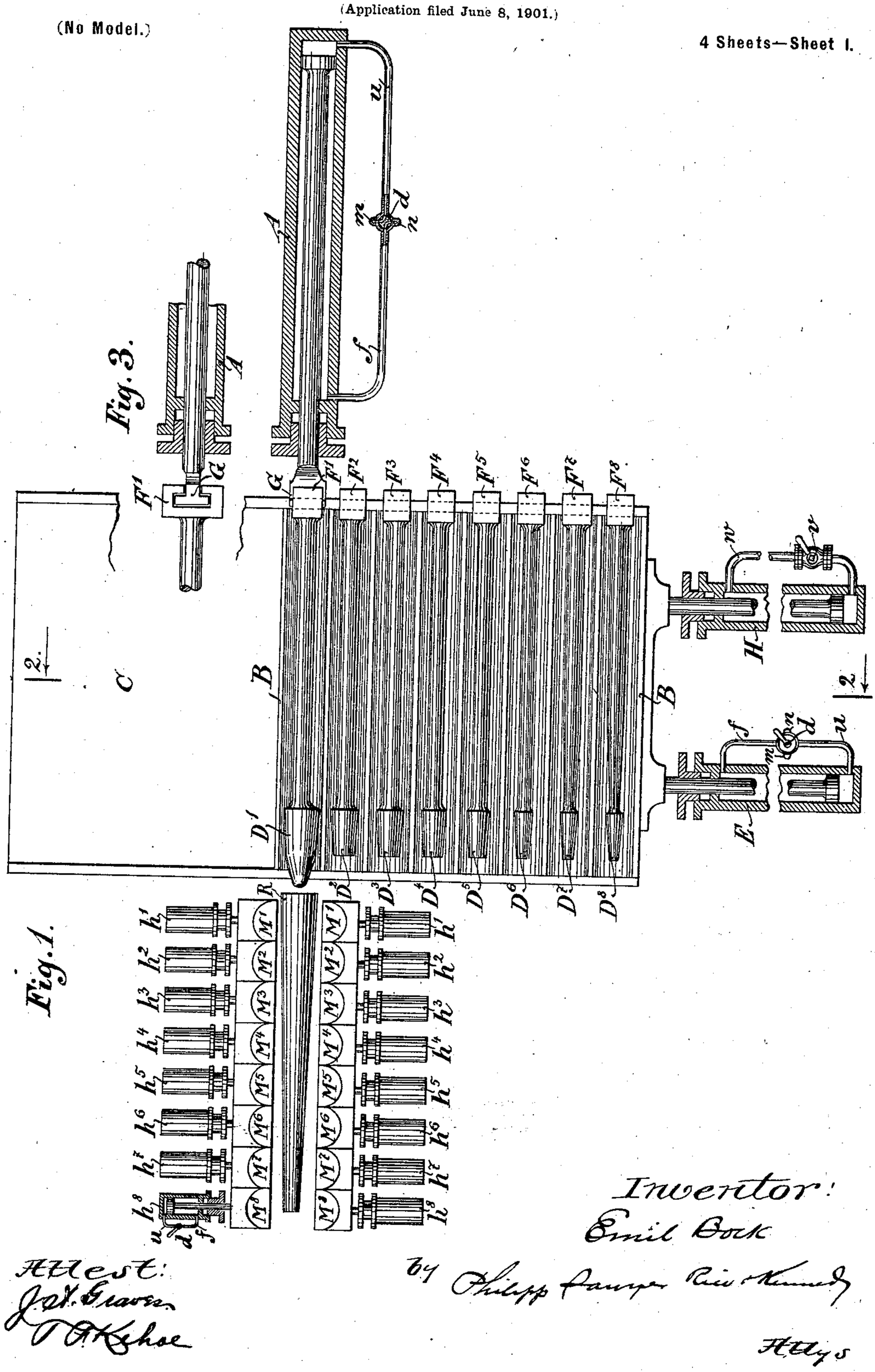
No. 698,171. Patented Apr. 22, 1902.

E. BOCK.

APPARATUS FOR MANUFACTURING CONICAL TUBES.

(Application filed June 8, 1901.)

(No Model.) 4 Sheets—Sheet 1.



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T. A. Kehoe

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(No Model.) 4 Sheets—Sheet 2.

Fig. 2.

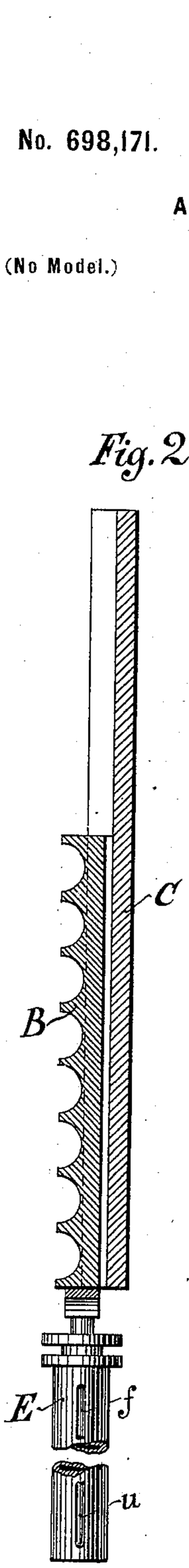


Fig. 5.

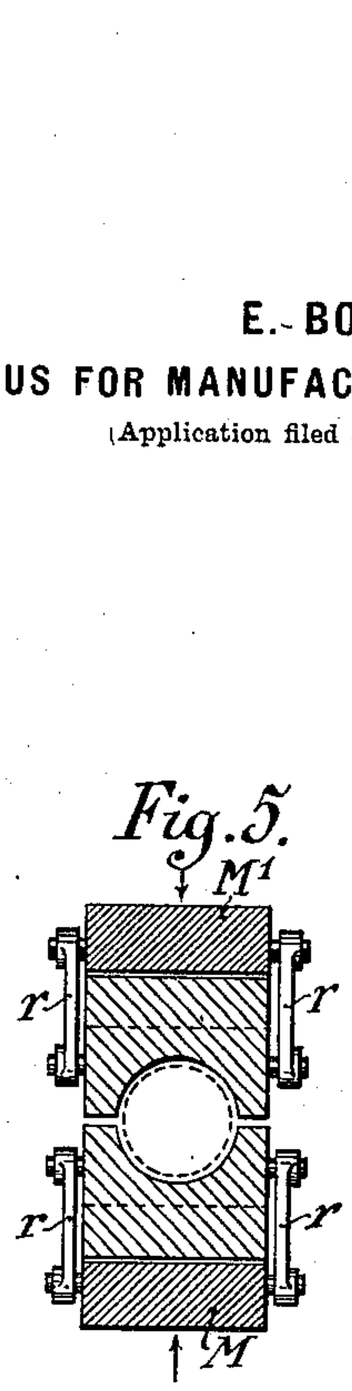


Fig. 6.

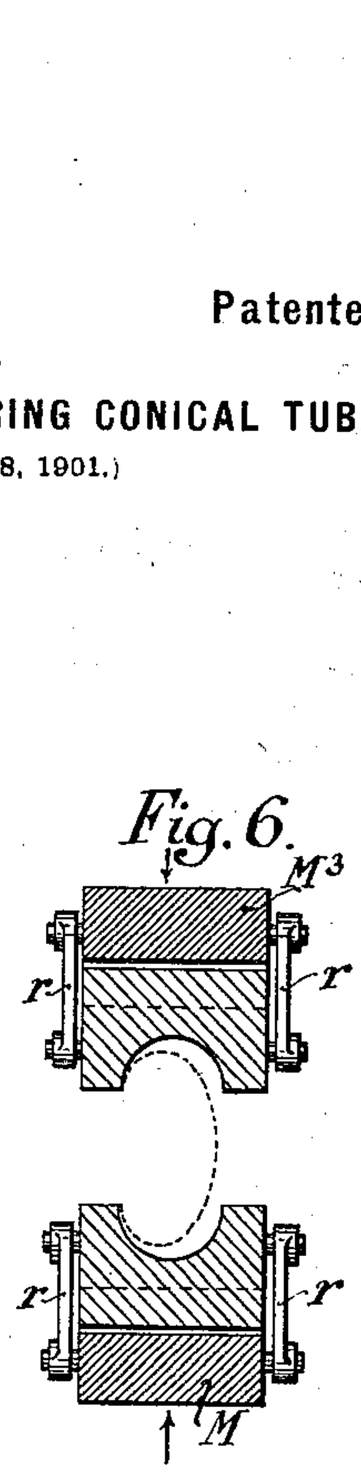


Fig. 8.

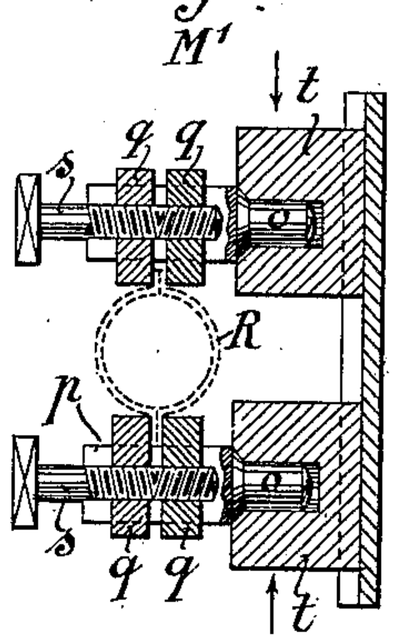


Fig. 9.

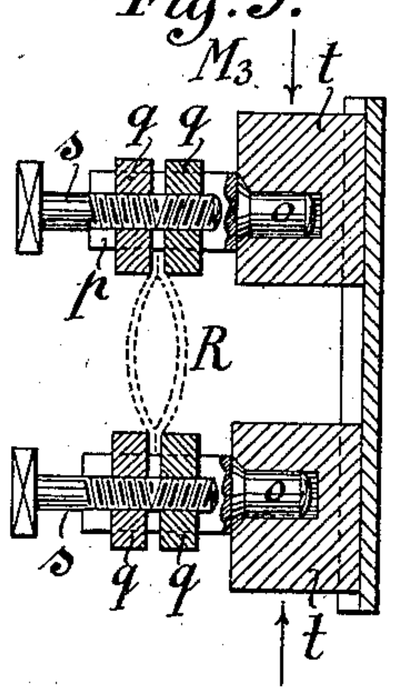
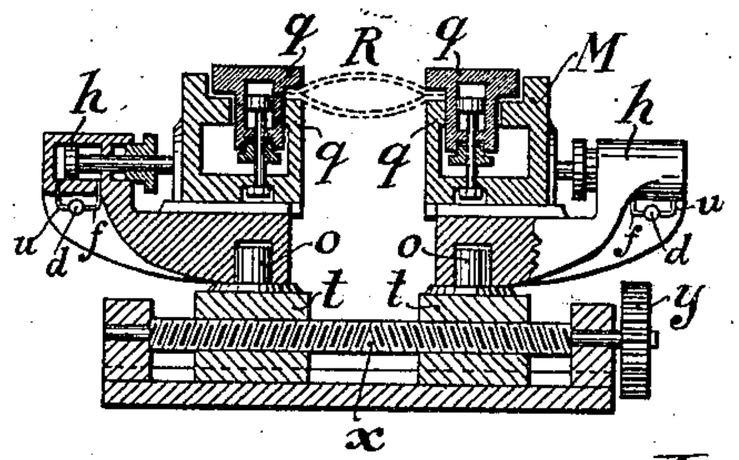


Fig. 11.



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No. 698,171. Patented Apr. 22, 1902.

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APPARATUS FOR MANUFACTURING CONICAL TUBES.

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(No Model.) 4 Sheets—Sheet 3.

Fig. 4.

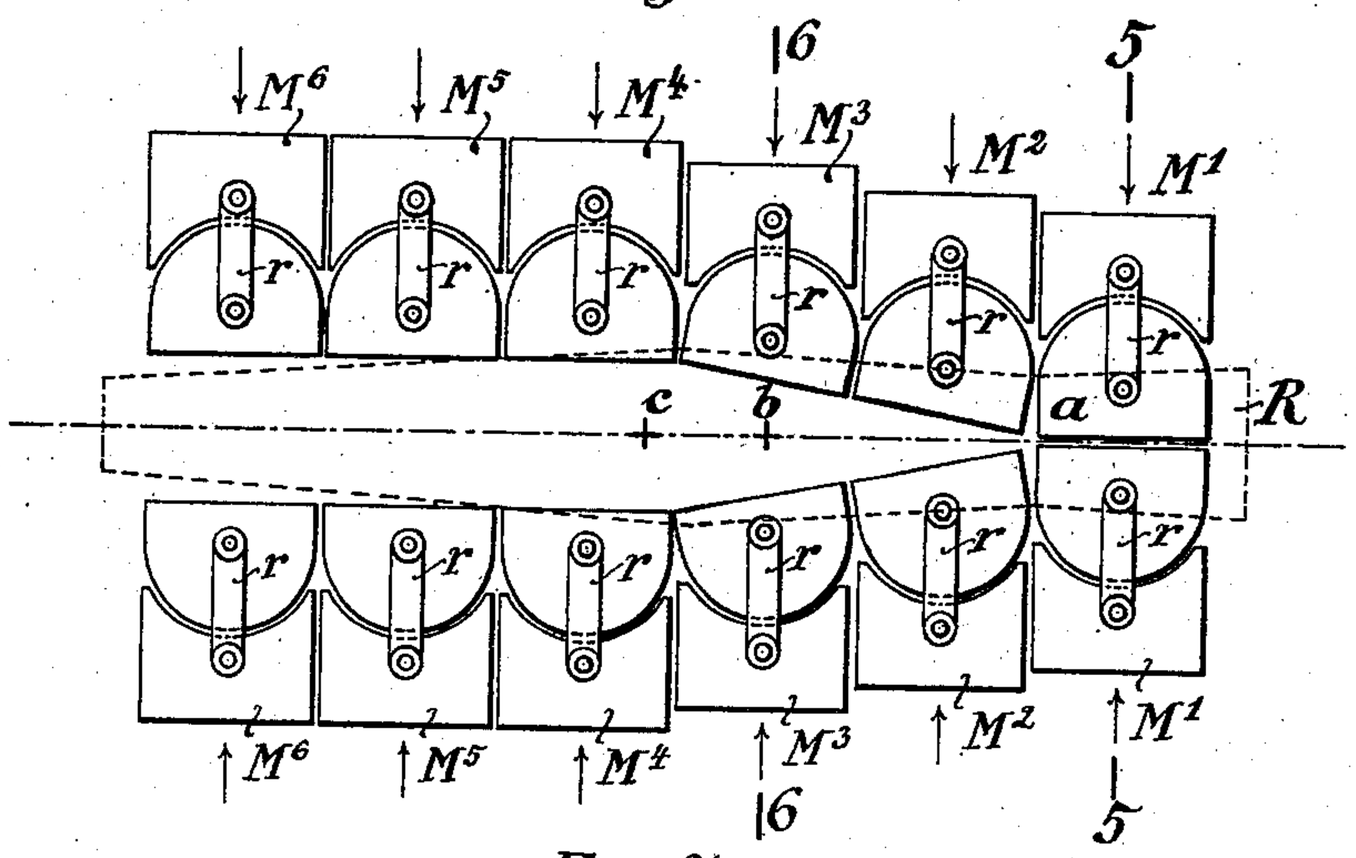


Fig. 7.

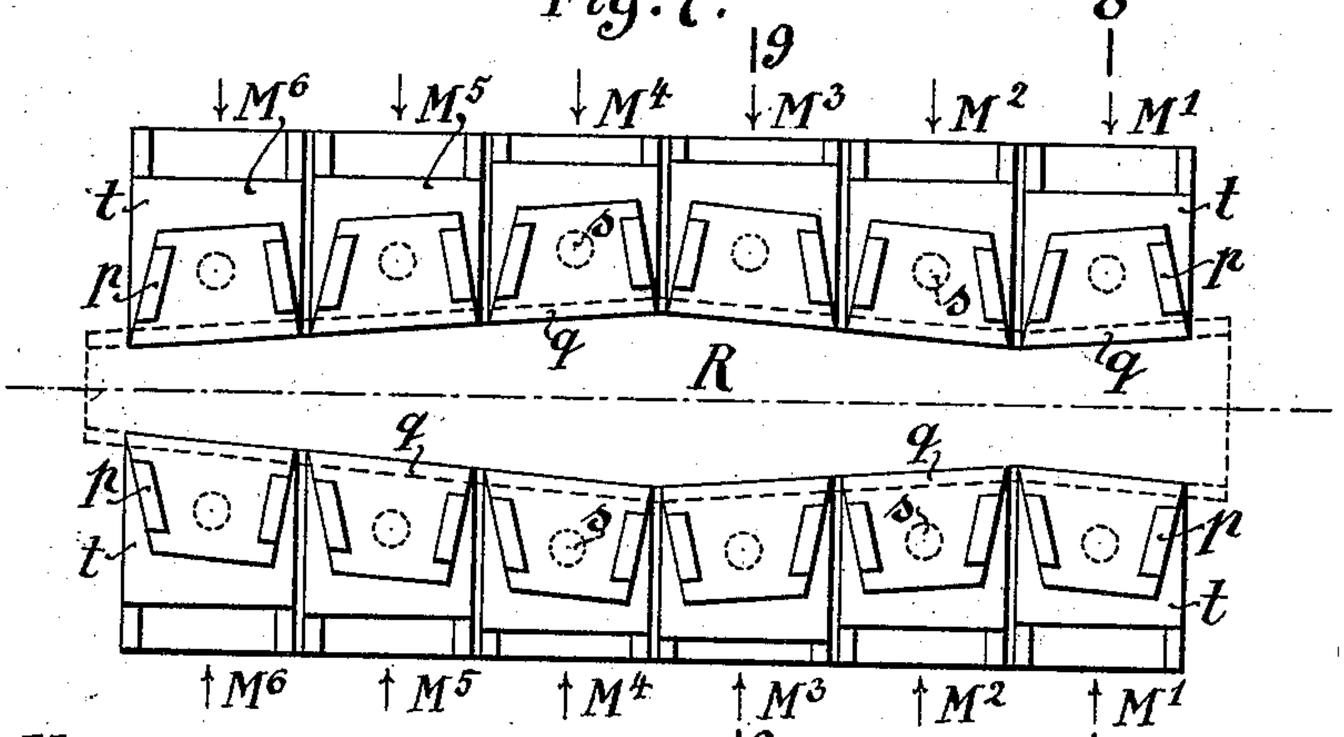
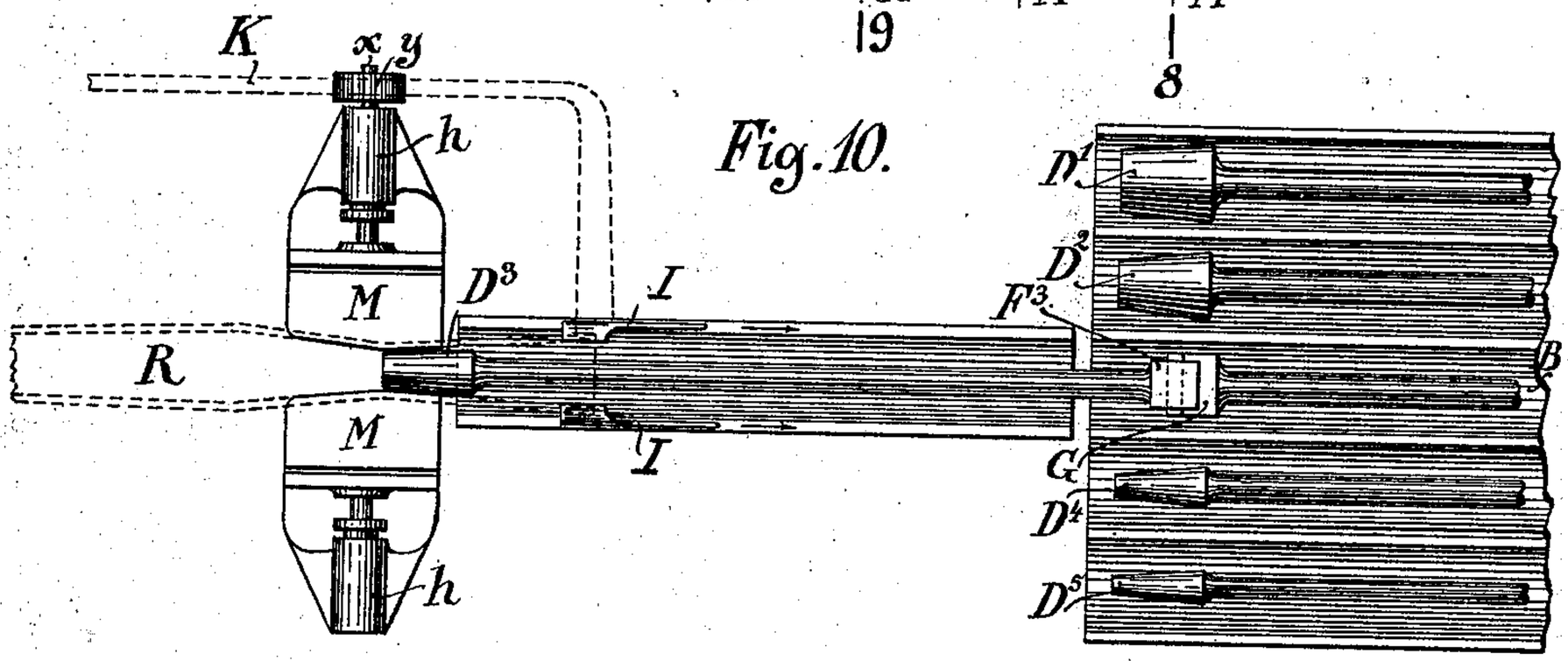


Fig. 10.



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APPARATUS FOR MANUFACTURING CONICAL TUBES.

(Application filed June 8, 1901.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 12.

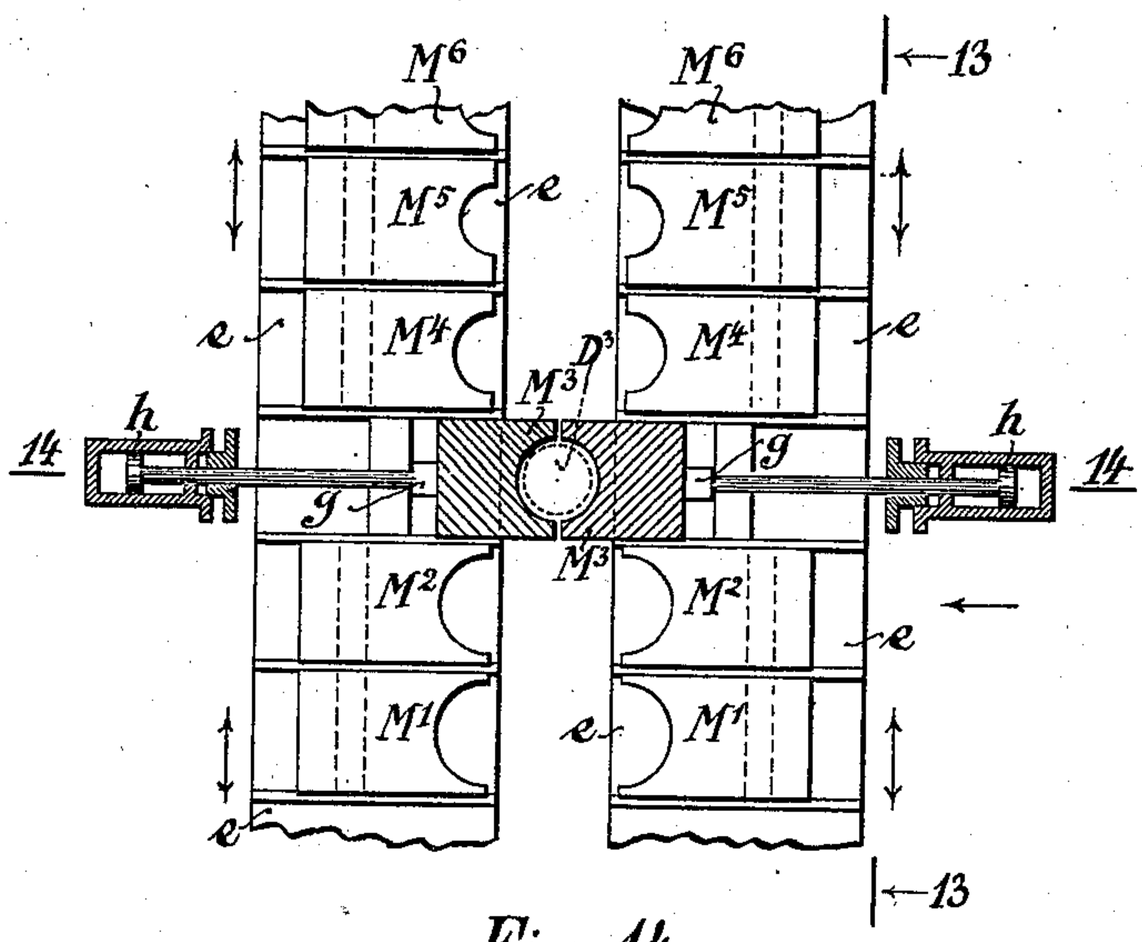


Fig. 13.

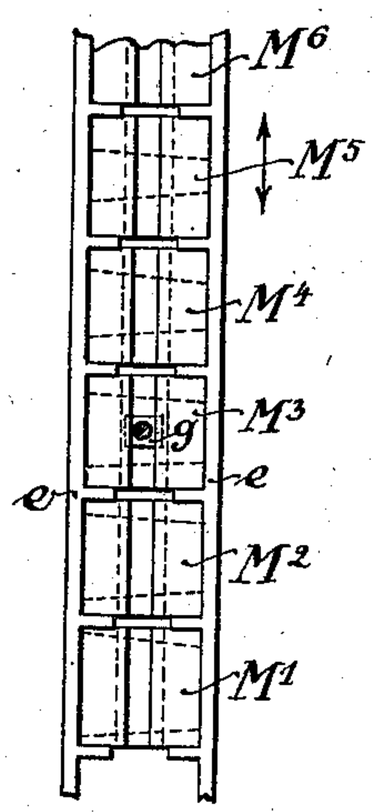
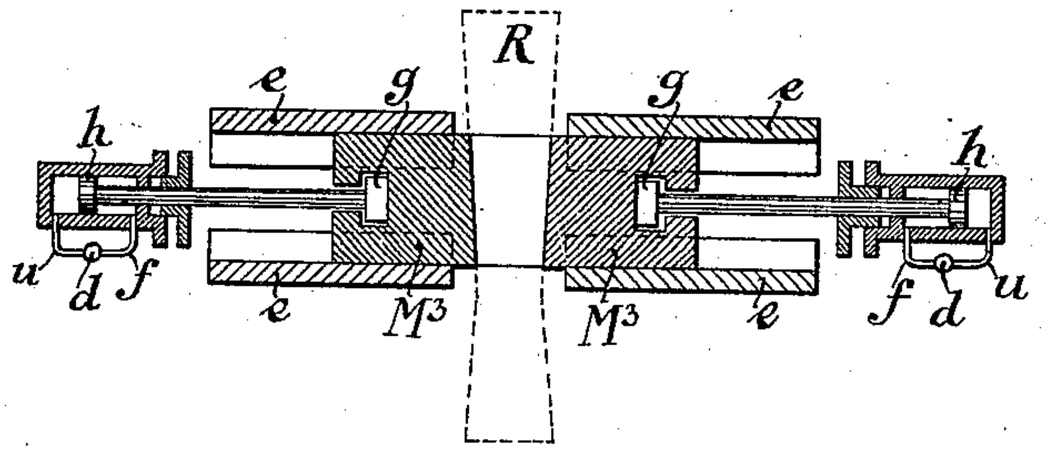


Fig. 14.



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UNITED STATES PATENT OFFICE.

EMIL BOCK, OF DUSSELDORF, GERMANY.

APPARATUS FOR MANUFACTURING CONICAL TUBES.

SPECIFICATION forming part of Letters Patent No. 698,171, dated April 22, 1902.

Application filed June 8, 1901. Serial No. 63,742. (No model.)

To all whom it may concern:

Be it known that I, EMIL BOCK, a subject of the King of Prussia, Emperor of Germany, residing at No. 28 Humboldtstrasse, Dusseldorf, in the Kingdom of Prussia, German Empire, have invented new and useful Improvements in Apparatus for Manufacturing Conical Tubes; and I do hereby declare that the following is a full, clear, and exact description of my invention, which will enable others skilled in the art to which it appertains to make and use the same.

In my application for patent filed on the 20th day of May, 1901, Serial No. 61,037, I described a method of manufacturing conical tubes, under which method I first secure the edges of suitably cut tapering plates or a single plate and then shape the same into a tubular form for certain lengths at a time and in succession. To this end a tapering mandrel of appropriate diameter is introduced, so as to open the plates and give them a tubular form, while at the same time an external and likewise tapering mold partly or entirely surrounds the tube being formed.

My present invention relates to an apparatus for carrying out the said method.

In a machine constructed according to my invention the tapering mandrels, having different diameters for forming the conical tubes, are movably supported on a frame or bed adapted to be moved laterally—*i. e.*, at right angles to the axial direction of the mandrels—so as to enable the latter to be successively introduced into the tube in course of formation by means of a convenient draw or plunger rod until the desired tubular form is obtained.

The accompanying drawings represent a practical construction of my apparatus.

In said drawings, Figure 1 is a plan view thereof, partly in section; Fig. 2, a vertical section thereof, taken on the line 2 2 of Fig. 1. Fig. 3 is a horizontal section illustrating the connection between the mandrel and the means for operating the same—namely, a hydraulic piston. Fig. 4 is a detail, on an enlarged scale, of the divided matrices employed in the formation of a conical tube from a tapering strip. Figs. 5 and 6 are cross-sections on the lines 5 5 and 6 6, respectively, of Fig. 4. Fig. 7 is a detail, on an enlarged scale, of the divided matrices employed in the formation of conical tubes with longitudinal ribs. Figs. 8 and 9 are cross-sections of the same, taken on the lines 8 8 and 9 9, respectively, of Fig. 7. Fig. 10 is a plan view, and Fig. 11 a cross-section thereof, illustrating an arrangement for drawing the tubes through a single pair of matrices. Fig. 12 is an elevation, partly in section, showing an arrangement of removable or exchangeable matrices. Figs. 13 and 14 are sections thereof, taken on the lines 13 13 and 14 14, respectively, of Fig. 12.

As is shown by Figs. 1 and 2, the mandrels D' D^2 D^3 are mounted side by side upon the frame B, which can be slid in the bed C of the machine by means of a hydraulic or other press E in such a manner as to cause the rear ends F' F^2 F^3 of the various mandrels to be placed in front of the ram G, which is preferably actuated by a hydraulic piston. In this case the two ends of the cylinder A, containing the piston and piston-rod, are connected, through two pipes *f* and *u*, with a valve *d*, having two openings leading to the outlets *m* and *n*, respectively, which are communicating one with the force-pipe and the other with the discharge-pipe. By suitably turning the said valve either end of the cylinder A may be connected with the force or discharge pipe or cut off from both, in which case this valve mechanism acts as a brake, allowing to arrest the mandrel at any desired point of the stroke. The press E, by which the frame B is moved, may also be actuated in the same way by a hydraulic piston, or it may be provided with a separate braking mechanism H, consisting of a cylinder filled with water or some other fluid, the two ends of which cylinder are connected by a pipe *w*, in which is disposed a valve *v*, allowing to set the spaces on the two sides of the piston into communication with each other when the piston and the frame B, connected therewith, will be free to move in either direction or to interrupt said communication, in which case this mechanism acts as a brake.

The tube R, which in Fig. 1 is represented as being entirely finished, is externally kept together during the operation by a number of divided matrices M' M^2 M^3, so that the bursting of a seam is avoided and the tube

pressed into the desired shape. The movement of the matrices is also effected automatically by means of hydraulic pistons h' h^2 h^3, preferably actuated in the manner above described with reference to the movement of the ram G, but obviously any other means may be employed for the purpose.

The machine operates in the following manner: Each time a mandrel is introduced into the tube the pair of matrices corresponding to the same are so moved as to inclose the tube and prevent damage to the joint. Thus if, for example, the largest mandrel D′ is to be introduced into the tube two parts of the divided matrix M′, corresponding to such mandrel, are simultaneously advanced, so as to inclose that portion of the tube R which is being shaped or pressed into form by the mandrel. After mandrel D′ has been withdrawn the frame B is so displaced as to bring the next smaller mandrel D^2 into engagement with the ram G, to be forced by the latter into the tube, while at the same time the corresponding smaller divided matrix M^2 is applied to the exterior of the tube.

In Figs. 4 to 9 the divided matrices M′ M^2 M^3 are represented on a somewhat larger scale, and in Figs. 4 to 6 the formation of a conical tube from a tapering strip is illustrated.

In Fig. 4 the tapering strip is shown in dotted lines as having the form of a finished conical tube up to the point *a*, up to which point it is therefore circular in section. (See Fig. 5.) At the point *b* the tube is already partly rounded, (dotted lines in Fig. 6,) while at the point *c* it still forms a flat sheet. The transition from the flat form to the tubular form must of course be gradual, and the gradual curving and rounding of the strip is effected by the two parts of those of the divided matrices which precede the matrix that at the time fully surrounds the tube being made to approach themselves. To secure a good application of the matrices to the tube in the transition stage, each part of the matrices is articulated in its support or slide, so as to be capable of adjusting itself to the taper and to the partly-rounded tube, the matrix being returned by its slide by means of the lateral link *r*.

For manufacturing conical tubes with longitudinal ribs from two superposed flat strips or plates, Figs. 7 to 9, it is necessary for the divided or pairs of matrices to receive an appropriate approaching movement to effect the transformation of the plates from the flat into a circular state and without injuring the material. The matrix is for this purpose replaced by a pair of cheeks *q q*, adapted to be firmly pressed or clamped together by the action of a right and left hand screw-threaded spindle *s*. The cheeks *q* are guided in a frame *p*, revolving on a pivot *o* in a slide *t*, guided in the bed-frame of the machine. This arrangement of the parts allows the tubes, or rather the double strips or plates for the same, to be firmly clamped together throughout the entire length of the joint, so that upon the matrices being moved toward each other they produce a gradual transformation from the flat into a tubular form of the plates. The manufacture of the conical tubes may also be carried out in such a manner that the tube is drawn, by means of pincers I, intermittently through a single pair of matrices M, Fig. 10. In this modification the machine operates as follows: When the first portion of the tube is finished through the coöperation of the mandrel D′ with the divided matrix M, the tube is advanced by the pincers I for an appropriate length, whereupon the mandrel D^2, with the divided matrix M, enters into action, and so forth until the tube is ready, said matrix M being adapted to be adjusted to correspond with the various mandrels. The tube R is shown in dotted lines and supposed to be so far advanced that mandrel D^3 is just in operation. To this end the two parts of the matrix are supported each by a slide *t*, Fig. 11, adapted to be moved toward or away from each other by means of a right and left hand screw *x*. The said screw *x* is operated by a toothed pinion *y*, actuated by a rack K, connected with the pincers I for intermittently moving the tube, the arrangement being such as to cause the slides to move closer for the required distance to suit the taper of the tube in course of formation. The pair of cheeks *q q* are at the same time forced together for pressing the joints by means of hydraulic pistons, which are withdrawn each time the tube is drawn farther through the pair of cheeks. The reversing of the pressure fluid utilized for operating the hydraulic pistons is effected by hand or mechanically in such a manner as to loosen the cheeks *q q* when the tube is being drawn forward by the pincers, while at the same time the slides *t*, carrying the pair of cheeks, are caused to advance and to tighten the said cheeks again for holding the tube during the introduction of the next mandrel. In this modification the lower cheek is formed to serve as a guide for the upper one and at the same time is designed as a slide, which is moved by the hydraulic piston *h* toward the tube when the cheeks have seized the tube and the mandrel is forced into the same.

If tubes are manufactured without longitudinal ribs, it will be required to fit the machine with removable or exchangeable matrices M. This can be effected by having an upright and vertically-movable frame *e*, with divisions for the reception of the matrices M′ M^2, which latter are moved in and out by hydraulic means, Figs. 12–14. The frame *e* is raised and lowered in the direction indicated by the arrow in Figs. 12 and 13, the individual matrices being provided with a notch which is engaged by the end *g* of the rod of the hydraulic piston *h*, Fig. 14. The machine in this modification operates as follows: If, for example, mandrel D^3 is pushed forward and the frame *e*, carrying the matrices, is

placed in front of the hydraulic piston *h*, the divided matrices M^3 are put in operation. On the return of mandrel D^3 the matrices M^3 are withdrawn simultaneously and the frame *e* is lowered for a length to suit the matrices M^4, being placed in front of the piston *h*, and to enable the following mandrel to enter into coöperation with the divided matrices, and so on until the tube is finished. In view of a mechanical exchange of the matrices the frame *e* is therefore moved at right angles to the axial direction of the hydraulic piston *h* and of the matrix just then connected therewith, and this in the same manner as the frame B is moved at right angles to the working direction of the ram G for the mechanical exchange of the mandrels. All the hydraulic pistons for moving the frame B, Fig. 1, the mandrels D' D^2 D^3, Figs. 1, 10, and 12, the matrices or cheeks of matrices M M' M^2 M^3, respectively, *q q*, Figs. 1, 4–12, and 14, are in the present modification shown to be operated by the two ends of the cylinder containing the piston, being connected, through pipes *f* and *u* with a valve *d*, with the pressure and discharge pipe. It is of course to be understood that all these hydraulic devices may be operated by hand, as presumed in the machine shown on the drawings, or they can all be controlled mechanically and automatically from the machine.

Having thus described my invention, what I claim is—

1. In a machine for manufacturing conical tubes from tapering strips the combination with mandrels of different diameters, of a slide carrying said mandrels, means for axially moving said mandrels, means for moving said slide at right angles to the movement of the mandrels, and means for holding said strips, substantially as and for the purpose described.

2. In a machine for manufacturing conical tubes from tapering strips the combination with mandrels of different diameters, of a slide carrying said mandrels, means for axially moving said mandrels, means for moving said slide at right angles to the movement of the mandrels, cheeks for holding said strips, and means for approaching said cheeks, substantially as and for the purpose described.

3. In a machine for manufacturing conical tubes from tapering strips the combination with mandrels of different diameters, of a slide carrying said mandrels, means for axially moving said mandrels, means for moving said slide at right angles to the movement of the mandrels, cheeks for holding said strips, means for approaching said cheeks being articulated in their supports, substantially as and for the purpose described.

4. In a machine for manufacturing conical tubes from tapering strips the combination with mandrels of different diameters of a slide carrying said mandrels, means for axially moving said mandrels, means for moving said slide at right angles to the movement of the mandrels, cheeks for holding said strips, said cheeks consisting each of two parts between which the edges of the strips are clamped, and means for automatically tightening the said parts of the cheeks, substantially as and for the purpose described.

5. In a machine for manufacturing conical tubes from tapering strips the combination with mandrels of different diameters, of a slide carrying said mandrels, means for axially moving said mandrels, means for moving said slide at right angles to the movement of the mandrels, cheeks for holding said strips, and means for automatically drawing said strips through the cheeks, substantially as and for the purpose described.

6. In a machine for manufacturing conical tubes from tapering strips the combination with mandrels of different diameters, of a slide carrying said mandrels, means for axially moving said mandrels, means for moving said slide at right angles to the movement of the mandrels, cheeks for holding said strips, pincers for automatically drawing said strips through the cheeks, and means for automatically approaching said cheeks, substantially as and for the purpose described.

7. In a machine for manufacturing conical tubes from tapering strips the combination with mandrels of different diameters, of a slide carrying said mandrels, means for axially moving said mandrels, means for moving said slide at right angles to the movement of the mandrels, means for holding said strips, pincers for automatically drawing said strips through the cheeks, and a rack connected with said pincers and acting upon a pinion operating a right and left hand screw by means of which the two slides carrying the cheeks are moved toward or away from each other, substantially as and for the purpose described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

EMIL BOCK.

Witnesses:
WM. ESSENWEIN,
HERMAN LIEBER.