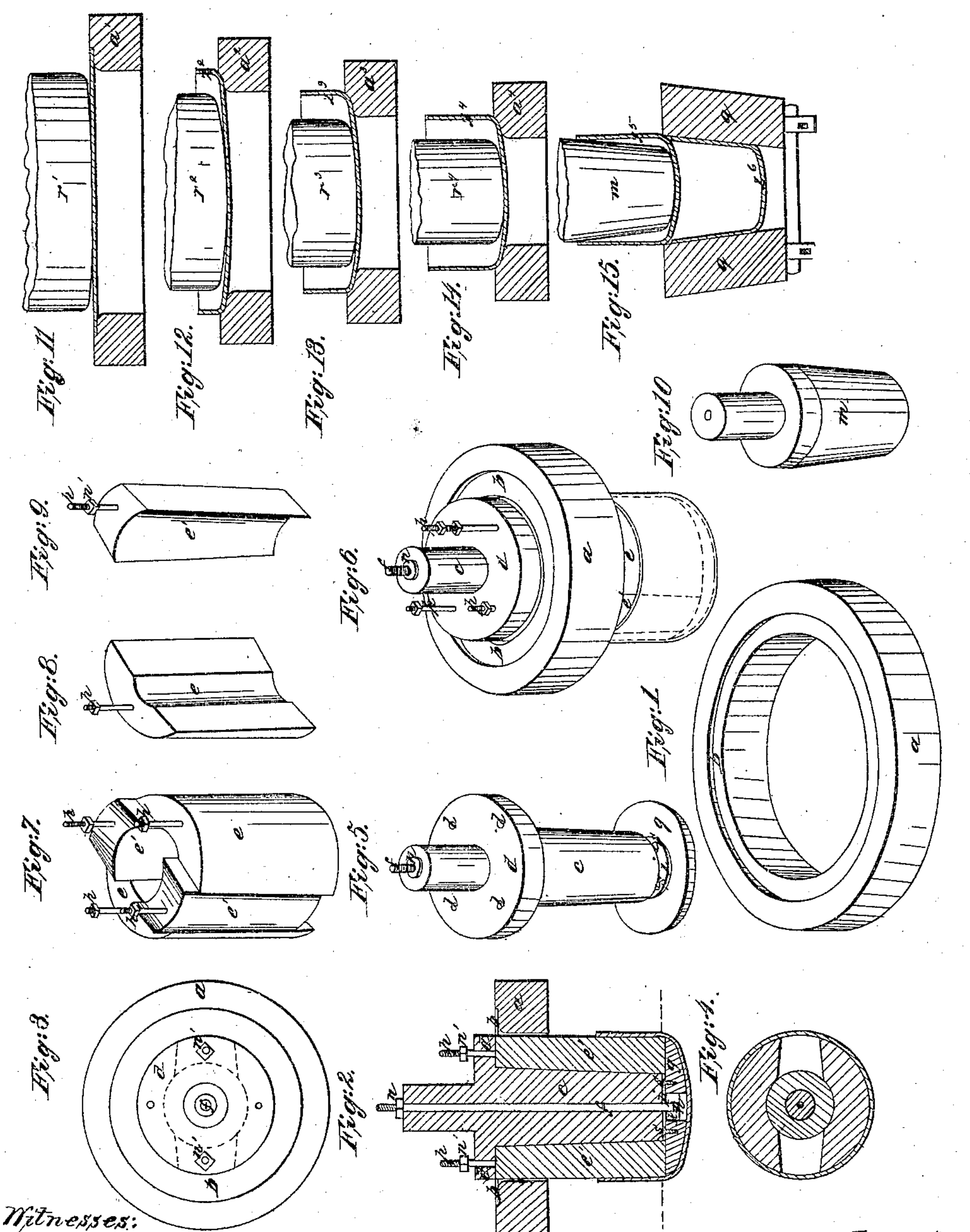
O. NEWTON.

DIE FOR MANUFACTURING BRASS KETTLES.

No. 34,374. Patented Feb. 11, 1862.



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ORRIN NEWTON, OF PITTSBURG, PENNSYLVANIA.

IMPROVEMENT IN DIES FOR MANUFACTURING BRASS KETTLES.

Specification forming part of Letters Patent No. **34,374**, dated February 11, 1862.

To all whom it may concern:

Be it known that I, ORRIN NEWTON, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in the Manufacture of Brass Kettles; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the annexed drawings, forming part of this specification.

Brass kettles have long been made without seam out of circular disks of metal, which are lengthened out radially or contracted circumferentially until they assume the required shape, which is ordinarily that of the frustum of a cone or tapered cylinder, the largest diameter being at the open end, and the bottom being slightly spherical or rounded out. These kettles were originally made by hammering out the metal to the required shape by hand; but as this process was slow and expensive the aid of machinery has been invoked to accomplish the result. There are chiefly two methods of making brass kettles by machinery—viz., the stamping or swaging process and the spinning process. The former consists in forcing the metal disk into a female die or matrix of the required shape of the article to be made by means of a male die or plunger the counterpart of the female die or matrix, or by a series of dies, where the concavity of the kettle is too great to allow of the operation being performed at once. This method is liable to very serious objections, as the metal is sure to "buckle" or wrinkle up more or less, and even if these wrinkles are by extreme pressure forced down the sides of the kettle will be thicker in some places than in others, and the metal will be stretched thin on the bottom, where it ought to be thickest. Besides this, the pressure necessarily applied is too great for the tenacity of the metal, which is apt to rend and crack, so that many disks will be used in the operation. Where the kettle is deep and the shape nearly cylindrical, the stamping or swaging process is obviously inapplicable, and even when it can be used the kettles thus manufactured are of very inferior quality. The spinning process, which is more generally adopted, consists in revolving the disk in contact with a former of the shape to be given to the disk, against which it is pressed by a tool or burnisher, which is first applied at the center of the disk, and being gradually moved outward in contact with the disk, toward its circumference, spins out the metal, causing it to assume the dished shape of the former. This process is repeated with a succession of formers, each more dished than that previously used, and the spinning operation is thus continued, until at last the kettle assumes the thimble shape desired. This method is tedious and expensive, and is liable to the objection that the kettle is made thinner at and around the bottom than on the sides, whereas the reverse should be the case. Various modifications and combinations of these two processes have been invented, which it is unnecessary to describe. In both the operations referred to it is necessary that the dies or formers, as the case may be, should have sides more or less flaring, as otherwise—that is, if the sides of the die were parallel to its axis—the metal shaped around it would bind on the male die and be difficult to remove; but by the apparatus which I employ I am able to make metallic kettles or other metallic hollow ware of cylindrical shape, if desired. My improved method of making brass kettles has all the advantages of both the processes hereinbefore referred to, without many of their disadvantages, and differs from both in this, that the metal is drawn out and not either spun or swaged, and that while the metal is lengthened radially and contracted circumferentially, this is effected more evenly and with greater uniformity than by any other plan, for the metal being always drawn in one direction—that is, outward toward the circumference of the disk—the grain of the metal is preserved far better than by either of the other processes of spinning or swaging. Another essential difference is that while by the old modes the whole disk is operated on at each step in the process and the circumferential contraction of the metal is commenced near the center of the disk, I begin near the circumference and draw out only a portion of the disk at each operation, turning up the edge all round at right angles to the disk, and gradually increasing the depth of the portion turned up, or side of the kettle, as at each successive operation I approach the center, leaving the bottom of the kettle or central part of the disk unaltered, otherwise than by giving it a slight convexity by stretching it over the bottom of the plunger, which convexity is never very great, but is slightly increased at each stage of the process as the diameter of the bottom is gradually reduced. The kettle is thus made cylindrical, or with parallel sides, until the final process by which the required flare or conical shape is given. Thus it will be seen that the bottom of the kettle is not drawn between dies at all, but preserves the same thickness as the disk from which the kettle was made, and the sides near to and around the bottom are drawn but slightly, for the drawing operation, though repeated three or four times, or oftener, if necessary, is not applied each time to the whole disk, as on each passage through the dies more of the disk is taken in than before. By these means the bottom and lower part of the sides of the kettle, where the greatest strength is required, are subjected to the slightest strain.

To enable others skilled in the art to make use of my improvement, I will proceed to describe more fully the operation of the apparatus which I employ for the purpose, as exhibited in the accompanying drawings, in which—

Figure 1 is a perspective representation of one of the annular dies used for drawing out the disk. Fig. 2 is a vertical section, through their axis, of an annular die with its plunger passed through it, and the partially-formed kettle on the bottom of the plunger. Fig. 3 is a top view of Fig. 2. Fig. 4 is a transverse section of the plunger and kettle through *x x*, Fig. 1. Fig. 5 is a perspective representation of the center piece and bottom piece of the plunger, the sides being removed. Fig. 6 is a perspective view of the plunger-die and kettle shown in section in Fig. 1. Figs. 7, 8 and 9 are representations of the side pieces of the plunger detached. Fig. 10 represents the male die for finishing the kettle. Figs. 11 to 14 are vertical sections of the dies and lower part of their plungers and the metallic disk in the several stages of the operation. Fig. 15 is a vertical section of the male and female finishing-dies.

In the several figures like letters of reference denote similar parts.

My apparatus consists of a series of annular dies, made of cast iron or steel, all being two or three inches in depth, and each die in the series being of smaller diameter than those preceding it. The cavity of each die is highly polished, and is cylindrical—that is, its sides are parallel to the axis of the annulus, so that it is of uniform diameter throughout, excepting that on the upper face of the die there is a recess in depth equal to the thickness of the metallic disk, or thereabout, the diameter of which recess is five or six inches greater than the cavity of the die.

In the drawings, Figure 1 represents one of these annular dies, *a* being the die, and *b* the recess on its upper face just referred to. Each of these dies is set in a suitable press in such a manner that so much of its plunger may pass below its lower face as that the partially-formed kettle be forced not only into but through the die. Each die has a plunger, which is cylindrical in shape, having sides parallel to its axis and to the line of its motion, and its lower extremity is slightly convex.

Fig. 2 represents a vertical sectional view of a plunger and its annular die through their axis. The diameter of each plunger is equal to the diameter of the cavity of its annular die, less twice the thickness of the metallic disk, so as to allow the plunger to pass down into the die, with the edges of the metallic disk between the die and plunger.

In Fig. 2 the space between the die and the sides of the plunger occupied by the metal disk as it passes through the die is marked *y*. The plunger is attached to a sufficiently-powerful press, and so placed in relation to the annular die that the axis of the plunger may coincide vertically with the center or axis of the annular die. The plungers must be made long enough to carry the disk entirely through the die and deliver it below, so that when the plunger is raised it leaves the metal disk or partially-formed kettle behind it; and they may be all made of the same length, so as to be conveniently used in the same press, although it is not otherwise necessary that the plungers for the first part of the operation should be so long as those used near the end. As the metal disk or partially-formed kettle, (see *z*, Fig. 2,) after being passed through one of the annular dies *a*, hugs the lower end of the plunger very closely, owing to the parallelism of its sides, and would not otherwise drop off of itself, each plunger is so constructed as that when it has passed through the die, and before it is withdrawn on the upstroke of the press by which it is worked, it contracts in diameter, and thus leaves the kettle free to fall off.

The peculiar construction of the plungers, by which the contraction just referred to is effected I will now proceed to explain. Each plunger is formed of several parts. (See Fig. 2.) A center piece, *c*, which is in shape the frustum of a cone tapering downward, forms the nucleus of each of the plungers used in the operation, and may be firmly attached to the machine or press by which the operations are performed; or, if preferred, each plunger may have its own center piece and be made complete in itself. (In this description of the plunger and dies I do not refer to those shown in Figs. 10 and 15, which are used in the last or finishing operation of making the kettle, and by which the requsite flare is given to the sides, as they are differently constructed from any of the others. These I denominate, by way of distinction, a "male" and "female" die. The center piece, *c*, has a flange or collar, *d*, projecting beyond the circumference of the conical piece *c*, between which flange *d* and the bottom piece, *g*, the side pieces, *e e' e e'* are situate, completely surrounding the center piece, *c*. The bottom piece, *g*, is a circular piece of slightly less diameter than the plunger, of which it forms a part. It has a plane surface on top, and is slightly rounded on the under side, so as to give a corresponding convexity to the bottom of the kettle. It has a circular hole, *k*, through it at its center, in which fits the button-head *h* at the bottom of the rod *f*, the outer face of the button-head being shaped to correspond with the outer surface of the bottom piece, *g*. A plate, *i*, is attached by screws *s s* to the middle of the upper or plane side of the bottom piece, *g*. This plate has a small hole in its center, through which the rod *f* passes, which extends up through a central bore in the axis of the conical center piece, *c*, as seen in Fig. 2. By this arrangement the bottom piece, *g*, is prevented from separating from the plunger, as the button-head *h* of the rod *f* cannot pass the plate *i*. The button-head *h* fits closely in the aperture *k* of the bottom piece, *g*, so that when the surface of the button-head is pressed down flush with the outer surface of the bottom piece, *g*, the bottom piece is held up against the center piece, *c*. The exterior appearance of the plunger, divested of the side pieces, *e e*, &c., is seen in perspective in Fig. 5.

When it is desired to remove the bottom piece, *g*, from the center piece, *c*, for the purpose of making the plunger larger or smaller by substituting a different set of side pieces, the screw-nut *n* at top of the rod *f* is removed, and the rod is withdrawn from below.

The side pieces *e e e′ e′* may be four in number, and of the shape shown in Figs. 7, 8, and 9. When placed together, as seen in Fig. 7, they form a hollow cylinder with parallel sides, the bore or cavity of which is conical, tapering downward, and exactly corresponding in diameter and taper with the center piece, *c*, of the plunger. These side pieces are sections of such a hollow cylinder with a tapering cavity, as just described, the planes of section not being parallel, but entering the cavity, and being slightly inclined to the axis of the cylinder, so that two of the side pieces *e′ e′* are smaller at bottom than at the top, while the two other side pieces, *e e*, are larger at the bottom than at the top. The effect of this is that when the two side pieces *e′ e′* are raised in their places above the level of the other two side pieces, *e e*, and the latter are pressed toward the former, as in Fig. 7, the diameter of the figure is reduced, and when this takes place, the side pieces being attached to the flange *d* of the plunger, the conical shape of the center piece, *c*, allows of the diametrical contraction of the plunger, so that it relieves itself of the partly-finished kettle *z*, which surrounded its lower extremity. Each of these side pieces has at its lower end a pin, *p*, projecting upward, which is passed through a corresponding hole, *l l*, in the collar or flange *d* of the plunger, as seen in Figs. 5 and 6.

By means of screw-nuts *n′ n′* on the pins *p p* of the side pieces *e′ e′* those side pieces are attached to the collar *d* of the plunger, the nuts *n′ n′* not being screwed close down onto the surface of the collar *d* for the reason hereinafter explained. By means of the nut *n* on the rod *f* the whole plunger is held together, the lower extremity of the side pieces *e′ e′* and *e e* resting on the upper face of the bottom piece, *g*, but not attached thereto. As the diameter of the bottom piece, *g*, had better be not quite as great as that of the body of the plunger, the extreme outer edges of the side pieces are rounded very slightly to make a smooth surface at the point of contact with the bottom piece.

Fig. 4 is a transverse section of the plunger (shown in Fig. 2) just above the bottom piece, *g*, showing the position of the side pieces and center piece. When it is desired to contract the diameter of the plunger after it has passed into the die, so as to relieve it of the partly-formed kettle *z*, the parts being then in the position shown in Fig. 2, the center piece is drawn up, (on the upstroke of the press,) which raises it up from the bottom piece until the collar or flange *b* presses against the nuts *n′ n′* on the pins of the side pieces *e′ e′*, thus loosening the center piece, *c*, from its side pieces *e e e′ e′*, and, owing to the conical shape of the center piece, *c*, leaving a space between it and the side pieces, which fall inward toward the center piece, thus slightly contracting the diameter of the plunger. As the center piece continues to move up the two side pieces *e′ e′* are now raised by the flange *d* pressing against the nuts *n′ n′* a little above the other side pieces, *e e*, which being left behind, resting on the bottom piece, *g*, the side pieces assume the relative position around their center piece, *c*, (shown in Fig. 7,) which still further contracts the diameter of the lower extremity of the plunger, so that the kettle *z* cannot but drop off. The side pieces used to form plungers of either greater or smaller diameter than those shown in Fig. 2 are similar, the only difference being that they are thicker or thinner, as the case may be, and the bottom piece also is of either greater or less diameter. All the sets of side pieces and bottom pieces for the various sizes of plungers are susceptible of being attached to the same center piece, *c*; but I prefer to have a separate center piece for each set of side pieces, so as to have each of the plungers to fit the various sizes of die complete in itself.

The construction and shape of the male and female dies used for finishing the kettle and giving it the requisite flaring or thimble shape are shown in Figs. 10 and 15. Fig. 10 is the male die *m*, which is in one piece, being the frustum of a cone with a slightly-convex bottom. The female die *q* is open at both ends. Its cavity is shaped like the kettle to be made in it, and, unlike the annular dies used in the preceding stages of the process, it is as deep or deeper than the kettle. The shape of the female die *q* is a counterpart of the male die, excepting that the former has no bottom. The advantage of this is that as they are both tapering the male die is not stopped in its descent until it, with the kettle around it, cannot be forced farther down, and consequently the sides of the kettle can be pressed by these dies with any amount of force which the machinery will sustain, and a very smooth and regular shape and surface are given to the sides of the kettle, the bottom not being pressed, but drawn tightly over the convex surface of the bottom of the male die.

The operation of the apparatus which I have described will be seen by reference to Figs. 11 to 15, which are vertical sections through the dies and plungers at the several stages of the operation, a portion only of the plunger being shown in each case.

In the commencement of the operation of making kettles the circular disk of brass (or other metal) is placed in the groove or recess b on the top of the first annular die in the series. (Marked a' in Fig. 11.) The diameter of the metallic disk z, it will be observed, is greater than the cavity of the annular die. This excess of diameter is to be drawn out and turned up around the plunger r'. This is done by forcing the plunger down through the annular die. The edges of the annular dies, over which the metal is drawn by the plungers, are slightly rounded, and, like the cavity of the dies, highly polished, so as to facilitate the operation and give a smooth surface to the metal. As the plunger is only less in diameter by twice the thickness of the metal than the cavity of the die, the metal which projects around the cavity is turned up around the sides of the plunger, and is drawn out very smoothly and evenly, and when the plunger r' has descended through the die a' the metal disk has assumed the shape of a shallow dish, hugging closely the bottom of the plunger. As the plunger is drawn up the sides contract, as before described, and the metal disk drops off below the die a'. Its shape after this first operation is seen at z^2 in Fig. 12. This disk, with its edge turned up all round, is then placed on a second annular die, a^2, (see Fig. 12,) the cavity of which is of smaller diameter than the preceding one. The plunger r^2 then descends, forcing the disk z^2 through and drawing out so much of the metal near the circumference as lies beyond the base or bottom of the plunger, turning up the edge of the disk still deeper and giving it a very smooth and polished surface, as before. The disk is then dropped from the plunger on its upstroke, as before described, and is removed to a third annular die, a^3, which is of still smaller diameter, (see Fig. 13,) and the process is repeated at each stage, the partly-finished kettle being forced through a more contracted die, and the edge being turned up deeper and deeper until the bottoms of the sides of the kettle are nearly as deep as is required, as at Fig. 14, when it is ready for the final operation. The shape of the kettle is then perfectly cylindrical, with a slightly-convex bottom, caused by the drawing of the metal tightly over the bottom of the plungers; but it will be observed that the bottom itself has been subjected to but comparatively slight strain, and has not been reduced in thickness, and also that that portion of the metal nearest to and around the bottom has been drawn through the die but once, so that the strongest part of the kettle is the bottom and the lowest part of the side, which is a very desirable point gained by my method of operation. The final process is to give the kettle the required flare or conical shape, which is effected by placing it on the mouth of the female die q, the diameter of which is the same as that of the cylindrical kettle. The male die is then forced down, which, pressing on the bottom of the kettle z^5, forces it into the female die q, reducing the size of the kettle at the bottom by drawing the sides upward. The metal being subjected to forcible compression between these finishing-dies, is compressed to assume the required shape z^6; but as the diameter of the cylindrical unfinished kettle, z^5, is equal to the larger diameter of the kettle when finished, z^6, there will be no tearing or rending of the metal. The mode of effecting this finishing operation is shown in Fig. 15, and the result is that the kettle receives a smooth and even surface, without any cracks, flaws, or irregularities, such as are apt to result from the swaging or spinning processes heretofore in use.

My improved method of making brass kettles and other metallic hollow ware is greatly superior to any other with which I am acquainted. Not only does it produce a better article, but the process is more expeditious than any other, and the result more certain, for by the swaging or spinning operations the metal disks are often rent or otherwise injured, so that the work bestowed on them is lost. By my method the metal is drawn out between dies, which, during the operation of drawing, compress it so closely that any buckling is impossible, and thereby an exact uniformity of thickness is secured, and the "drawing out" of the fiber of the metal being always in the same direction—that is, radially and toward the circumference of the disk—the grain of the metal is preserved, whereby the kettle is rather strengthened than weakened. Another great advantage is that the drawing of the metal is commenced near the circumference and gradually approaches the center, and that the metal is forced completely through and not merely into the dies, which is not possible unless the sides are turned up parallel to the axis of the kettle. In the swaging process the dies are conical, and the consequence is that the disk, not being sustained on both surfaces between dies, will "buckle" more or less, and the creases thus formed can only be partially removed by the pressure exerted when the dies come together, which they do only at the end of the downward stroke of the die; but by my method of drawing the disk through cylindrical dies the metal cannot possibly buckle at all, but is gradually contracted circumferentially and drawn out radially as it passes into the die.

With my apparatus kettles can be made oval as well as circular, the dies and plungers being in that case elliptical, instead of cylindrical. I am also able to make cylindrical vessels out of circular disks of metal, and the metal used may be either brass, copper, tin, or any other metal which is sufficiently ductile for the purpose. This process may be advantageously applied to making cylindrical metallic cans without seam or joint for preserving fruit and vegetables, and for making many other articles of metallic hollow ware. This method of drawing out a metallic disk by commencing at its circumference and turning the edges up at right angles to the disk I have previously applied to the manufacture of seamless caps and boxes, where the article was small and the side to be turned up not deep, and for this I obtained Letters Patent of the United States on the 22d day of May, 1860; but in that process the cylindrical plungers used were solid, which cannot be employed where the article to be made is large and the edges have to be turned up to any great depth, on account of the necessity of using cylindrical plungers and the impossibility of removing the kettle from a solid plunger of uniform diameter; but in the manufacture of brass kettles and other large articles the depth of which is great in proportion to the diameter it is necessary to provide some means of withdrawing the plunger without applying force to the article being made, and as the drawing process cannot be used unless the sides are turned up at right angles to the disk, the arrangement for relieving the plunger of the metal disk after each passage through the dies is necessary to the successful application of the drawing-out process in the manufacture of brass kettles and similar articles.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The use, in the manufacture of brass kettles and other articles of hollow ware from sheet metal, of plungers around which the metal is worked, so constructed as to contract when the plunger is withdrawn, in combination with annular dies, for the purpose of drawing out the metallic sheets into the required shape, substantially in the manner and for the purposes hereinbefore set forth.

2. The combination of a conical center piece, *c*, and corresponding side pieces *e e e' e'*, and bottom piece, *g*, to form a plunger for drawing or pressing sheet metal in or through dies, so that the diameter of the plunger will contract to allow of its being easily withdrawn from the metal on which it is operating, or from the dies into or through which it was forced, substantially as described.

In testimony whereof I, the said ORRIN NEWTON, have hereunto set my hand in presence of witnesses.

ORRIN NEWTON.

Witnesses:

M. G. CUSHING,

A. S. NICHOLSON.