(No Model.) 2 Sheets—Sheet 1.

J. W. BODGE.

ART OF DRAWING SHEET METAL.

No. 460,550. Patented Oct. 6, 1891.

Fig. 1.

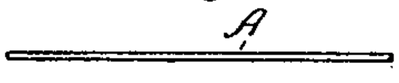


Fig. 2.

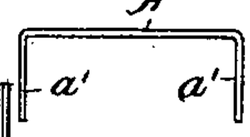


Fig. 3.

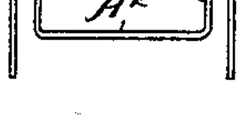


Fig. 4

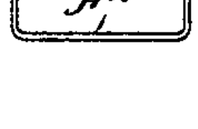


Fig. 5.

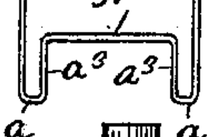


Fig. 6.

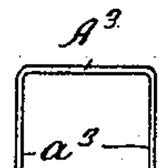


Fig. 7.

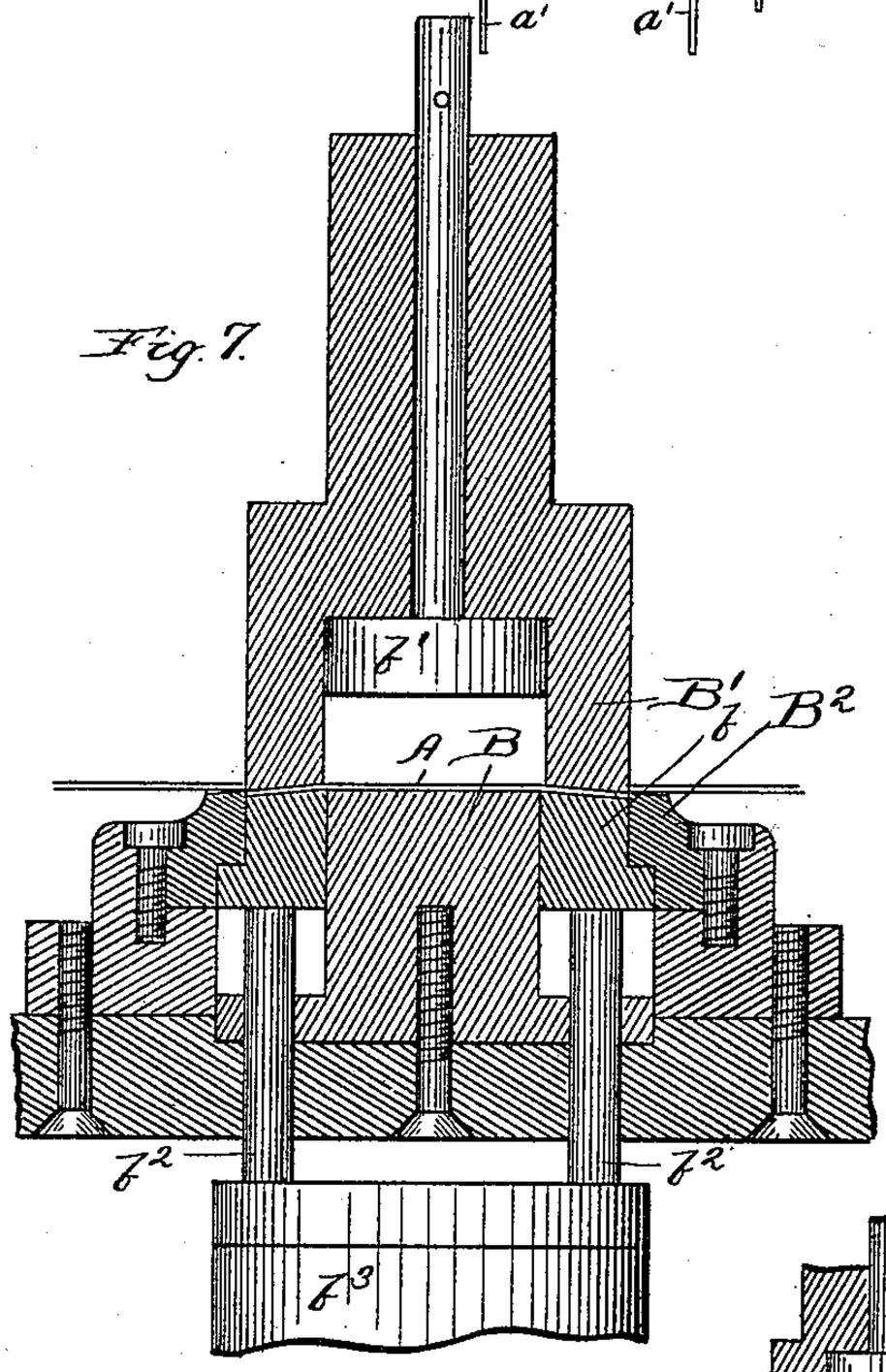


Fig. 8.

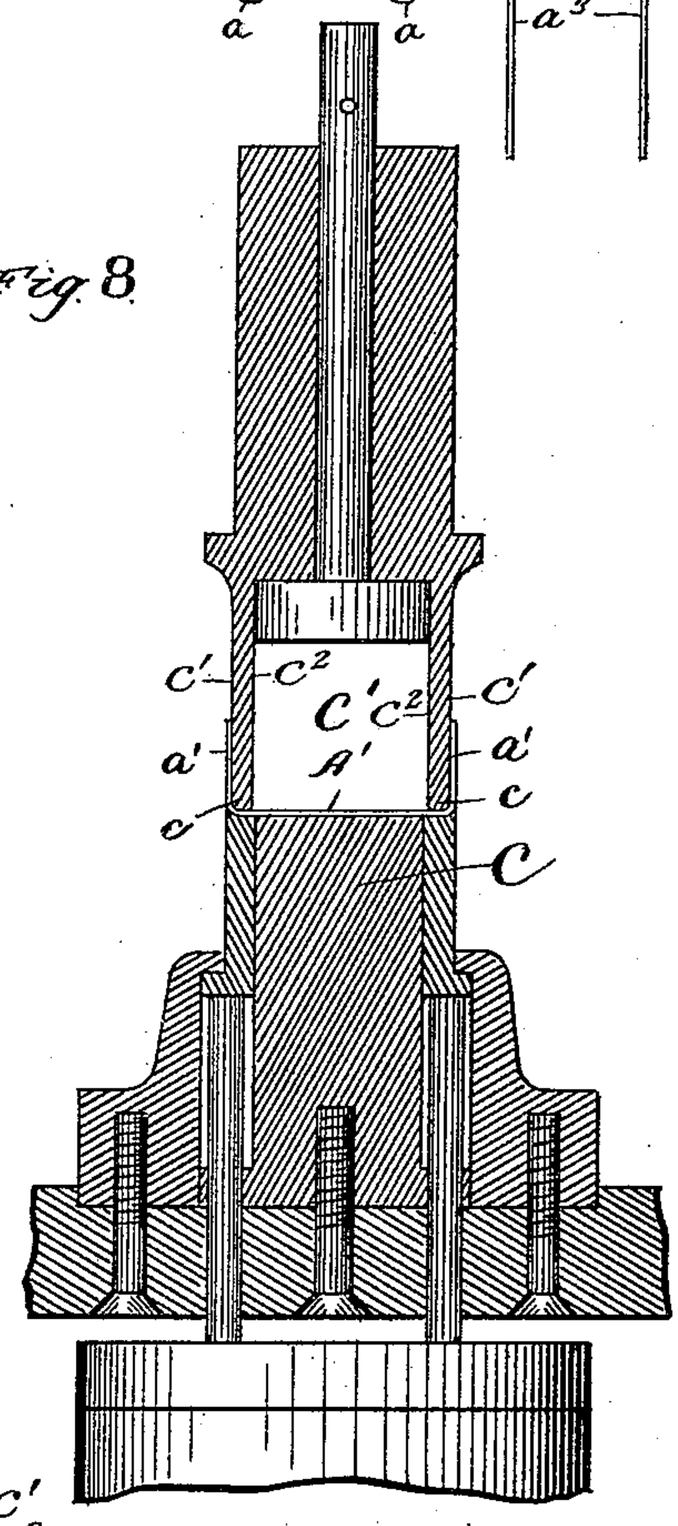


Fig. 9.

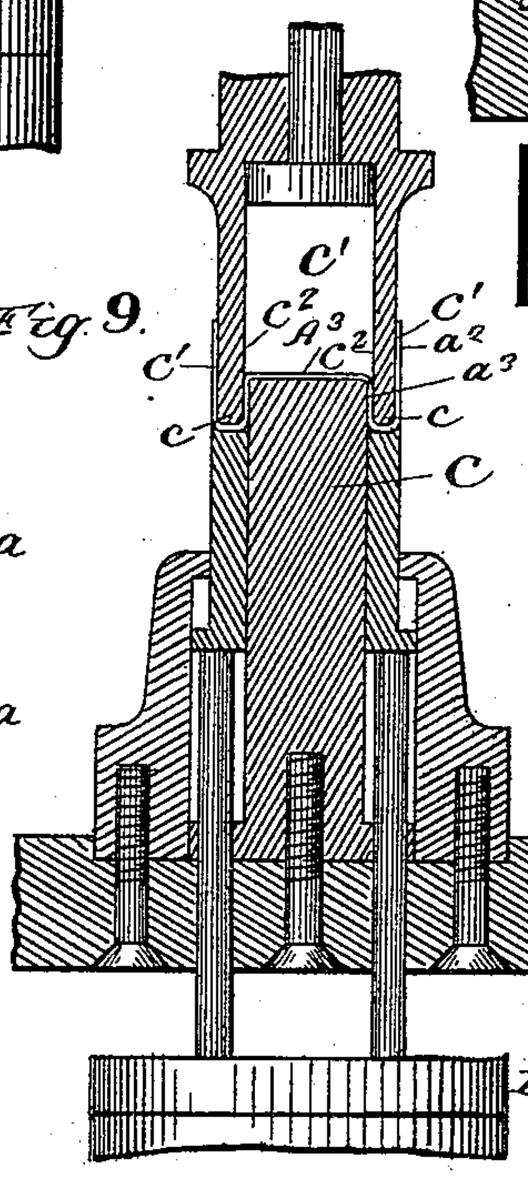
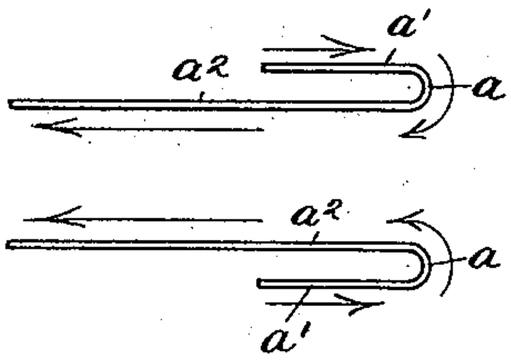


Fig. 14.



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(No Model.) 2 Sheets—Sheet 2.

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ART OF DRAWING SHEET METAL.

No. 460,550. Patented Oct. 6, 1891.

Fig. 10.

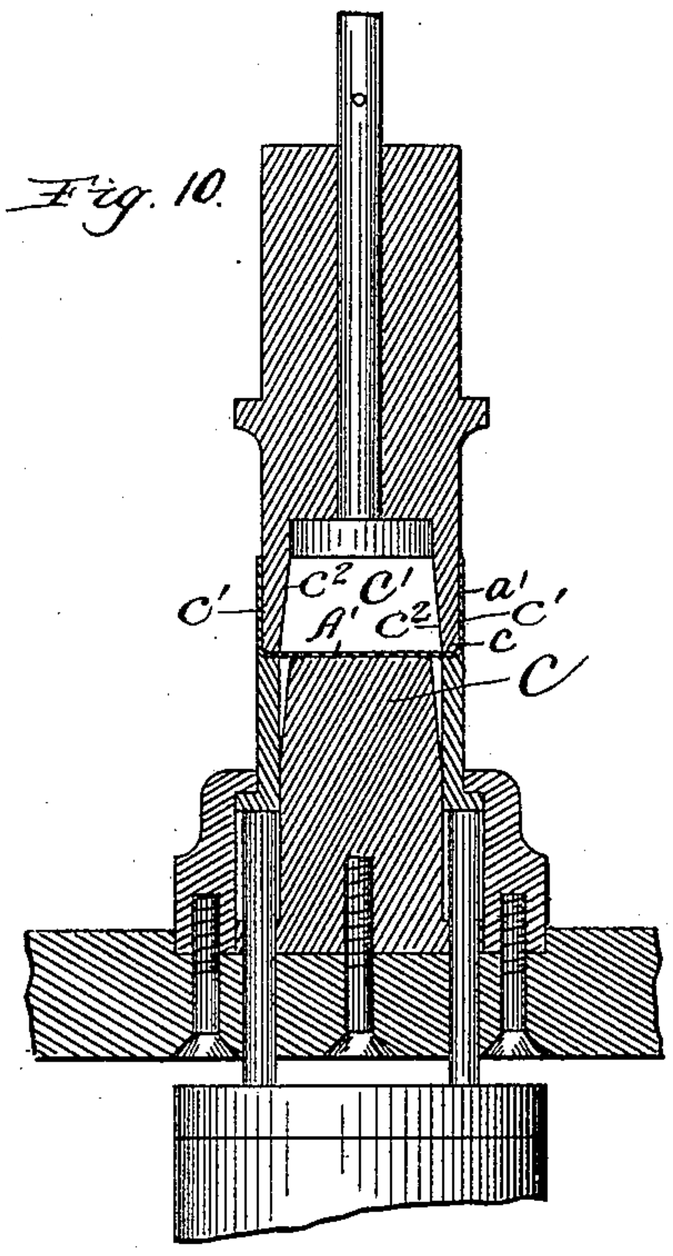


Fig. 12.

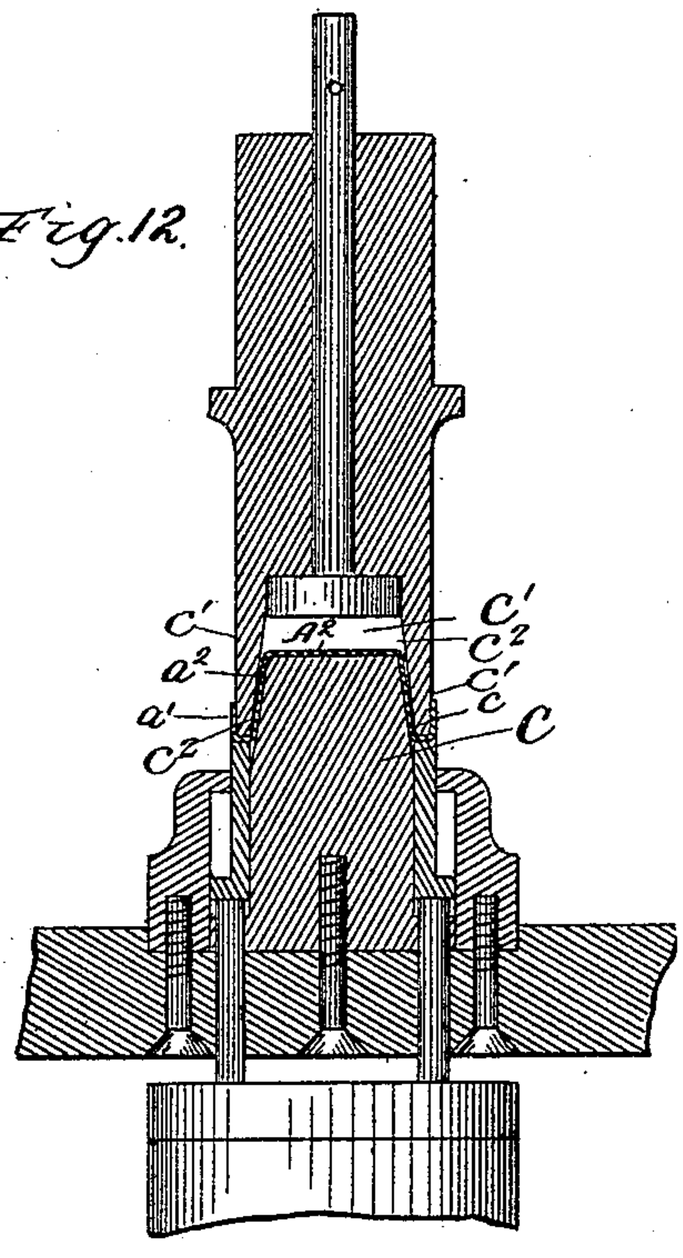


Fig. 11.

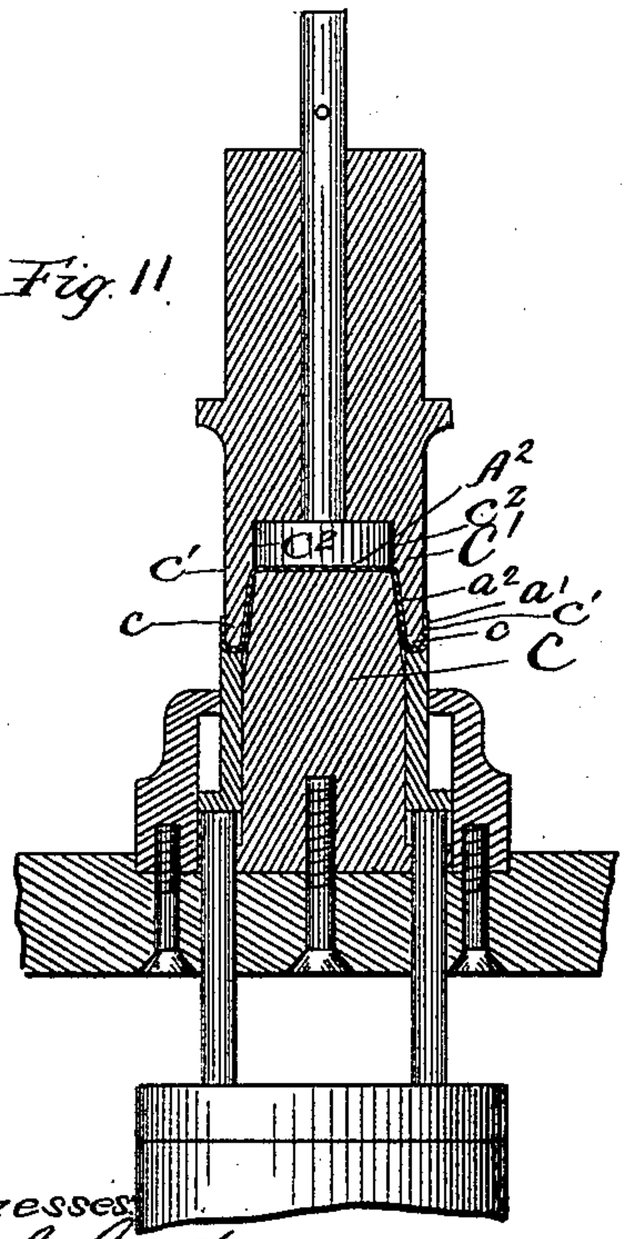
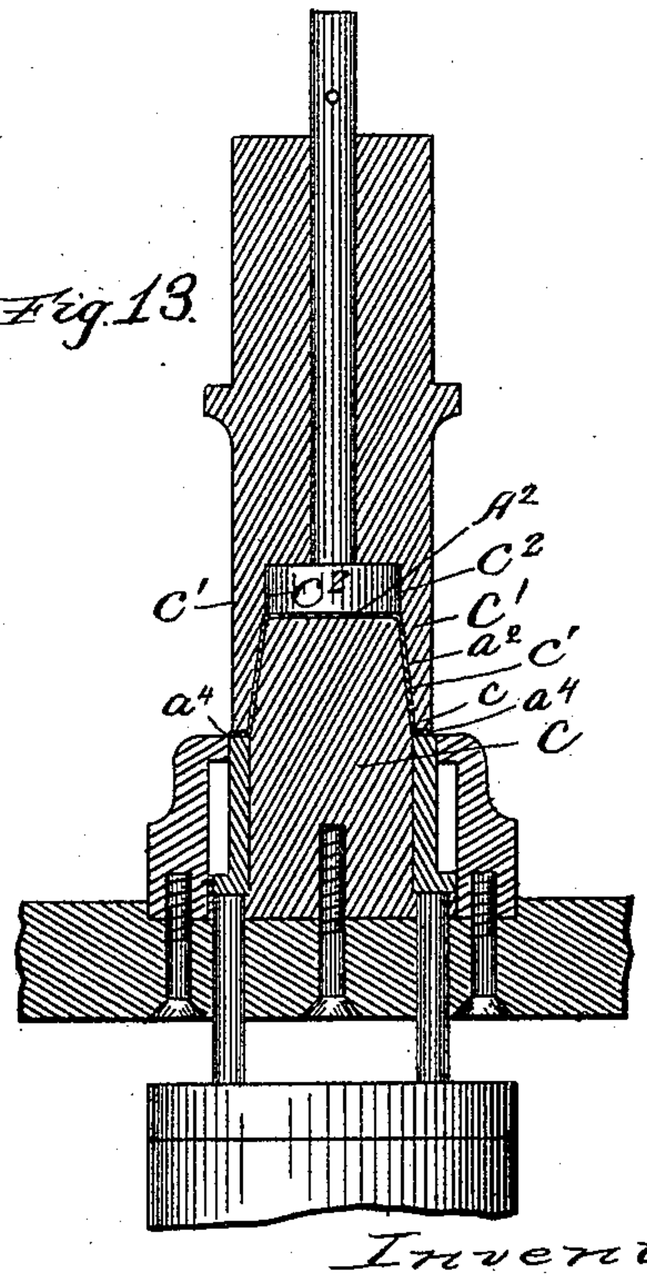


Fig. 13.



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UNITED STATES PATENT OFFICE.

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ART OF DRAWING SHEET METAL.

SPECIFICATION forming part of Letters Patent No. 460,550, dated October 6, 1891.

Application filed December 27, 1890. Serial No. 375,934. (No specimens.)

To all whom it may concern:

Be it known that I, JOHN W. BODGE, a citizen of the United States, residing in Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in the Art or Process of Drawing Sheet Metal, of which the following is a specification.

My invention relates to improvements in the art of drawing or stamping sheet metal into cylindrical, cup, or disk shape forms.

Heretofore great difficulty has been experienced in drawing tin-plate or other metal sheets into cylindrical or cup shaped articles of any considerable depth or length. Heretofore this has been done by drawing the sheet metal entirely in one and the same direction by suitable drawing-dies constructed for the purpose, several sets of dies, each successively smaller than the preceding set, being employed to produce articles of any particular depth or length. In this old method of drawing there is great liability to stretch and crack or break the stock, and thus produce defective articles. The percentage of loss from this source is so great that it is customary to select the best, softest, and heaviest stock for the purpose, and even then there is always a large percentage of failures where the articles to be drawn have any considerable depth or length.

The object of my invention is to provide a simple, cheap, and efficient process for drawing sheet metal into cylindrical shape, cup shape, disk shape, or other forms without danger of stretching, cracking, or breaking the stock, and thus producing defective articles.

I have discovered, and herein my invention consists, that tin-plate or other sheet metal may be readily and cheaply drawn into cylindrical or cup shape forms without danger of cracking or breaking the stock by drawing it successively in different directions—that is to say, I first draw the plain sheet into a shallow cup or disk shape in one direction, and I then turn this shallow cup inside out by drawing it in the opposite direction into a deeper cup of smaller diameter, which may be again turned inside out by drawing in the reverse direction, and thus produce a cup or vessel of still greater depth and still smaller diameter. By successively reversing the direction in which the drawing is done, thus successively turning the vessel inside out, the sheet metal may be easily and successfully drawn into cylinders or cones of any suitable or desired depth or length and without danger of breaking or cracking the stock at any point. The drawing operation is also much facilitated by my new process, as the stock seems to naturally flow or curve around the annular corner which unites the outside large tube with the inside small tube in the process of drawing the large tube into the small tube. By my process, also, the tendency seems to be to compact the metal upon itself and rather to close the pores in the metal than to separate the same or produce flaws, cracks, or breaks therein.

To render my process more readily understood by those skilled in the art, I have in the accompanying drawings, which form a part of this specification, at Figures 1, 2, 3, 4, 5, and 6, illustrated a disk of tin-plate in several successive stages of being drawn into a cylindrical-shaped cup. Fig. 7 represents a drawing and cutting male and female die, which may be used for cutting out the blank and drawing it into a shallow cup, as shown at Fig. 2. Fig. 8 represents a pair of drawing-dies which may be used for turning the cup shown in Fig. 2 inside out and drawing it into, first, the intermediate form shown in Fig. 3, and then further into the form shown in Fig. 4. Fig. 9 represents a precisely similar pair of dies to that shown in Fig. 8, but smaller in diameter, and which serves to again reverse or turn the cup shown in Fig. 4 inside out and produce the deeper cup of smaller diameter shown in Fig. 6 Figs. 10, 11, 12, and 13 show dies used for making a conical-shaped vessel or article.

In the drawings, A represents a blank of sheet metal—for example, tin-plate.

A′ represents a shallow cup produced by the first step of the process. The side *a′* of this cup may be cylindrical or conical, as desired. This first step of the process may be performed by any suitable instrumentality known to those skilled in the art. An ordinary pair of drawing and cutting dies B B′ B²— such as are commonly used in the old process of drawing in one direction—may be used.

The drawing and cutting dies B B′ B² have the usual follower or extractor ring *b* and rejector *b′*. The extractor-ring *b* is supported in the usual manner by pins b^2 on a rubber or other spring b^3. After the shallow cup A′ is formed the next step of my process is to reverse this cup or draw it in the opposite direction, thus turning the cup A′ inside out and producing a deeper cup A^2, of smaller diameter. This step or process of drawing the cup A′ into a deeper cup of smaller diameter by reversing the direction in which the previous drawing was done, and thus turning the cup A′ inside out may be effected by any suitable instrumentality or tool. That which I prefer to use for the purpose consists of a pair of drawing-dies C C′. The male die or punch C is a simple drawing-punch; but the female die C′ is of annular form, its exterior diameter corresponding to the interior diameter of the shallow cup A′, which is to be reversed or turned inside out, and its interior diameter corresponding to the exterior diameter of the smaller cup A^2, so that the cylindrical side or wall *a′* of the larger vessel may flow or turn around the edge or face *c* of this annular die C′, and thus unite with and form the cylindrical side or wall a^2 of the smaller and deeper cup A^2, produced by these dies. This operation is illustrated in Fig. 3 and also in the sectional view of the dies, Fig. 8. The cup A^2 may then again in like manner be reversed or turned inside out and drawn into the still deeper and smaller cup A^3. This is preferably done by a duplicate set of dies to that shown in Fig. 8, the same being simply of smaller diameter, as shown in Fig. 9. The smaller dies shown in Fig. 9 have the same letters of reference as the corresponding ones shown in Fig. 8. The cylindrical side or wall of the cup A^3 is shown at a^3; and this process or operation of reversing the direction of the drawing and turning the cup inside out, and thus drawing it into a deeper or longer tube of smaller diameter, may be indefinitely repeated.

In the act of turning, flowing, or drawing the larger outside tube or vessel into the smaller inside tube or vessel an annular curved shoulder *a* is formed between the two tubes *a′* and a^2 or a^2 and a^3, and which unites the two tubes, and it is at this point that the work is done. Owing to the pulling or drawing of the two tubes *a′* a^2 in opposite directions, as is clearly illustrated in the diagram view, Fig. 14, and owing, also, to the curved annular shoulder *a*, uniting the larger and smaller tubes, it will readily be understood by those skilled in the art that the operation is a peculiarly easy and natural one, requiring a comparatively small amount of force and tending rather to compact the metal and close its pores than to crack or break or injure it. In curving or drawing the larger tube into the smaller one the curved shoulder *a* between the two tubes seems to act in the nature of a leverage and thus to facilitate or render easy the drawing operation. In the act of drawing the larger tube into the smaller one the outside periphery of the annular drawing tool or die C′ serves to support the stock of the larger tube which fits upon it and to keep it smooth and cause it to flow or draw in proper lines. The annular shoulder or face *c* of the annular die C′ is or should be made curved or rounded to facilitate the turning of the stock around it. This rounded shoulder *c* also serves to support and guide the stock in the act of flowing or drawing from the larger tube into the smaller one. In Figs. 10, 11, 12, and 13 the process is illustrated as applied to the drawing of conical or flaring vessels, the same being also left with a horizontal flange a^4, as shown in Fig. 13. The dies used in these figures only differ from those shown in Figs. 8 and 9 by being made conical. Figs. 10 and 11 show the same pair of dies in different positions. Those shown in Figs. 12 and 13 are the same, excepting that the interior diameter of the hollow conical die and also its punch are somewhat smaller than those shown in Figs. 10 and 11. The use of two separate pairs of dies, where the dies are conical, to draw the cup shown in Fig. 10 into the shape shown in Fig. 13 is simply to better support the stock. If the small die shown in Figs. 12 and 13 were applied directly to the cylindrical cup shown in Fig. 10, there would be too much space left between the small end of the conical punch and the larger interior diameter of the hollow conical annular die to do the best work. For this reason I employ two sets of dies for performing one operation where the articles to be drawn have any considerable flare.

The die C′, I call an "annular die," as both its outside periphery or wall *c′* and its inside periphery or wall c^2 are operative and serve to guide and support the flowing, turning, or drawing of the metal, as does also the annular shoulder or end *c* of this die. In ordinary dies heretofore in use only the end and inner peripheries of the die are operative—as shown, for example, in Fig. 7.

I claim—

1. The process of drawing metal sheets into cylindrical or other shapes, consisting in first drawing the sheet in one direction and then drawing it in the opposite direction and turning the article or shape first drawn inside out, substantially as set forth.

2. The process of drawing metal sheets, consisting in successively reversing the direction in which the metal is drawn, substantially as specified.

3. The process of drawing metal sheets into shapes, consisting in first drawing it into a hollow or vessel form and then drawing said form first produced into a form of smaller diameter and at the same time turning the form first produced inside out, substantially as specified.

4. The process of producing from a hollow

sheet-metal form a form of smaller diameter and greater length or depth, consisting in turning said first-mentioned form inside out, substantially as specified.

5. The process of producing a smaller tube from a larger tube, consisting in turning, flowing, or drawing the larger tube around the end or edge of an annular die and thus turning the larger tube inside out and producing the smaller tube, substantially as specified.

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