June 11, 1935. E. KLEINMANN ET AL 2,004,555

METHOD AND APPARATUS FOR THE MANUFACTURE OF ELECTRICAL CONTACT PLUGS

Filed Sept. 2, 1933 4 Sheets-Sheet 1

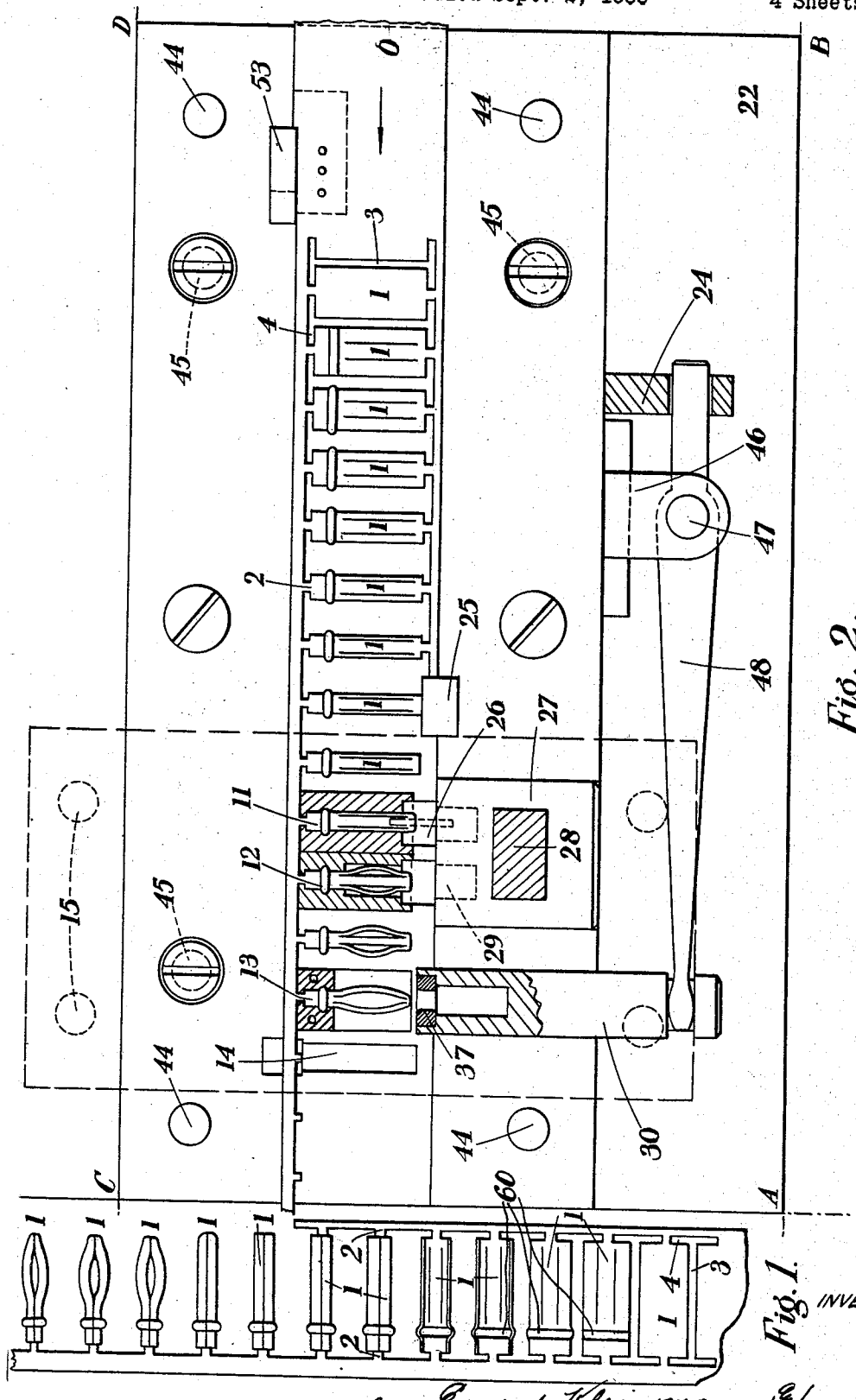


Fig. 2.

Fig. 1.

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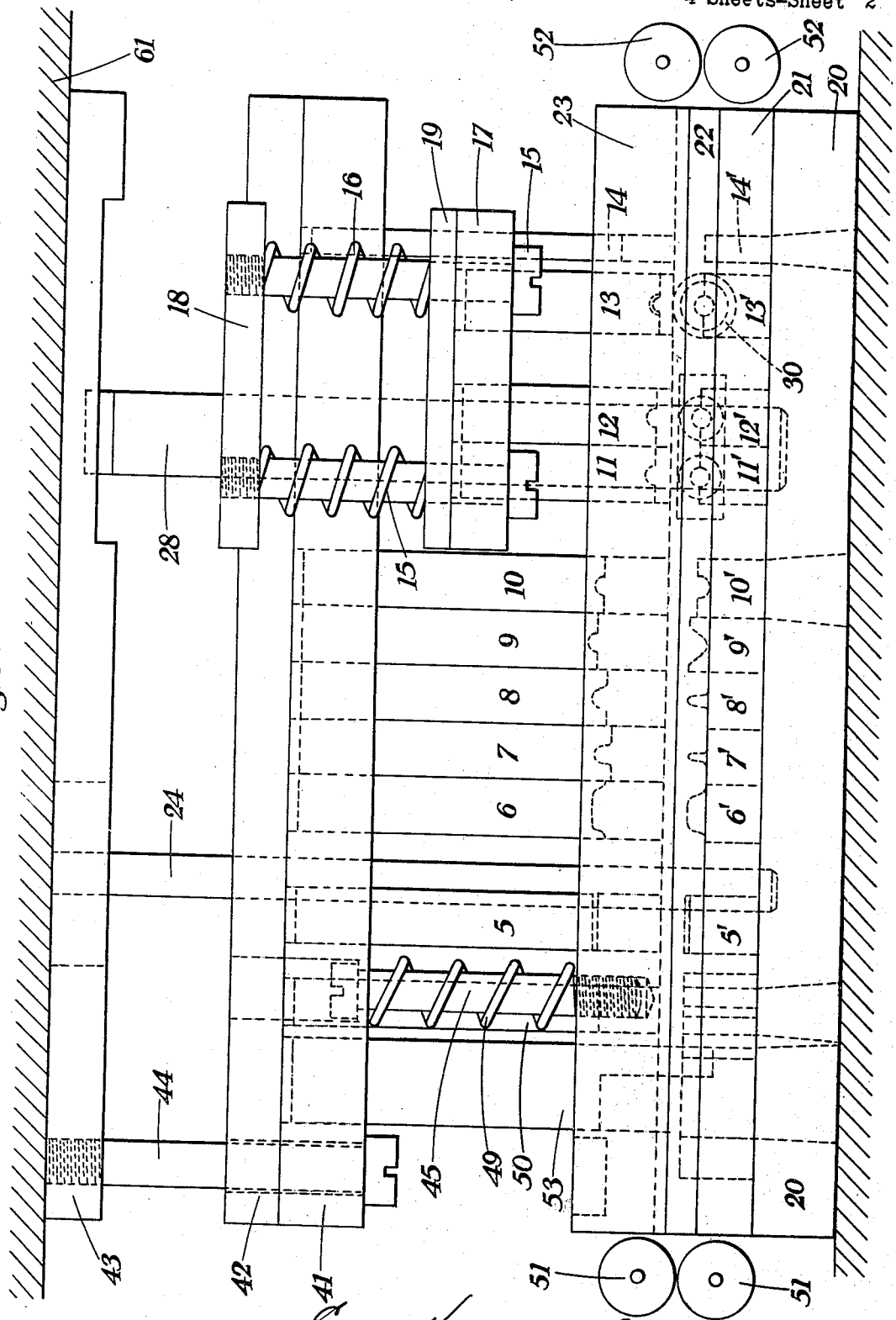


Fig. 3.

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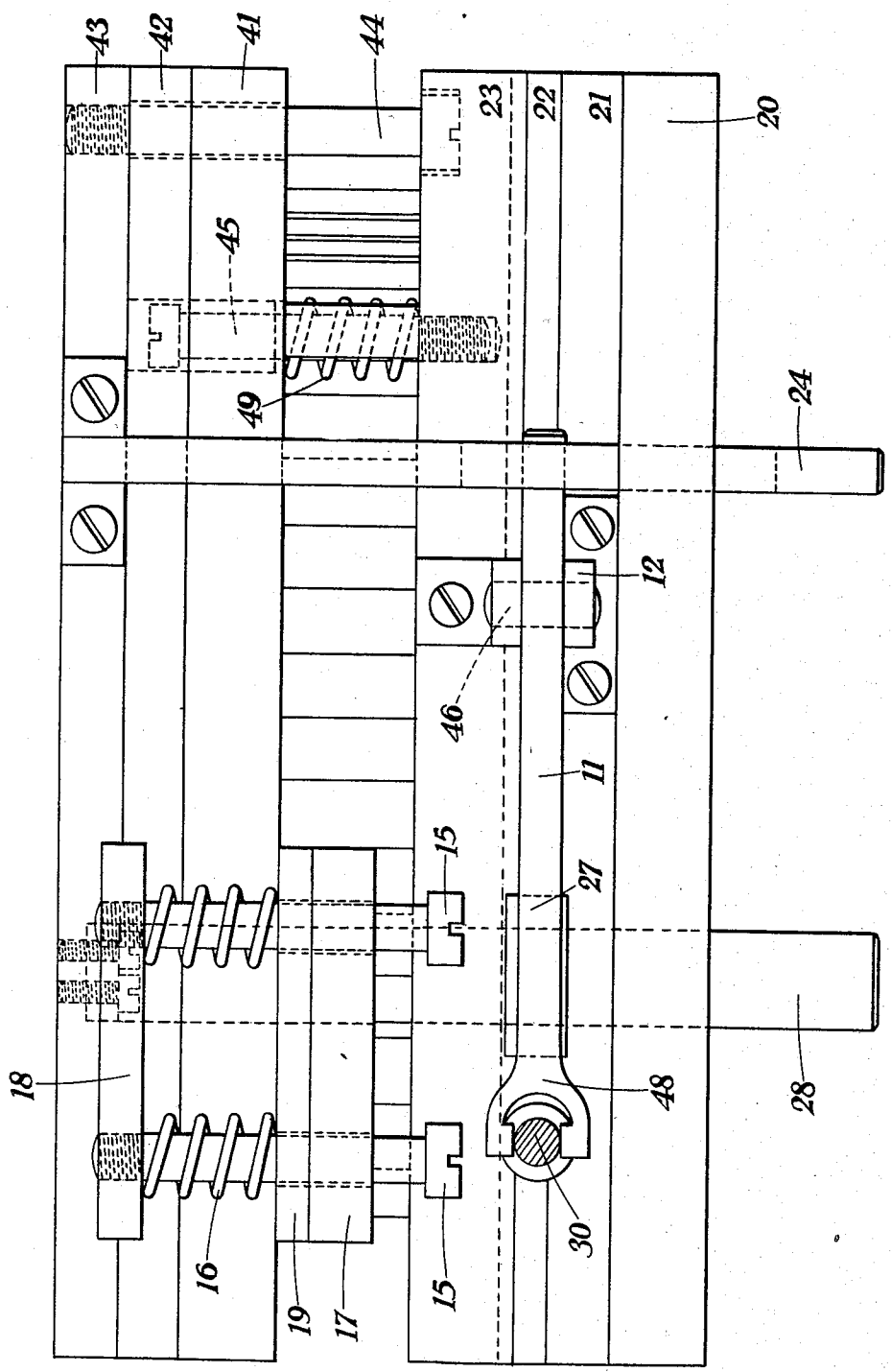
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June 11, 1935. E. KLEINMANN ET AL 2,004,555

METHOD AND APPARATUS FOR THE MANUFACTURE OF ELECTRICAL CONTACT PLUGS

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Fig. 4.



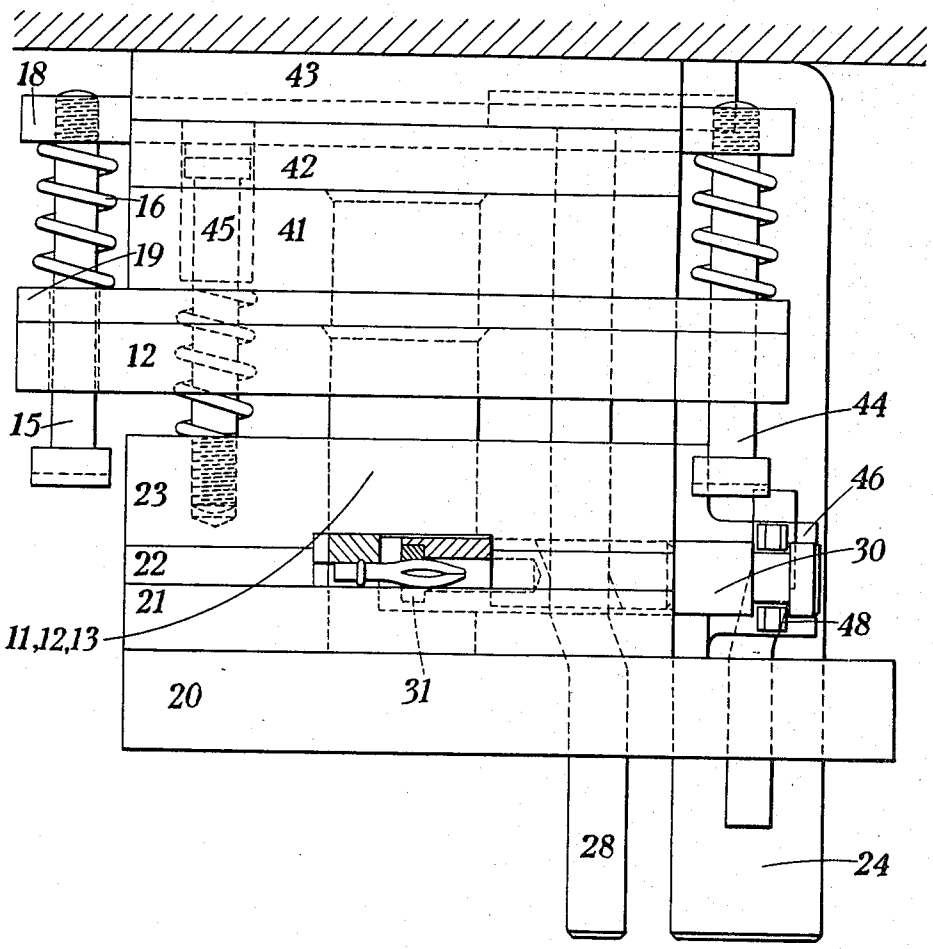
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Fig. 5.



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METHOD AND APPARATUS FOR THE MANUFACTURE OF ELECTRICAL CONTACT PLUGS

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Application September 2, 1933, Serial No. 688,043

19 Claims. (Cl. 153—2)

This invention relates to methods of and apparatus for the manufacture of electrical contact plugs or pins such as are commonly employed in electron discharge tubes or elsewhere where electrical connection is to be made with a socket. Such plugs or pins are now commonly made in what is called banana shape; that is, they are substantially cylindrical but are bulged outwards between their ends so as to enable them to make resilient contact with the sockets into which they are inserted. The invention has for its chief object to provide a method of and apparatus for the rapid and cheap manufacture of such banana plugs.

According to the invention, the plugs are made from a metal strip which is stamped so as to form a series of pieces, each of a size and shape suitable for one plug, these pieces remaining attached to the strip along part of each of two opposite ends, and the pieces are then successively acted upon to bend them into cylindrical form, detach them from the sheet at one end and then to compress them axially before detaching them at the other end to complete the bulged plugs. The bending is preferably carried out gradually by a series of operations. The pieces will usually be of a rectangular form that remain attached to the strip by a small fillet at the middle of each of the shorter sides and the long sides bent round towards one another without the use of a mandrel to form the cylinder; and slits parallel to the longer sides but not extending to the shorter sides will usually be formed in the pieces before bulging and preferably on or just after, stamping to form the pieces. The invention also includes apparatus by means of which the method may be carried out as well as other features that will be hereinafter referred to and claimed.

In order that the invention may be clearly understood and readily carried into effect, it will now be more fully described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a plan of a strip of sheet metal illustrating the method of making banana plugs according to the invention.

Figure 2 is a plan, partly in section, of apparatus for carrying out the method illustrated in Figure 1.

Figure 3 is one side elevation of the apparatus of Figure 2, the tools comprised in it being shown in their elevated position.

Figure 4 is the other side elevation of the apparatus of Figure 2, the tools being shown in their lowest position.

Figure 5 is an end elevation of the apparatus of Figure 2, the tools being again shown in their lowest position.

Referring first to Figure 1, **0** denotes the strip of sheet metal from which the banana plugs are to be made. The width of this strip is slightly larger than the length of the plugs to be made. Double-T-shaped openings **3** and **4** are punched in the strip so as to form a series of pieces **1** each of the appropriate size for forming a single plug, these pieces remaining joined at the mid-point of each end to the remainder of the strip **0** by the lugs or fillets **2**. The pieces are rectangular. The punching of the double-T-shaped openings is followed by an operation in which two parallel slits are stamped in the sheets. These are for the purpose of giving added resiliency to the plugs. These slits extend from a point near one end of the piece to a point just short of the extensions just referred to. The slit piece **1** is then rolled into cylindrical form. This is done in a succession of steps in which the unsecured or longer sides of the pieces are bent first so that the sheet has semi-cylindrical form and is then acted upon so that the free edges touch to form a closed cylinder. The lug and the remaining part of the metal strip adjacent it is then cut away from one end of the cylinder so that one end is free as shown just above the middle of Figure 1. The free end of each cylinder is then turned slightly inwards as shown by the fourth plug from the top of Figure 1. The cylinder is then compressed axially to cause the plug to bulge at its middle. Subsequently the plugs may be gauged in order to ensure that they conform to the required dimensions as shown at the top of Figure 1, after which the remaining lug is cut and the finished plug allowed to fall into a collecting container.

Apparatus for continuously carrying out the steps just described is illustrated in Figures 2–5 of the accompanying drawings. The tool executes all the operations necessary for the production of a banana plug according to the method just described with reference to Figure 1. The formation of the T-shaped slots to form the pieces **1** is effected by means of the punch **50**. The punch **5**, which co-operates with the die **5'**, forms the slits and also produces the bead **60**. Bending of the pieces **1** into cylindrical form is effected in five stages by means of the punches **6—10**, which co-operate with the dies **6'—10'** respectively. The cutting of the lug at one end of the cylinder, formed by the punches and dies just referred to, is effected by the device **25** (Figure 2)

which is arranged behind the punch 10 as seen in Figure 3 and comes into operation when the punch 10 and die 10' have performed their operation. The cupping of the end of the cylinder tube which is left free as a result of the cutting away of the lug by the device 25, is effected by the punch 26 which operates on the end of the longitudinally slit cylindrical tube 1 while it is gripped in the dies 11, 11'. The axial compression of the slit cylinder as a result of which it is turned into a banana plug, is effected by the punch 29 which acts on the projecting end of the plug while it is gripped by the beaded end in the dies 12, 12'. Gauging of the banana plug is effected by means of the die 30 which is pushed over the already formed banana plug while it is gripped by the beaded end in the dies 13, 13'. The banana plug is cut off from the remaining portion of the metal strip by the device 14, 14'. The joints between the dies 11, 12, 13 and 14, and 11', 12', 13' and 14' are horizontally arranged in a horizontal plane, being carried in the plate 21 which rests on the base plate 20, and the metal strip 0 is fed over them in step-by-step manner by the pairs of rollers 51 and 52. The strip is correctly positioned at the end of each step by the punch 53 which cuts away a portion of one edge of the strip at each step, the strip being positioned by virtue of the coming into contact of the step thus formed in it with the side of the punch. The punches 53, 50, 5, 6, 7, 8, 9, 10, and the device 14 are mounted at their upper ends in a plate 41. Their upper ends have overhanging enlargements that are received in corresponding recesses in the top of the plate 41 and they are secured in position in it by a plate 42 secured on top of it. The dies 11, 12, 13 are similarly carried at their upper ends in a plate 17 and secured in this plate by a plate 19. The plates 19 and 17 are slidably carried on two vertically arranged bolts 15, the upper ends of which are screwed into a plate 18 fixed on to and projecting over the side of the plate 42. The plates 19 and 17 are resiliently urged downwards against the heads of the bolts 15 by springs 16.

The plates 41 and 42 are arranged to slide vertically on bolts 45. They are urged upwards by springs 49 surrounding the bolts 45, which springs are able to displace them in that direction until the heads of the bolts 45 come into contact with the bottoms of recesses in the plates 42 and 41. The plates 41 and 42 are also connected to an upper plate 43 by the bolts 44, the ends of which are screwed into the plate 43, the shanks passing through the plates 41 and 42 and their heads being situated on the side of the plate 41 remote from plate 43. The apparatus is mounted in a press with the base plate 20 on the bed 60 of the press, the plate 43 being engaged by the press ram 61. The plate 43 carries two cam members 24 and 28 (see Figures 2 and 5). Each is in the form of a vertical member which moves down with the member 43. The member 28 has a kink at a point in its length and passes through an opening in the slide member 27, the face of which carries the two dies 26 and 29 the former of which cooperates with the dies 11—11' to cup the free end of the cylinder, while the latter cooperates with the dies 12 and 12' to compress the cylinders axially to bulge them, the cam member 28, on moving down, causing the members 26 and 29 to be forced against the ends of the cylinders gripped in the two pairs of dies 11, 11' and 12, 12'. The cam member 24 has a similarly kinked vertical opening into which projects the end of a lever 48 pivoted at 47 in a bearing 46. The other end of the lever engages a plunger 30, the end of which carries a gauge 31. On downward movement of the cam member 24 the plunger 30 is slidden so that the gauge 31 passes over the bulged cylinder that is gripped by its neck in the dies 13, 13' to ensure that the extent of bulging of all the cylinders is uniform. When the plate 43 is moved down, it first takes up the plate 42 and the plate 18 and moves them down against the action of the springs 49. The arrangement is such that the dies 11, 12 and 13 reach the dies 11', 12' and 13' to grip the cylinders positioned between them before the punches 50 and 5 to 10 come into operation. On further downward motion of the plate 42, the plates 17 and 19 and the dies 11, 12 and 13 carried by them remain stationary, the springs 16 being then compressed, and the punches 50 and 5 to 10 then all act on the metal strip, and the dies 26 and 29 and the gauge 37 come into operation.

In the continuous production of the plugs the plate 43 is reciprocated vertically and the metal strip is fed into the apparatus in a step-by-step manner. On each reciprocation of the plate 43, the punch 53 is the first tool to come into operation. It cuts away a portion of one edge of the strip and the contact with its side of the ledge so formed ensures that the metal strip remains arrested in the proper position during the rest of the downward stroke of the plate 43 and on its upward stroke until the punch 53 is clear of the strip. On being fed in, the strip is acted upon by the punch 50 which punches the double-T-shaped openings and forms the slits. On the next step of the metal strip the piece formed by the punch 50 comes into position between the punch 5 and die 5' which form the bead 60 on it. On the next five steps the piece comes between the punches and dies 6 and 6', 7 and 7', 8 and 8', 9 and 9', 10 and 10' successively whereby the gradual bending round of the longer sides of the piece is effected to form a cylinder. On the next effective step of the strip, the cylinder is dealt with by the dies 11, 11' and 26, whereby its end is cupped; on the next by the dies 12, 12' and 29, whereby it is bulged; then by the dies 13, 13' and gauge 37; and finally is cut off by the device 14, 14' to form the finished bulged contact plug. When once the entering end of the metal strip has reached the device 14, 14', all the tools perform an effective operation on each stroke of the plate 43, and a finished plug is produced at each stroke.

It is to be understood that the claims are not limited to the method described or to the construction shown in the drawings since clearly modifications may be made and, therefore, the claims are intended to be construed to cover all such modifications as their language will allow in the light of the prior art.

We claim:—

1. A method for the manufacture of a bulged electrical contact plug consisting in stamping a metal sheet so as to form a piece of the appropriate shape that remains attached along part of each of two opposite ends to said sheet, bending said piece into cylindrical form while it remains attached to said sheet at both ends, then detaching it from said sheet at one end, subsequently compressing the cylinder axially to bulge it and then detaching it at the other end.

2. A method for the manufacture of a bulged electrical contact plug consisting in punching

double T-shaped openings in a metal sheet so as to form an appropriately-shaped piece that remains attached at the middle of each of its two opposite ends to said sheet, bending said piece into cylindrical form while it remains attached to said sheet at both ends, then detaching it from said sheet at one end, subsequently compressing the cylinder axially to bulge it and then detaching it at the other end.

3. A method for the manufacture of a bulged electrical contact plug consisting in stamping a metal sheet so as to form a piece of the appropriate shape that remains attached along part of each of two opposite ends to said sheet, forming slits in said piece, said slits extending at right angles to said ends but not reaching them, bending said piece into cylindrical form while it remains attached to said sheet at both ends, then detaching it from said sheet at one end, subsequently compressing the cylinder axially to bulge it, and then detaching it at the other end.

4. A method for the continuous manufacture of bulged electrical contact plugs consisting in punching a series of openings in a metal strip of appropriate width, said openings being so spaced and shaped as to form a series of pieces each of a shape suitable for one plug, each of said pieces remaining attached at the middle of each of its two ends to said strip, bending said pieces in turn into cylindrical form while they remain attached to said strip at both ends, then detaching the cylinders from said strip at one end, compressing them axially to bulge them, and then detaching them at the other end.

5. A method for the continuous manufacture of bulged electrical contact plugs consisting in stamping a series of double T-shaped openings in a metal strip of appropriate width so as to form a series of substantially rectangular pieces each of a size suitable for one plug and so that each of said pieces remains attached to said strip by a short fillet at the middle of each of its shorter sides, forming slits in each of said rectangular pieces, said slits extending parallel to the longer sides of said pieces without reaching either of the shorter sides, bending said longer sides round towards one another to form a cylinder while said piece remains attached to said strip by both said fillets, then detaching the cylinders from said strip at one end, compressing them axially to bulge them and then detaching them at the other end.

6. A method for the continuous manufacture of bulged electrical contact plugs consisting in stamping a series of double T-shaped openings in a metal strip of appropriate width so as to form a series of substantially rectangular pieces each of a size suitable for one plug and so that each of said pieces remains attached to said strip by a short fillet at the middle of each of its shorter sides, forming slits in each of said rectangular pieces, said slits extending parallel to the longer sides of said pieces without reaching either of the shorter sides, forming a bead in each of said pieces adjacent one of said shorter sides and extending parallel thereto, bending said longer sides round towards one another to form a cylinder while said piece remains attached to said strip by both said fillets, then detaching the cylinders from said strip at the end remote from said bead, gripping said cylinders by their beaded ends and acting on the other ends to compress them axially to bulge them and then detaching them at the other end.

7. A method for the manufacture of bulged electrical contact plugs according to claim 6, in which the ends of said cylinders remote from said beads are cupped inwards before said cylinders are bulged.

8. Apparatus for the continuous production of bulged electrical contact plugs from a moving sheet metal strip comprising means for punching a series of openings in said strip so as to form pieces of appropriate shape that remain attached to said strip along part of each of two opposite ends, and a series of tools for acting on said pieces successively and operative to bend them step by step into cylindrical form while they remain attached to said strip at both ends, to detach the cylinders from said strip at one end, to compress the cylinders axially to bulge them and then to detach the bulged cylinders at the other end.

9. Apparatus for the continuous production of bulged electrical contact plugs from a sheet metal strip according to claim 8 and including means for feeding said strip in a step-by-step manner when said tools are elevated, said punching means and said series of tools being mounted so as to reciprocate together and all being adapted to act on said strip during each stroke.

10. Apparatus for the continuous production of bulged electrical contact plugs from a sheet metal strip according to claim 8, in which said series of tools includes a plurality of tools for acting on said pieces to bend them gradually into cylindrical form without the use of a mandrel.

11. Apparatus for the continuous production of bulged electrical contact plugs from a sheet metal strip according to claim 8, and including means for forming slits in said pieces before bulging, said slits extending at right angles to said two opposite ends without reaching either of them.

12. Apparatus for the continuous production of bulged electrical contact plugs from a sheet metal strip according to claim 8, and including means for cupping inwards the one detached end of said cylinders.

13. Apparatus for the continuous production of bulged electrical contact plugs from a sheet metal strip according to claim 8, and including means for forming a bead in each of said pieces parallel to and adjacent the end remote from that subsequently first detached from said strip.

14. Apparatus for the continuous production of bulged electrical contact plugs from a sheet metal strip according to claim 8, and including means for gauging said bulged cylinders before they are separated from said strip.

15. Apparatus for the continuous production of bulged electrical contact plugs from a sheet metal strip according to claim 8, and including means for gripping each of said cylinders by the attached end after the other end has been detached from said sheet, and a device for acting on said other end to compress said cylinder axially to bulge it.

16. Apparatus for the continuous production of bulged electrical contact plugs from a sheet metal strip according to claim 8, and including means for gripping each of said cylinders after one end has been detached from said sheet so that the other end projects from said means, and a die for acting on said other end to cup it inwardly.

17. Apparatus for the continuous production of bulged electrical contact plugs from a sheet metal strip comprising means for feeding said strip in a step-by-step manner, means for punching an opening in said strip at each step so as to form a series of pieces of appropriate shape

that remain attached to said strip along part of each of two opposite ends, a series of tools for subsequently acting in turn on said pieces to bend them into cylindrical form while they remain attached to said strip at both ends, to detach the cylinders from said strip at one end, to compress the cylinders axially to bulge them and then to detach the bulged cylinders at the other end, and means for punching said strip to arrest it in position to be acted upon by said first-mentioned punching means and said tools, both said punching means and said series of tools being mounted so as to reciprocate together and all being adapted to act on said strip during each stroke.

18. Apparatus for the continuous production of bulged electrical contact plugs from a sheet metal strip according to claim 8, including means for feeding said strip in a step-by-step manner to said punching means and said tools, and in which said punching means and said tools comprise a series of punches and dies, all of said dies being arranged in line and said strip being fed over them, and all of said punches being mounted on a single reciprocatory member for movement towards and away from said dies together.

19. Apparatus for the continuous production of bulged electrical contact plugs from a sheet metal strip according to claim 8, including means for feeding said strip in a step-by-step manner to said punching means and said tools, a split die for gripping said attached end of each of said cylinders during axial compression, a device for acting on the detached end to compress said cylinder axially to bulge them, and in which said punching means and said tools comprise a series of punches and dies, all of said last-mentioned dies and half of said split die being arranged in line and said strip being fed over them, and all of said punches and the other half of said split die being mounted on a single reciprocatory member for movement together towards and away from said dies and half die, said other half die being so mounted as to come into operation to grip said cylinders before the coming into operation of said punches, and said reciprocatory member carrying a cam for operating said device to effect axial compression after said cylinders have been gripped by said split die.

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