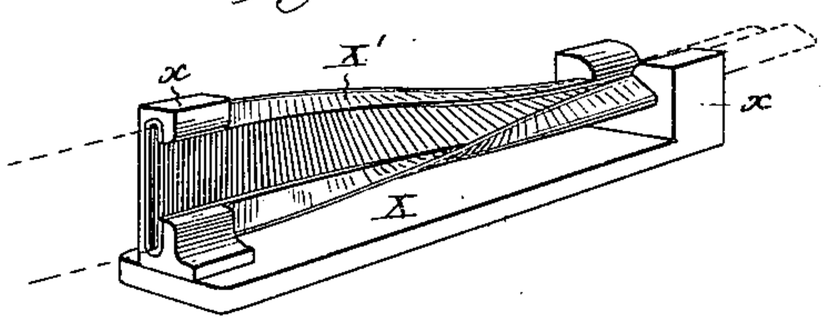


Fig. 9.

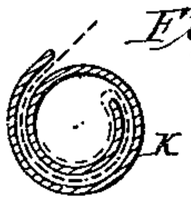
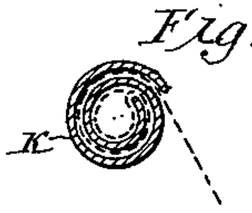


Fig. 10.



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UNITED STATES PATENT OFFICE.

JOHN HOWARD WHITE AND EDWARD LOWRY WHITE, OF WASHINGTON, DISTRICT OF COLUMBIA.

APPARATUS FOR MAKING PAPER TUBES.

SPECIFICATION forming part of Letters Patent No. 652,868, dated July 3, 1900.

Original application filed April 28, 1899, Serial No. 714,892. Divided and this application filed May 16, 1900. Serial No. 16,904. (No model.)

To all whom it may concern:

Be it known that we, JOHN HOWARD WHITE and EDWARD LOWRY WHITE, citizens of the United States, residing at Washington city, in the District of Columbia, have invented certain new and useful Improvements in Apparatus for Making Paper Tubes, of which the following is a specification.

Our invention relates to the manufacture of paper tubes of various forms and sizes and adapted to various uses in a new way and by improved apparatus. Heretofore, so far as our knowledge extends, such tubes have been made by wrapping paper strips longitudinally or spirally around a mandrel, so that one ply or fold overlaps another and cementing the seam or overlapping edge of the strip during the process of forming. It is also common to waterproof or otherwise coat such tubes.

The objects of our invention are so to manufacture a paper tube that it will retain its form permanently without the use of cement, thus enabling us to dispense with cementing or gluing, when desired, also to facilitate the formation of the tube and secure its stiffness or rigidity when requisite.

In order to carry out our invention in the best way now known to us, we take a paper strip or ribbon of proper width and thickness and preferably fold one edge or side of it, about one-third of the width of the strip, over upon the body of the strip and press it so as to lie close thereto and then fold the strip into tubular form, preferably in such wise that the internal bore or area of the tube is formed by the abutting edges of the portion of the strip first folded, while the opposite side or edge of the strip is wrapped around the other portion, so as to lie close thereto. The strip is also preferably heated or heated and pressed while in this condition, the result of which heating or heating and compression we have discovered to be to cause the paper to become permanently set, so that it retains the form given to it without the use of cement. This heating and compressing we call "ironing." For many purposes the tube thus manufactured is sufficiently stiff.

We have not shown herein any means for cementing the tube, so as to cause its edges to adhere; but our invention is not, of course, limited to the manufacture of an uncemented tube, as it is obvious that the operation would not be interfered with if cement were applied to the overlapping portions of the tube during its manufacture; but, as before stated, for many purposes the use of cement is unnecessary. Waterproofing material, such as paraffin, may be applied to the tube during its manufacture if desired.

Our apparatus, the construction of which may be varied in several ways which would readily suggest themselves to a skilful mechanic on reading this specification, consists, essentially, of folding devices—such as guides, rollers, &c.—which form the tube approximately into the shape desired. It then passes through a heater, which gives it the final shape and at the same time imparts a permanent set to the thus-prepared tube, which, if desired, may then be coated or waterproofed by applying the necessary material while still hot. The tubes may be cut into lengths suitable for the purposes desired in usual ways.

The accompanying drawings show so much of one form of an improved apparatus for carrying out the objects of our invention as is necessary to illustrate the subject-matter claimed.

Unless otherwise specified, the different parts of the apparatus, broadly considered, are of usual well-known construction, our improved apparatus consisting of novel combinations and organizations of instrumentalities hereinafter specified.

The feed end is herein called the "front" of the machine and the discharge end the "rear."

Figure 1 is a plan or top view of the apparatus, and Fig. 2 a side elevation thereof. Figs. 3 to 11, both inclusive, show detail views of the apparatus on an enlarged scale. Fig. 3 shows a front elevation of the mechanism which forms the first fold of the paper strip. Fig. 4 shows the details of the devices for supporting and adjusting the wrapping mechanism which forms the overlapping fold of

the formed tube. Fig. 5 shows a longitudinal central section through the "ironer" which gives a permanent set to the tube. This figure also shows a waterproofing device. Fig. 6 shows in perspective the folding-guide and its support. Figs. 7 to 10, both inclusive, represent cross-sections of this guide on the correspondingly-marked lines on Fig. 6, showing its details of construction, the dotted lines showing the varying form imparted to the paper strip in traversing the guide. Fig. 11 shows a modified construction of the guide which forms the first fold of the strip, being a substitute for some of the guides and rollers shown in Fig. 1. Fig. 12, Sheet 2, shows the varying forms imparted to the strip as it traverses the guides, the different forms being marked correspondingly with the devices shown in Fig. 2, which produce the configuration shown.

The drawings show the mechanisms mounted on a suitable bed-plate or frame A. A paper strip of suitable width and texture passes from a reel or spool B through the longitudinally-slotted arms *d* of a guide D, the slots being slightly curved (see Fig. 12) to accommodate the bending of the strip by the first folding guides or rollers E F, one of which has a V-shaped convex edge or periphery *e* and the other a correspondingly-shaped concave rim, into which the first one fits. The concave roller F preferably turns on a fixed axis, while the convex one, E, turns on a pivot carried by a slide *f'*, free to move relatively to the fixed roller, being normally drawn thereto by a spring f^2, thus pressing the paper strip as it passes between them into the elbow or trough shape shown at *w*, Fig. 12. The strip then passes between the compressing-rolls G H, one of which is provided with an annular square-shouldered groove *g*, while the other carries a correspondingly-shaped annular rib or flange *h*. The paper strip is bent by the rolls E and F into the form shown at *w* in Fig. 12 and in this form passes to the rolls G and H. The flange *h* presses the strip in the form shown at *w* into the groove *g*, the side walls of which keep the strip in proper alinement when passing through the rolls and while being bent, thereby insuring a straight and even folding of the paper during the bending operation. After passing through the rolls E and F the paper strip assumes the form shown at *x* in Fig. 12. One of these rolls, preferably the upper one, is mounted in sliding spring-pressed bearings, Figs. 2 and 3, so that a yielding pressure is applied to the paper strip passing between the rolls, which action folds one side of the strip equal to about one-third of its entire width down upon the body of the strip, as shown at *x*, Fig. 12. From these rolls the paper strip thus folded traverses a mandrel I, mounted on a bracket J and extending toward the discharge end of the machine, and then passes through a coiled or snail-shaped folding or wrapping guide K, preferably of the form shown in the drawings. The axes of the mandrel and guide coincide. This guide is mounted in a hanger L, pin-jointed at *l* to a laterally-adjustable slide l^2, held in its adjusted position by a thumb-screw l^3. (See Fig. 4.) The slide works in a guide-plate l^4, having a vertical screw rod or stem l^5 extending through a bushing l^6 in a laterally-projecting arm of a bracket M. This screw-rod l^5 is preferably made polygonal where it passes through the bushing, and the bushing may turn in the bracket M and be held in any desired position therein by means of a set-screw *m*. (See Fig. 2.) The guide-plate may be vertically adjusted by means of a nut *m'* on the screw rod or stem. We are thus enabled to adjust the wrapping-guide accurately in all necessary directions.

The construction and operation of the guide K are clearly shown in Figs. 6 to 10, both inclusive. The partially folded and bent paper strip enters the larger end of the guide, as shown in Fig. 7, the lapped or turned down edge being folded around its inner edge, while the other edge extends up along the inside of the outer side of the same. As the strip traverses the guide, it is turned into a tubular spiral form with its single outer side or edge overlapping its double portion; but the tube is not completely closed, that closure being done later on by the ironer. The coiled folded paper strip passes from the wrapping-guide K through what we call an "ironer," shown as consisting of a metal block or matrix O, having a longitudinal central bore *o*, coinciding with the axis of the mandrel I, which extends through it. The greater part of the bore is of uniform diameter; but its entrance or feed end o^3 is made bell-mouthed or flared in such manner as to receive the partially-formed tube and guide it into the bore proper without breaking or crushing the paper. Both the wrapping-guide K and ironer or matrix O may be heated in usual ways, preferably by Bunsen burners. The drawings show separate burners R S under the guide and ironer, supplied with either liquid or gaseous fuel from a suitable reservoir by means of pipes *r s*, provided with suitable stop cocks or valves *r' s'*. We are then enabled to secure any desirable degree of heat and to regulate it properly, which is advantageous, as we find it useful to use a higher degree of heat than usual in machines which merely employ heat to dry the cement employed in pasting the tube. The degree of heat employed may vary from 200° to 500° Fahrenheit and even higher, depending upon the quality and thickness of the paper and the speed with which it is passed through the mold. The heat is sufficient to soften the sizing of the paper, thus rendering it temporarily flexible, pliable, and non-elastic and enabling it to be, as it were, molded as it passes through the ironer. After the paper tube has left the ironer it cools, the sizing resets, and the tube is given a permanent

form. We find this heating of the paper reduces to a minimum the friction in passing through the machine by counteracting the resiliency or tendency of the paper to resume its original shape, while at the same time the ironer imparts a permanent set to the then-formed tube as it passes therethrough. As before remarked, the mandrel I extends centrally through the bore of the matrix or ironer, there being just sufficient space between the two to allow the paper strip or formed tube to pass in a compressed condition, the heat applied in the ironer giving a permanent set to the tube, which is held in the confined space between the mandrel and the ironer. A paper tube may thus be formed with a longitudinal seam held permanently closed by the elasticity, resilience, or "set" thus given to the folded strip without the use of cement, glue, or paste. We find such tubes useful for many purposes in the arts—such as match-splints, for instance—but the seam may be pasted in usual ways, if desired, during its formation or afterward. While we have not shown any means for pasting the seam, our invention is of course not limited to an unpasted seam. While we prefer to simultaneously heat and compress the tube in order to give it its final form, the compression may be omitted, as the heat to which the tube is subjected is sufficient to alone impart to it a permanent form or set, especially when the tube is subsequently coated.

It is frequently desirable to waterproof or coat paper tubes. We attain this end in an improved way by means shown in the accompanying drawings. A recess P in the discharge end of the ironer O is shown as closed by a screw-plug P′, through which the central bore *o* extends. (See Fig. 5.) A coating-chamber P, preferably of hour-glass shape in cross-section, as shown, is formed, preferably, by beveling the inner walls of the recess P and screw-plug P′. A pipe p^2 connects this coating-chamber with a reservoir P^3, containing suitable waterproofing material, such as paraffin, kept in a properly fluid condition by a suitable heater P^5—such, for instance, as a Bunsen burner. The central portions of the ironer and screw-plug around the base are made square or flat, while the coating-chamber flares outwardly from this central part. The waterproofing or coating material flows to the paper through the annular central neck or passage thus formed between the ironer and screw-plug, and as this neck may be entirely closed or opened to any desired extent by the screw-plug the supply may be perfectly regulated. We are thus enabled to apply the waterproofing or coating material to the heated paper tubes, which we deem advantageous, as the hot paper absorbs the waterproofing material more readily and with greater uniformity than unheated paper would do.

The finished continuous tube which issues from the apparatus may be severed into suitable lengths by cutters of well-known construction. The cutter may be of the form shown in our patent, No. 642,656, of February 6, 1900, and may be located at some point beyond or in rear of the matrix O and mandrel I.

The form of the finished tube made by the above-described apparatus is shown in perspective in Fig. 12 and in cross-section at *z* in that figure. From this figure it will be seen that the side or edge of the paper strip which forms the inner wall of the finished tube is double for about one-third of the width of the strip and that this doubled or folded-over portion constitutes the circumference of the bore or inner wall of the finished tube, with the inner edge of the strip abutting against the doubled portion, and that the outer coil or layer of the tube overlaps or encircles this doubled portion. We find that this construction not only facilitates the formation of the tube, but produces a stronger, stiffer, and better article than can be obtained by the ordinary way of overlapping or wrapping single strips.

Our improved form of tube may be made by apparatus differing from that above described. For instance, Fig. 11 shows a device which may be substituted for the bending-rollers E F and other parts intimately connected therewith. This figure shows in dotted lines the paper strip traversing fixed guides. A base-plate X supports brackets *x x*, provided with suitably-shaped guide-slots connected by a properly-curved sheet-metal guide X′, by which one side or edge of the paper strip is bent or folded over upon the other, as above described, in proper shape to enter the rolls G H and traverse the mandrel, guide K, &c.

We have hereinbefore described tubes circular in cross-section only. Our apparatus, however, is readily adaptable to the manufacture of tubes of other shapes and of larger diameter suitable for various purposes which would readily occur to one reading this specification. While we prefer to apply the coating material by means of a chamber formed at one end of the ironer, the coating material may of course, with perhaps inferior results, be applied by an apparatus contiguous to the discharge end of the ironer or at any time subsequently.

We do not herein claim the tube itself, as claims thereto constitute the subject-matter of another application, Serial No. 714,893, filed April 28, 1899.

We do not herein claim the art or process of making paper tubes consisting in folding the paper strip into tubular form and then heating it in the manner hereinbefore specified, nor the improvement in the art of making paper tubes consisting in the successive steps of folding the paper strip into tubular form and then compressing and heating the tube, nor the improvement in the art of making paper tubes consisting in folding a paper

strip into tubular form, then heating the tube, and then applying waterproofing or strengthening material thereto. These features are claimed in our application for patent, Serial No. 714,892, filed April 28, 1899, of which this case is a division. Notice is hereby given that said former application claims the subject-matter just mentioned, together with other features of the art or process in connection therewith, and which have been described in the foregoing specification. Nor do we claim herein, broadly, apparatus for making paper tubes, comprising means for folding the paper strip into tubular form and means for then heating the tube thus formed to mold it; nor do we claim herein, broadly, apparatus for making paper tubes, comprising means for folding a strip of paper into tubular form and a heated matrix through which the tube passes and which holds the tube so that it retains its tubular form without the use of paste, such apparatus is thus claimed in our application for patent, Serial No. 741,314, filed December 22, 1899, which is a division of our application, Serial No. 714,892, filed April 28, 1899, said application Serial No. 741,314 also containing other claims on the apparatus referred to, wherein a paper tube is formed by folding a strip of paper into tubular form and then heating it.

We do not herein claim the specific form of bending mechanism comprising the rollers which fold one edge or side of a paper strip upon the body thereof or the rollers which compress the fold thus formed, either when used without other mechanism or in connection with a mandrel around which the folded strip passes, and a bending or wrapping guide through which the mandrel extends and around which the strip is wound by the guide, such subject-matter being claimed in our application for patent, Serial No. 741,314, filed December 22, 1899.

What we claim as our invention is—

1. The combination of means for forming a tube from a paper strip, a hollow matrix, a mandrel extending therethrough and means for heating the matrix.

2. The combination, substantially as hereinbefore set forth, of means for folding one edge of a paper strip upon the body of the strip, means for pressing the folded edge upon the strip, and means for bending or wrapping the folded strip into tubular form.

3. The combination, substantially as hereinbefore set forth, of means for forming a tube from a paper strip, a heater for softening the sizing to enable the tube to retain its tubular form, before entering the ironer, and an ironer which heats and presses the tube into its final form.

4. The combination, substantially as hereinbefore set forth, of means for forming a paper tube, of a hollow block or matrix, a mandrel extending therethrough, means for heating this block, and a coating-chamber communicating therewith, to coat the tube, as it passes therethrough.

5. The combination, substantially as hereinbefore set forth, of means for forming a paper tube, means for heating the tube to impart a stiffness thereto to enable it to retain its tubular form, and means for coating the tube while hot.

6. A curved longitudinally-twisted folding-guide, having a guide-groove on each edge, one of which grooves serves to hold the edge of the paper strip traversing it in proper position, while the other groove folds its edge upon the body of the strip adjacent thereto, leaving the other edge free, substantially as hereinbefore set forth.

7. The combination, substantially as hereinbefore set forth, of a curved longitudinally-twisted folding-guide, which folds one edge or side of the paper strip traversing it, upon the body or central portion of said strip, a wrapping-guide which folds the edges of the strip into contact, and a mandrel extending through the wrapping-guide and around which the tube is formed.

8. The combination of a mandrel, devices for wrapping a paper strip around the mandrel, and a folding device for giving a preliminary fold to the strip, consisting of a plate having guide-grooves in its opposite longitudinal edges, and having one of its grooved edges gradually folded over toward the body of the plate, but terminating inside the opposite edge thereof.

In testimony whereof we have hereunto subscribed our names.

JOHN HOWARD WHITE.
EDWARD LOWRY WHITE.

Witnesses:
LLOYD B. WRIGHT,
A. M. PARKIUS.