(Model.) 2 Sheets—Sheet 1.

A. W. PAULL & G. F. BUTTERS.

METHOD OF DRAWING SHEET METAL.

No. 343,390. Patented June 8, 1886.

Fig. 2.

Fig. 4.

Fig. 1.

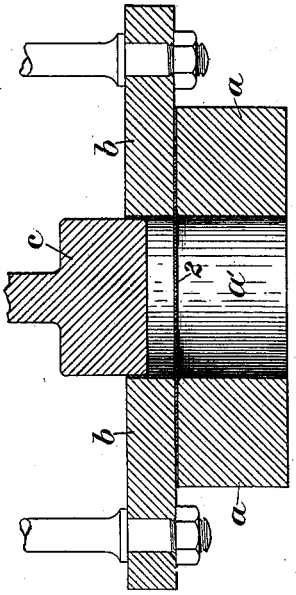
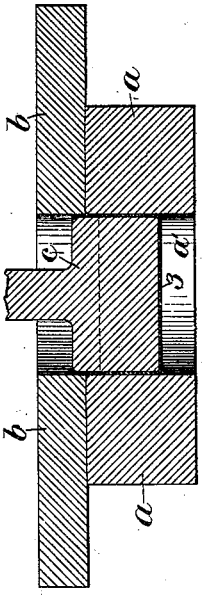


Fig. 3.



Witnesses.
Wesley L. Gill
W. B. Corwin

Inventors.
Archibald W. Paull
George F. Butters
by their attys
Bakewell & Kerr

(No Model.) 2 Sheets—Sheet 2.

A. W. PAULL & G. F. BUTTERS.

METHOD OF DRAWING SHEET METAL.

No. 343,390. Patented June 8, 1886.

Fig. 10.

Fig. 11.

Fig. 8.

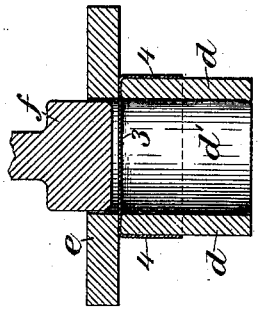


Fig. 9.

Fig. 5.

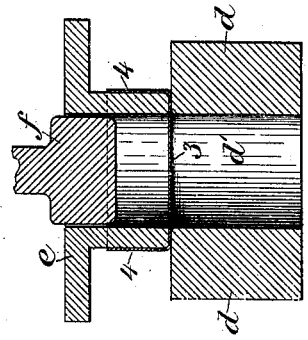


Fig. 6.

Fig. 7.

Witnesses.
Harry L. Siel.
W. B. Corwin

Inventors.
Archibald W. Paull
George F. Butters.
by their attys
Bakewell & Kerr

UNITED STATES PATENT OFFICE.

ARCHIBALD W. PAULL AND GEORGE F. BUTTERS, OF WHEELING, WEST VIRGINIA; SAID BUTTERS ASSIGNOR TO SAID PAULL.

METHOD OF DRAWING SHEET METAL.

SPECIFICATION forming part of Letters Patent No. 343,390, dated June 8, 1886.

Application filed December 29, 1885. Serial No. 186,970. (Model.)

To all whom it may concern:

Be it known that we, ARCHIBALD W. PAULL and GEORGE F. BUTTERS, of Wheeling, in the county of Ohio and State of West Virginia, have invented a new and useful Improvement in Methods of Drawing Sheet Metal; and we do hereby declare the following to be a full, clear, and exact description thereof.

Heretofore it has been customary to form seamless dish or cup shaped articles from sheet metal by drawing the same in a suitably-shaped die by means of a plunger. A suitable blank or piece of sheet metal is placed on the upper end of the die over the mouth of the same, and is clamped or held thereon by a metal ring or holder, through which the plunger works. When the plunger descends upon the sheet, it forces the middle part of the same into the cavity of the die, drawing the surrounding parts of the sheet from under the holder or clamp. If the clamp is not held firmly down on the sheet, it will wrinkle or buckle and not draw properly, and the wrinkles will prevent it from drawing into the die, so that the plunger will break or distort the article. The same result will follow if it is attempted to draw a cup of small diameter out of a wide blank, because the friction of the clamp on the wide blank is too great for the strength of the material, the whole pressure of the plunger being confined to the small diameter of the article, so that it is apt to break through the metal. For these reasons the diameter and depth of the article which can be produced by the present method are limited, our experience being that it is impossible to draw an eight-inch blank into a cup of less than four inches in diameter by such method. The result is that its utility is limited to the production of shallow articles.

The object of our invention is to produce drawn seamless cup-shaped or tubular articles of any desired depth from flat sheet-metal blanks.

To enable others skilled in the art to make use of our invention we will now describe it by reference to the accompanying two sheets of drawings, in which—

Figure 1 is a vertical section of a die, clamping-ring, and plunger with the flat sheet in position to be acted on. Fig. 2 is a view of the blank. Fig. 3 is a view of the die, ring, and plunger at the completion of the first step of the operation. Fig. 4 is a view of the blank after the first step. Fig. 5 is a view of the die, ring, and plunger used in the second step of the operation, the blank being in position to be acted on thereby. Fig. 6 is a view of the partially-formed article, illustrating the operation of the second step. Fig. 7 is a view of the completed article. Fig. 8 is a view of the die, ring, and plunger operating on an inverted blank. Figs. 9, 10, and 11 show the shapes assumed by the blank during the operation illustrated in Fig. 8.

Like characters of reference indicate like parts in the various figures.

The die *a*, clamping-ring *b*, and plunger *c* are all of the usual construction. The clamping-ring *b* and plunger *c* are each connected with a reciprocating head, to which motion is communicated by suitable means, so that they descend and perform their appropriate functions on the blank, and are then raised preparatory to acting on the succeeding blank. The machine thus referred to differs in no way from those heretofore used for the purpose, and forms no part of our invention, except that the operation performed thereby constitutes the necessary first step of our improved method. It is therefore unnecessary to describe it more particularly.

The blank 2 is a flat sheet of iron or other suitable metal of proper size, and is placed on the top of the die *a*. The clamping-ring *b* descends upon it and clamps it firmly upon the upper end of the die. The plunger *c* then descends upon it, passing through the ring *b* and forces it into the cavity *a'* of the die, thereby transforming it from a flat sheet, 2, into a cup-shaped blank, 3, Fig. 4. In this operation, that part of the blank which lies between the ring *b* and the top of the die *a* is drawn inward by the pressure of the plunger *c* and downward between the sides of the plunger and the die-cavity *a'*, and goes to form the vertical flange or skirt of the blank 3. This operation is what we have referred to as the old

method, and it constitutes the first step of our improved method. As we have stated, the ring *b* must clamp the edge of the blank tightly, or it will buckle, and then it cannot be drawn or forced into the die, and the pressure of the plunger will cut or break through the center and destroy the blank. If the attempt is made to produce a deep cup, the diameter of the blank must be correspondingly increased, and then the friction of the clamp on the wide blank is too great for the strength of the material, and the plunger will break through the center. For these reasons the blank 3 is comparatively shallow. We then place the cup 3 on the top of a die, *d*, having a narrower die-cavity, *d'*, and by means of a clamping-ring, *e*, which will enter the cup, clamp it in place on the die between the flat clamping-faces of die *d* and ring *e*. A plunger, *f*, then descends through the ring *e* and forces the blank down into the die-cavity *d'*, thereby drawing the flange 4 into the die, the flange decreasing in height as the plunger descends, and finally disappearing between the ring *e* and top of the die *d*.

In Fig. 6 we show the form assumed by the blank when the stroke of the plunger is partially made, and in Fig. 7 the form it has at the completion of the stroke. It is immaterial how wide the flange or skirt 4 of the blank 3 may be, so far as the operation of the plunger *f* is concerned, as it will draw it from between the flat clamping-faces into the die with ease and without buckling, whatever its width may be. Consequently, if a still deeper and narrower cup than that shown by Fig. 7 is desired, the blank 6 may be put through the same operation with a still narrower die, ring, and plunger until the requisite depth and diameter be obtained. If the repeated manipulations should make the metal of the blank too hard and brittle, it may in the meanwhile be annealed, as will be understood.

In Fig. 8 we show that the cup 3 may be acted on by the plunger *f* while in an inverted position. The effect is precisely the same as in Fig. 5.

In Figs. 9, 10, and 11 we show forms assumed successively by the inverted blank during the descent of the plunger. The blank may be discharged from the dies *a* and *d* in the usual way, either by dropping through the bottom or by being projected out through the mouth by a piston or spring bottom of ordinary construction. Whatever may be the width of the flange 4 the pressure of the ring *e* remains the same, and the holding-surface of the ring does not have to be increased, so that the friction of the same on the metal is never sufficient to cause the plunger *f* to fracture the blank. Consequently the thinnest grades of tinned sheets can be used and a minimum cost for material results. Thus in carrying out our invention, we first flange the edge of the straight blank parallel, or nearly so, to the line of movement of the plunger, and then draw the same by means of a smaller plunger, the flange being free during the second operation, so that the metal may draw freely into the die. It is better that the flange 4 should be at right angles to the body; but this is not imperative, as the angle may be more or less obtuse, in which case the flange would converge toward instead of being parallel with the line of movement of the plunger *f*.

Our invention is applicable to the manufacture of a great variety of seamless or drawn sheet-metal vessels—such, for instance, as cups of all kinds, lantern-tops, powder-kegs, and boxes, stew-pans, basins, cans, tubular fittings, and other articles, many of which it has been impossible to make by drawing heretofore.

What we claim as our invention, and desire to secure by Letters Patent, is—

The method of forming cupped or tubular sheet-metal articles cold, which consists, first, in flanging a flat blank by pressing it into a die-cavity while the whole surface of the blank not over the die-cavity is clamped or held; second, clamping the edges of the unflanged or bottom part of the flanged blank around the cavity of a second die of less diameter while the flange is left free; and, lastly, drawing the clamped and flanged portions between the clamping-faces and transforming them into a tubular shape by pressing the article into the cavity of the die, substantially as and for the purposes described.

In testimony whereof we have hereunto set our hands this 25th day of December, A. D. 1885.

ARCHIBALD W. PAULL.
GEORGE F. BUTTERS.

Witnesses:
W. J. QUINN,
WM. RODENBACK.