No. 618,917. Patented Feb. 7, 1899.

R. C. STIEFEL.

MANUFACTURE OF TUBES.

(Application filed May 24, 1897.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

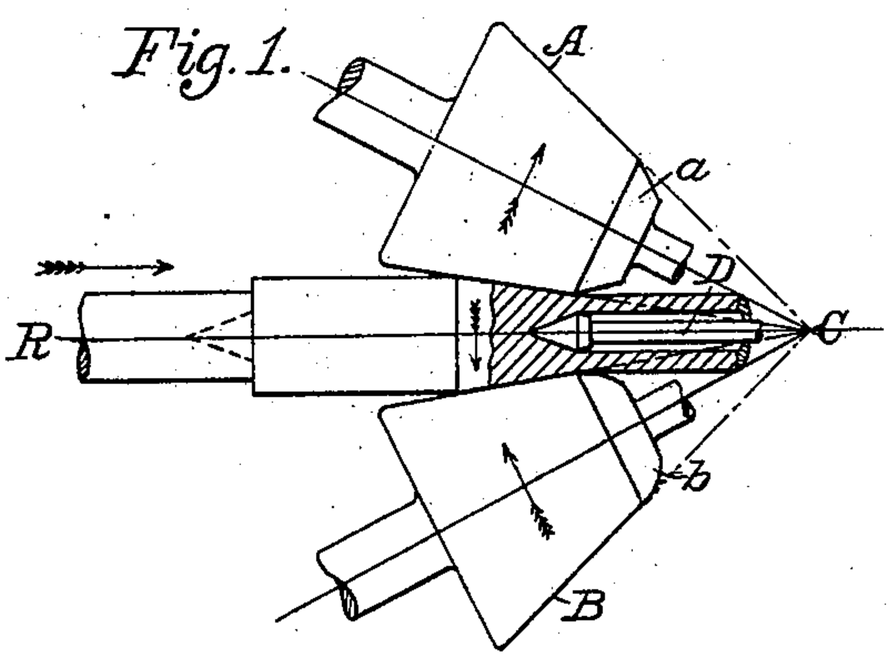


Fig. 4.

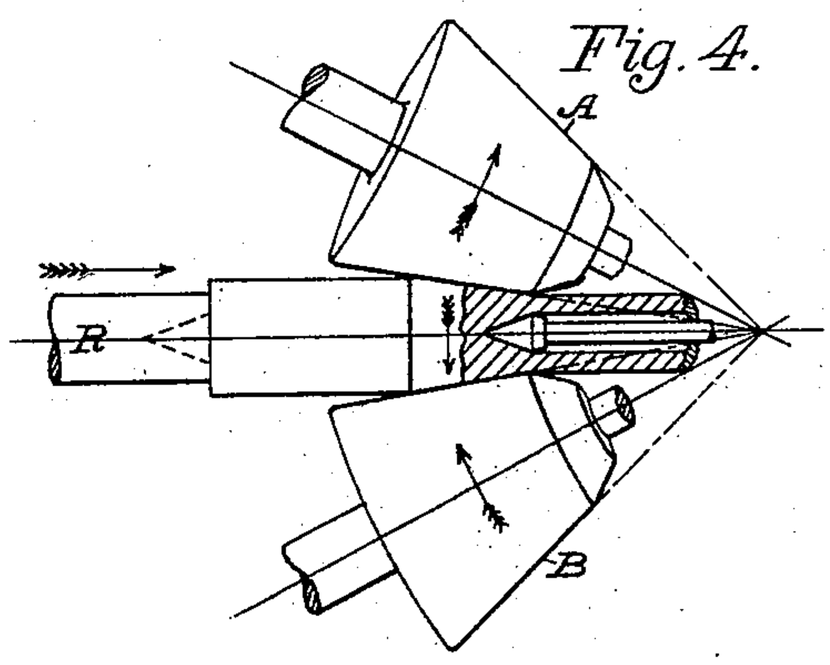


Fig. 2.

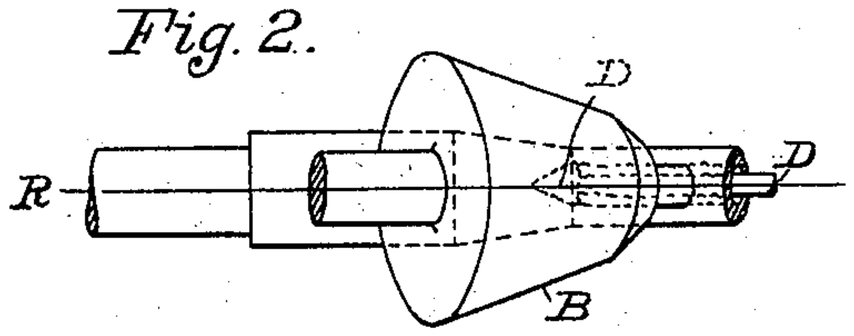


Fig. 3.

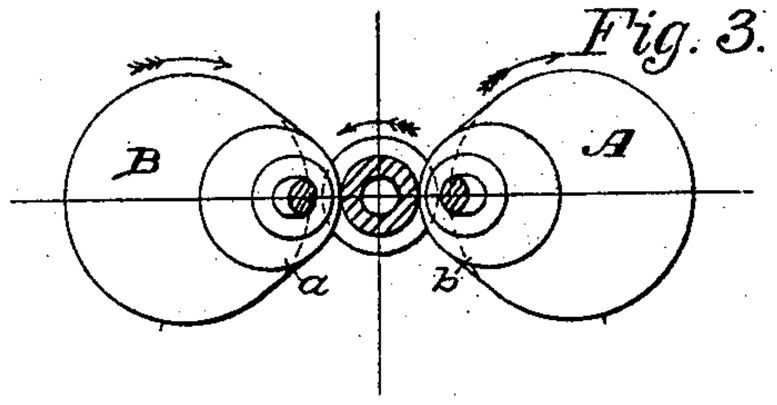


Fig. 5.

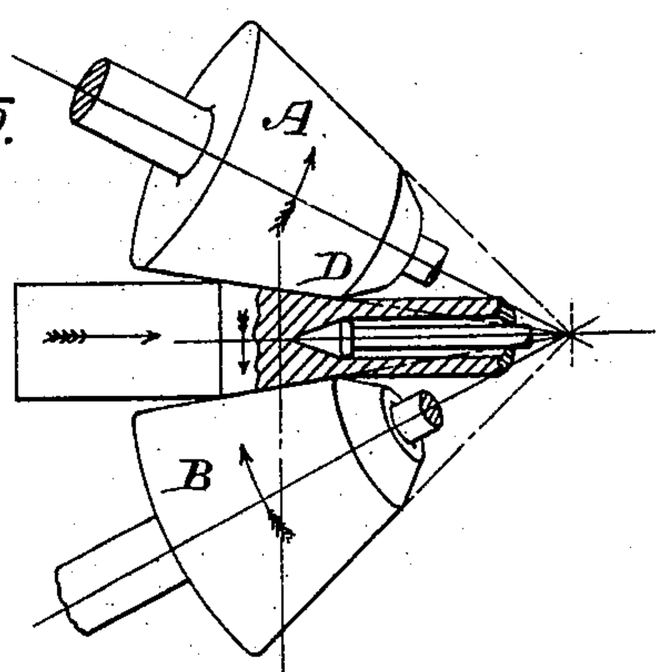


Fig. 6.

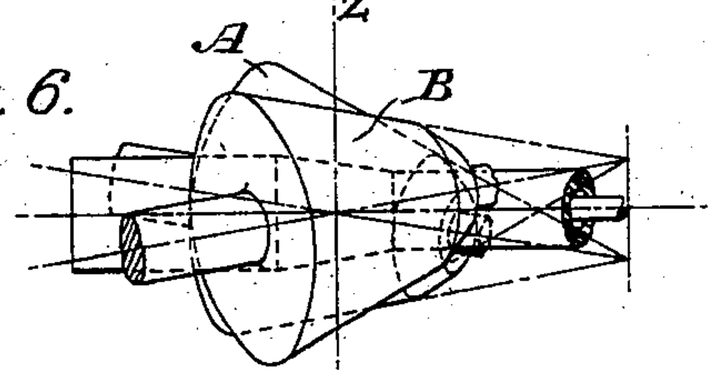
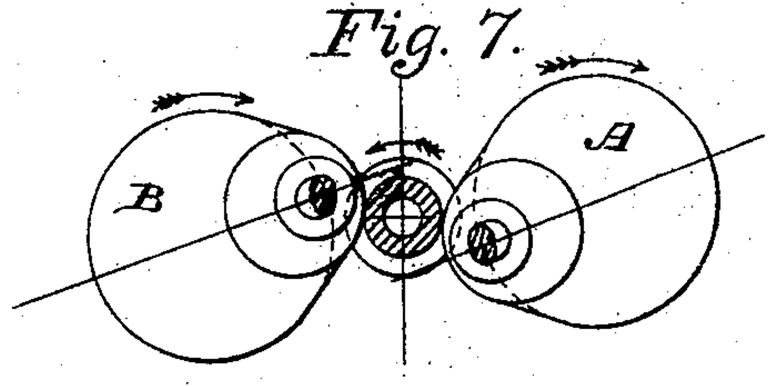


Fig. 7.



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by Wm. A. Skinkle
his Attorney.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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Fig. 8.

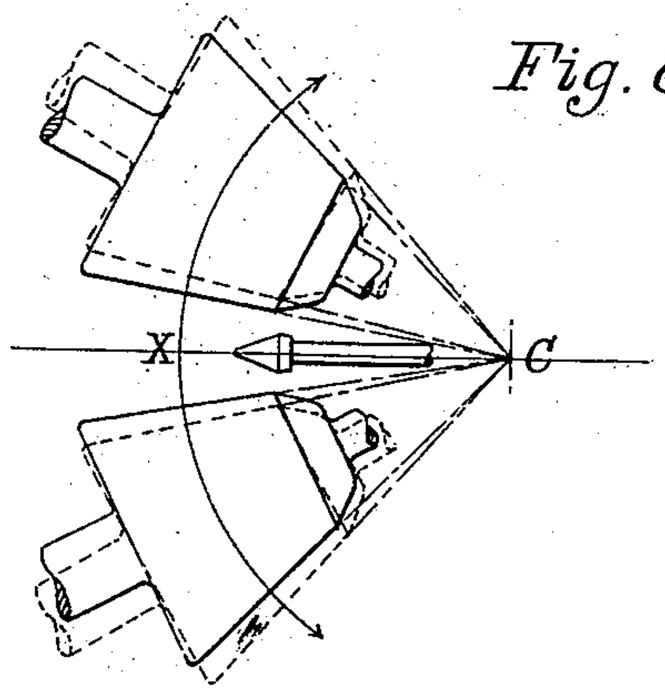

Fig. 9.

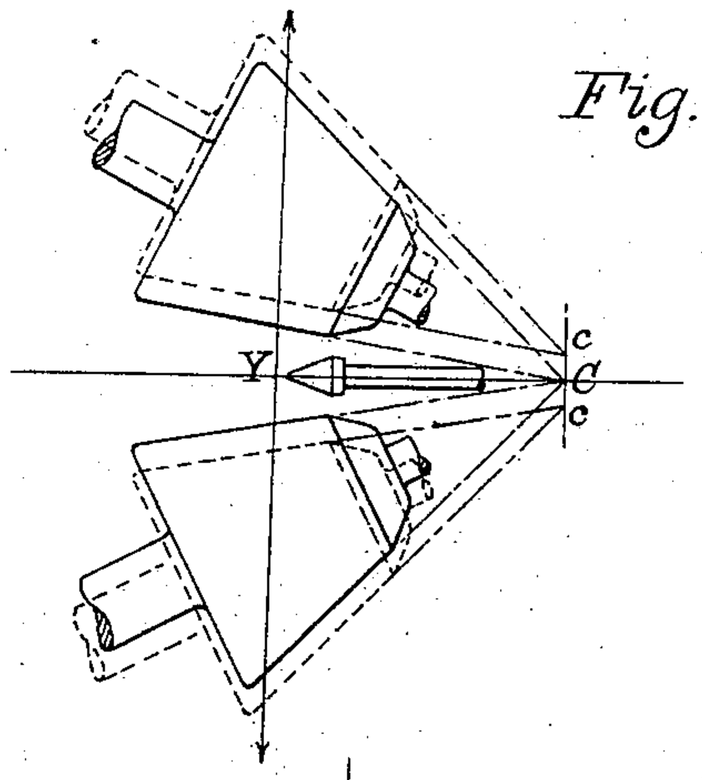

Fig. 10.

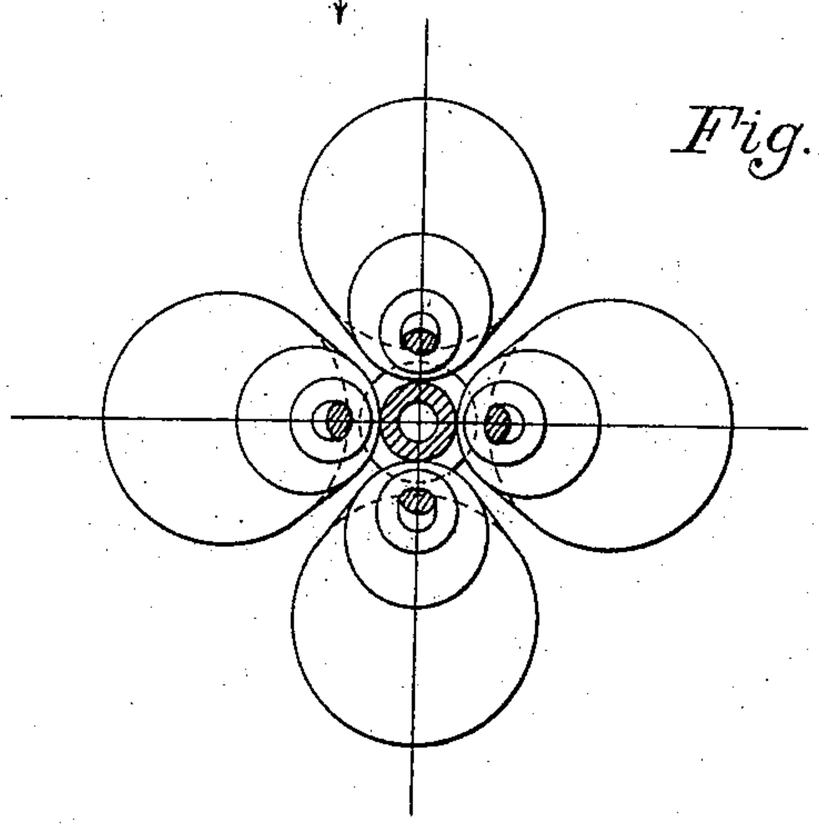

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Fig. 11.

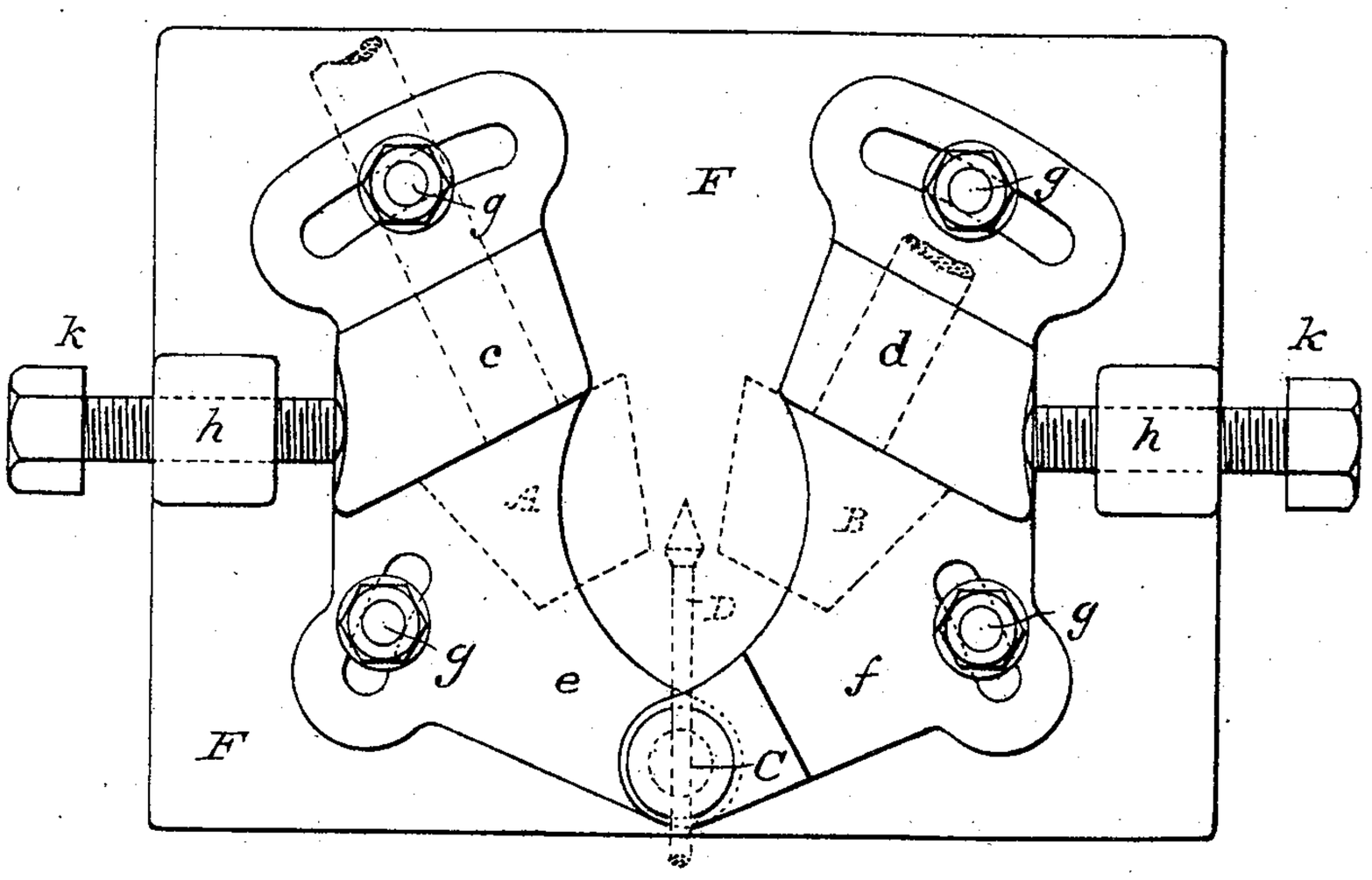
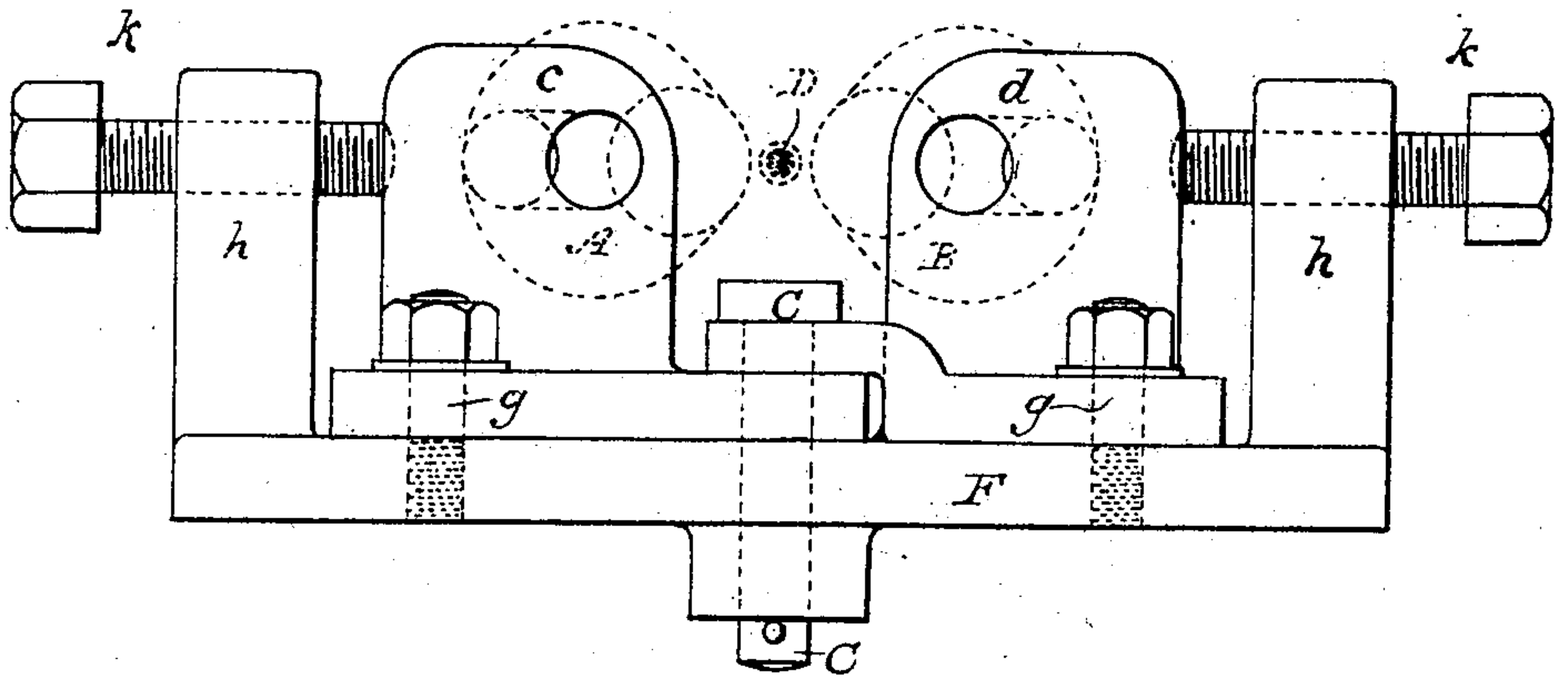


Fig 12.



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UNITED STATES PATENT OFFICE.

RALPH C. STIEFEL, OF ELLWOOD CITY, PENNSYLVANIA, ASSIGNOR TO THE SHELBY STEEL TUBE COMPANY, OF PITTSBURG, PENNSYLVANIA.

MANUFACTURE OF TUBES.

SPECIFICATION forming part of Letters Patent No. 618,917, dated February 7, 1899.

Application filed May 24, 1897. Serial No. 637,971. (No model.)

To all whom it may concern:

Be it known that I, RALPH C. STIEFEL, a citizen of the Republic of Switzerland, residing at Ellwood City, in the county of Lawrence and State of Pennsylvania, have invented certain new and useful Improvements in the Manufacture of Tubes, of which the following is a specification, that will enable those skilled in the art to which my invention pertains to make and use the same.

My invention relates to piercing heated cylindrical blanks or billets preparatory to or in the process of forming such blanks or billets into metallic tubes. Its objects are to pierce such blanks longitudinally by passing them endwise between rolls, by which I mean any suitable rotating or revolving bodies, and over the point of a mandrel lying in the pass between them, the rolls compressing and slightly reducing the diameter of the blanks without twisting or disturbing the longitudinal arrangement of their fibers and without there being any slip between the surfaces of the revolving bodies and those portions of the blanks with which they come into contact. The method by which this is done and the details of the apparatus for doing it will be readily understood from the following description read in connection with the accompanying drawings.

The drawings show my invention by diagrammatic views which illustrate one form of revolving bodies having conical working faces formed upon them well adapted to carry out the purpose of my invention; also, the piercing-mandrels, &c., and their relative positions, no attempt being made to show the framework or housings by which the parts are carried or the means for driving the several moving parts of the mechanism, as such matters are well understood by those familiar with this class of machinery and can be readily supplied by a skilful mechanic without departing from the spirit of my invention as set forth in the claims at the end of this specification.

Figure 1 is a plan or top view illustrating the preferred shapes and one form of the relative arrangement of the several parts of a mechanism which constitutes a part of my invention and with which the objects thereof may be attained. Fig. 2 is a side elevation, and Fig. 3 an end view, of the same. Fig. 4 illustrates a slight modification in the disposition of the rolls shown in Fig. 1. Figs. 5, 6, and 7 are respectively a plan view, a side elevation, and an end view, of a modification of my invention. Figs. 8 and 9 are diagrammatic views illustrating the effects of different methods of adjusting my rolls to adapt them within certain limits to varying sizes of work. Fig. 10 is an end view illustrating four rolls grouped about a common pass instead of two, as shown in the preceding figures, it being within the scope of my invention to use either two rolls or as many more than two as may be desired and as can conveniently be grouped about a common pass to effect the purposes of my invension. Figs. 11 and 12 illustrate a roll-supporting mechanism by means of which the rolls may be adjusted toward or away from each other to vary the width of the pass between them while preserving the convergence of the axes of the rolls and their working surfaces upon a common point upon the axis of the pass.

At this time I prefer to use two rolls, as illustrated in the leading figures of the drawings, and shall confine my description to this construction.

In Figs. 1, 2, and 3 I show two rolls A and B, located at opposite sides of a pass, with their axes lying in the same horizontal plane as the axis of the pass. These rolls revolve in the same direction and may be driven in any suitable manner. They are conical throughout their main or working portions and are so arranged that their axes and the lines of their working sides all converge toward and intersect a common point C on the axial line of the pass. The pass between the rolls is wider at its entrance than at its exit end, so that a billet introduced between the rolls is gradually compressed and reduced in diameter as it advances toward the exit end of the pass. This is for the purpose of giving the rolls a continuing and uniform grip on those portions of the billet lying within the pass and in contact with their opposing surfaces. This grip is of sufficient intensity

or power to compel the rotation of the billet against the resistance of the piercing-mandrel D, which lies in the pass and which penetrates and opens the billet as the latter is forced endwise through the pass, the endwise motion of the billet, together with its rotation, enabling the mandrel to bore or pierce into the mass of hot metal advancing against it.

With the rolls disposed as shown in Figs. 1, 2, and 3 they impart to the billet rotary motion only, and it is forced to move endwise by means of a hydraulic ram R or other suitable mechanical appliance pressing upon the rear end of the billet. Under this arrangement the heated billet is subjected to two forces—first, the endwise thrust of the ram R, forcing it into the converging pass between the adjacent surfaces of the rolls and against the point of the stationary mandrel D, located in the pass, and, second, the rotary movement imparted to it by the rolls, so that it yields to the boring action of the point of the mandrel, flowing or expanding around the conical head of the mandrel and passing therefrom in tubular form. It will be observed that owing to the converging sides of the pass that portion of the billet within the grip of the rolls is smaller in diameter at its exit than it is at its entrance end. Now if the rolls were cylindrical or of uniform diameter they would of necessity impart a higher speed of rotation to the smaller diameter of that portion of the billet within their grip than to the portion having the larger diameter, which would result in a twisting of the fiber of the billet.

With my conical rolls arranged as shown there is absolutely no twist imparted by the rolls to the billet and no slip between the contacting surfaces of the rolls and the billet, for while the converging sides of the pass cause a gradual diminishing of the diameter of the billet it will be observed that the diameters of the rolls diminish progressively in the same ratio as the diameters of the billet decrease, the larger diameter of the billet being gripped by large diameters of the rolls, while the smaller diameters of the billet are gripped by proportionately smaller diameters of the rolls, so that an absolutely uniform speed of rotation is imparted to every portion of the billet within the grip of the rolls. This I regard as the most important feature of my invention, and it is the result of converging the axes of both rolls and the lines of their working surfaces to a common point on the axial line of the pass. So far as I am aware, this has never been done before, and I know of no device with revolving bodies having a tapering or converging pass between them in which there is not some twist imparted to the billet or some slip between the billet and the working faces of the rolls, or both.

As shown in Fig. 1, I locate the point or tapering head of my piercing-mandrel within or substantially within the pass and between the convergent adjacent sides of the rolls, so that the largest part of the mandrel-head is at or near the narrowest part of the pass, preferably slightly beyond or outside of a line drawn across the narrowest part of the pass, as indicated in the drawings. This is to insure the continuance of the grip of the rolls on the billet until it has been entirely pierced through from end to end and has had its rear end opened sufficiently by the mandrel to pass over the largest portion of its head without the further application of endwise force. The action of the rolls on opposite sides of the pass compresses the opening tubular structure closely against the sides of the mandrel-head, making the tube slightly oval, so that there is comparative freedom between the top and bottom surfaces of the mandrel and the inside of the tube. If, therefore, the largest diameter of the mandrel-head is located slightly beyond or outside of the narrowest part of the pass, the action of the last part of the mandrel-head merely serves to take out this oval and form the tube into a true cylinder.

The small ends of the conical rolls may be made to taper more rapidly than the main portions of the rolls, as shown at *a*, or they may be rounded over, as shown at *b*. In either case they may impinge only slightly upon the outside of the work as it passes over and off the mandrel-head and by their difference in speed rubbing upon and to some extent burnishing the exterior of the tubular product, or they may be so shaped, &c., relatively to the conical head of the mandrel as not to touch upon the work after it leaves the head of the mandrel. They are not, however, important features of my invention and may be entirely dispensed with without affecting it.

While I have in the description of the operation of the mechanism shown in Figs. 1, 2, and 3 stated that in this disposition of the parts the rolls would pass a billet without slipping upon its surface, I had reference particularly to the circumferential slip, but not to the endwise slip of the billet along the surface of the rolls as it is being pushed through the pass by the ram. In order to overcome this endwise slip of the billet on the contacting surfaces of the rolls, I may slightly incline the axes of my rolls, as shown in Fig. 4, so that the rolls themselves will have a slight tendency to feed the billet forward. This inclination should be just enough to have the feeding tendency of the rolls equal to the speed of the feed imparted to the billet by the ram. With this construction there is absolutely no slip of any kind between the rolls and the billet. In it, however, the axes of the rolls and the lines of their working surfaces do not converge at a common point on the axis of the pass, the axis and sides of one roll converging on a point in line with but above the axis of the pass, while the axis of the other roll and its sides converge upon a point in line with but below the axis of the pass, the two points lying in a common vertical line through the pass.

In connection with my rolls any suitable guides may be employed to hold the work in its proper position in the pass between the rolls.

In Figs. 8 and 9 are illustrated the effects of certain adjustments of the rolls toward or away from each other to permit of variation of the sizes of work they may produce.

I consider it better to adjust the rolls toward or away from each other circumferentially by swinging them around a common center C, as shown by line X in Fig. 8, so that their axes and the lines of their working faces will converge upon this center C in every position to which the rolls may be adjusted. Mechanism by which this adjustment may be effected is illustrated in detail in Figs. 11 and 12 of the drawings, in which the rolls A and B and their driving-shafts (shown by dotted lines) are mounted in suitable bearings in lugs *c d*, rising from swinging plates *e f*, pivoted at C in the vertical plane of the axis of the pass to a main base-plate F. These plates rest upon the top of the base-plate F and are free to swing around the pivotal center C except when they are clamped to the plate by clamping stud-bolts *g*. Suitable blocks or pillars *h*, rising from the base-plate, carry adjusting-screws *k k*, which force the roll-carrying plates toward each other and, with the clamping-bolts, resist their tendency to separate when work is being performed in the pass between them. The mandrel-head D is also shown in dotted lines in these figures at the exit end of the pass. Theoretically this is the best method of adjustment; but within certain limits the rolls might be adjusted laterally, as on the line Y, at right angles to the axis of the pass, Fig. 9, and although the converging points *c c* of their axes and working surfaces would not intersect a common point C on the axes of the pass the rolls would still work with a certain degree of efficiency and success in effecting the purposes of my invention.

In Figs. 5, 6, and 7 I illustrate a modification of my invention in which the axes of the rolls are oppositely inclined relatively to the axis of the pass, so that the rolls themselves will cause the endwise movement of the billet without the aid of a hydraulic ram or other mechanical appliance to force the billet through the pass and over the head of the mandrel. In this construction while the axes and lines of the faces of the rolls do not intersect a common point on the axis of the pass they do intersect points on a common line passing through the axis of the pass, but above and below said axis, respectively, as hereinbefore set forth in reference to Fig. 4. In the construction shown in Fig. 4, however, the axes of the rolls are only inclined enough to render the rolls passive in their effect upon the endwise movement of the billet—that is to say, they neither assist or resist this movement; but in the construction shown in Figs. 5, 6, and 7 the inclination of the rolls is such as to make them active promoters of this endwise movement of the billets, enabling me to dispense with other agencies for this purpose. When the rolls are thus oppositely inclined, a horizontal line drawn transversely across the axis of the pass at mid-length of the contact-line of the rolls on the billet should intersect also the axes of the two rolls, as shown by the line Z, Figs. 5 and 6. With the exception of the inclination of the axes of the rolls, the general shapes of the parts and their relative positions are substantially like those fully described in connection with Figs. 1, 2, and 3.

Having thus described my invention, what I claim as new and useful, and desire to secure by Letters Patent, is—

1. The combination of conical revolving bodies disposed to form a pass between them the sides of which converge toward its exit end, a piercing-mandrel located in said pass, the axes of the revolving bodies and the lines of their working faces substantially converging toward and intersecting a common point on the axial line of the pass substantially as set forth.

2. The combination of conical revolving bodies disposed to form a pass between them with a piercing-mandrel located in said pass, the pass gradually diminishing in width toward its exit end and the diameters of the revolving bodies diminishing progressively in the same direction and substantially the same ratio as the width of the pass substantially as set forth.

3. The combination of conical revolving bodies disposed to form a pass between them the sides of which converge toward its exit end, a piercing-mandrel located in the axial line of the pass, the axes of the opposed revolving bodies and the lines of their working faces converging toward and passing through points substantially on a common line drawn through the axis of the pass at right angles to a plane through the axis of the pass and through the straight line which intersects the center of the pass at a right angle and the axes of the revolving bodies, substantially as set forth.

4. The combination of conical revolving bodies disposed to form a pass between them the width of which diminishes toward its exit end in substantially the same ratio as the diameters of the revolving bodies diminish toward its exit end, a piercing-mandrel located in the pass and means for forcing billets or blanks endwise through the pass and against the mandrel substantially as set forth.

5. The combination of conical revolving bodies disposed to form a pass between them the sides of which converge toward its exit end, a piercing-mandrel located in said pass, the axes of the opposed revolving bodies and the lines of their working surfaces converging toward and substantially intersecting a common point on the axial line of the pass, the revolving bodies being adjustable toward or

away from each other by swinging about an axis passing through the said common point and at right angles to a plane common to the axes of the revolving bodies and of the pass substantially as set forth.

6. The combination of conical revolving bodies disposed to form a pass between them the sides of which converge toward its exit end, a piercing-mandrel located in said pass, the axes of the opposed revolving bodies and the lines of their working surfaces converging toward points substantially on a line drawn through the axis of the pass at a right angle to a plane through the axis of the pass and through the straight line which intersects the center of the pass at a right angle and also the axes of the revolving bodies, the revolving bodies being adjustable toward or away from each other by swinging about an axis on said common line, substantially as set forth.

In testimony whereof I affix my signature, in the presence of two witnesses, at Ellwood City, Pennsylvania, April 23, 1897.

RALPH C. STIEFEL.

Witnesses:
SAML. A. ROELOFS,
GEO. WILLIAMS.