Jan. 27, 1948. H. M. BURT ET AL 2,434,905

METHOD OF FABRICATING CONTACTS FOR FLUORESCENT STARTER SWITCHES

Filed July 8, 1944 4 Sheets-Sheet 1

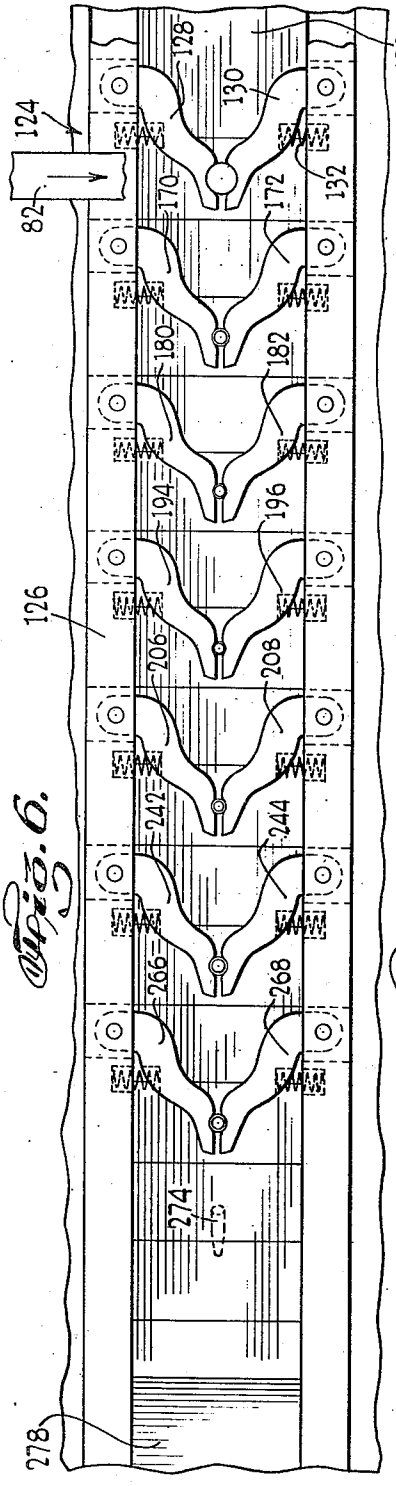


Fig. 6.

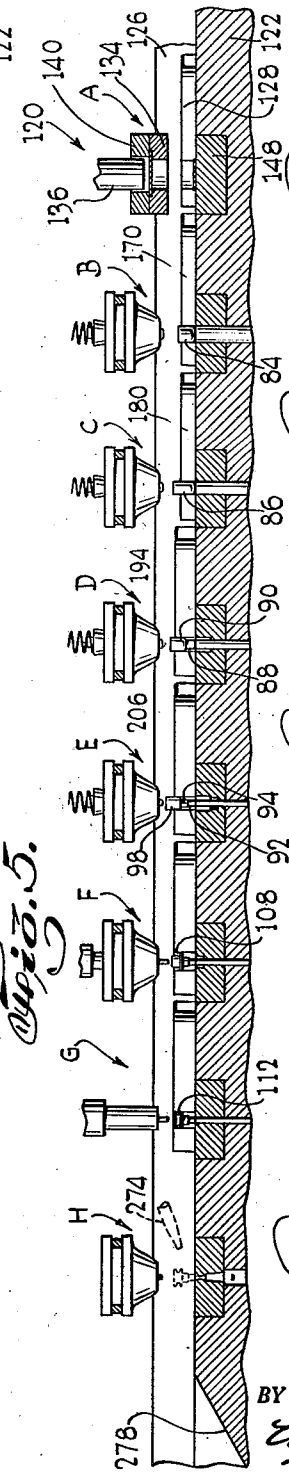


Fig. 5.

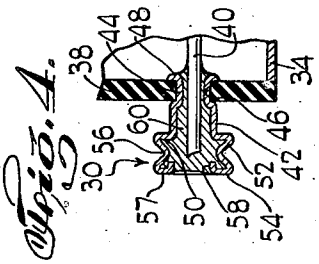


Fig. 4.

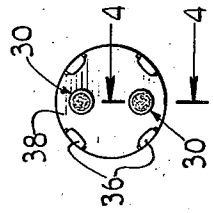


Fig. 3.

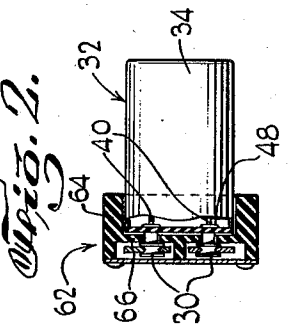


Fig. 2.

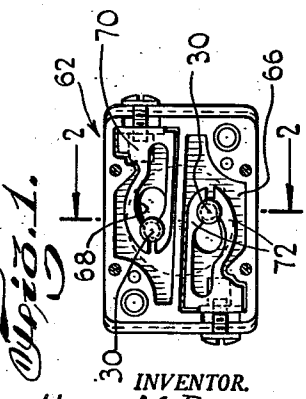


Fig. 1.

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METHOD OF FABRICATING CONTACTS FOR FLUORESCENT STARTER SWITCHES

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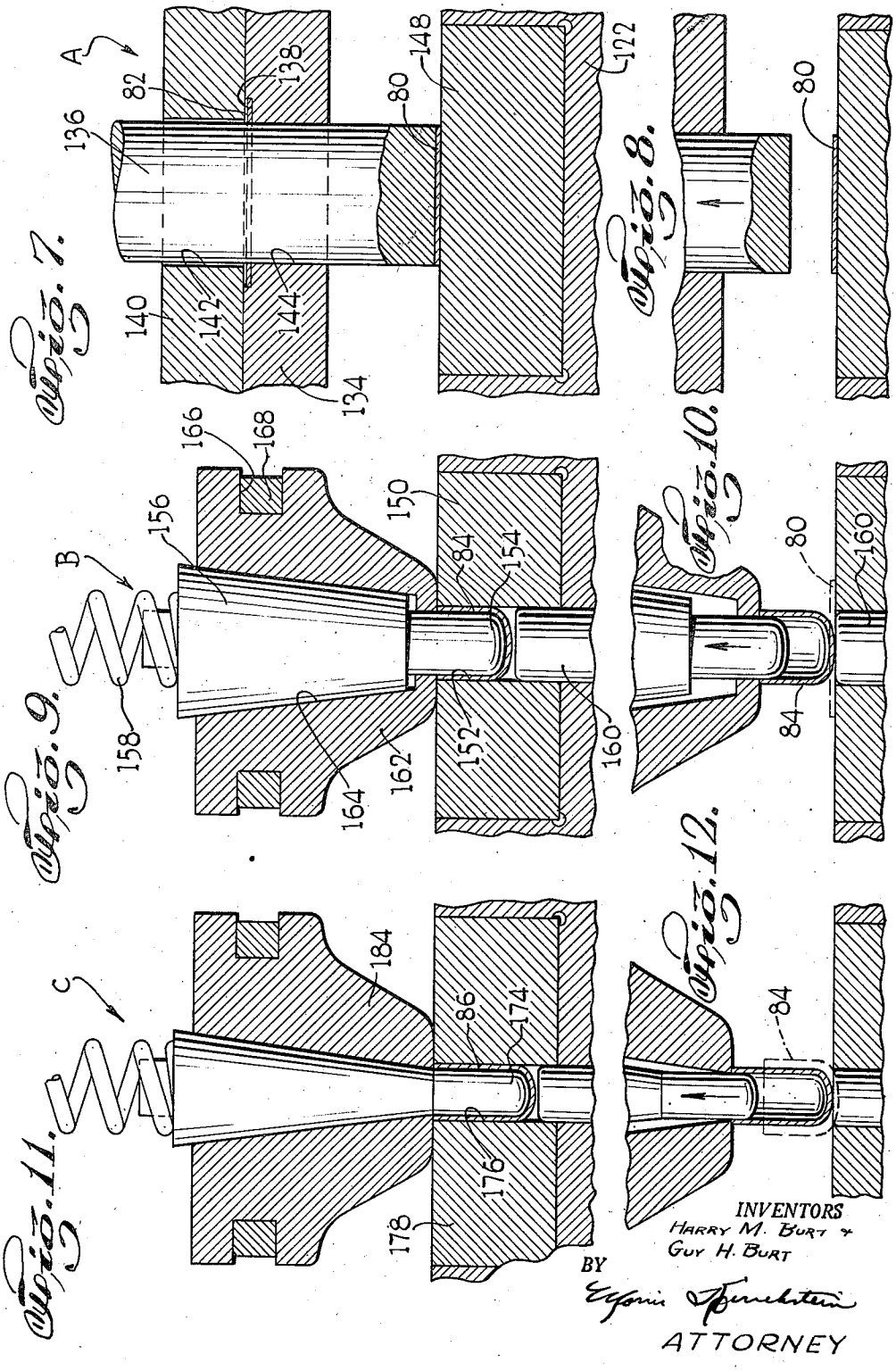


Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

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METHOD OF FABRICATING CONTACTS FOR FLUORESCENT STARTER SWITCHES

Filed July 8, 1944 4 Sheets-Sheet 3

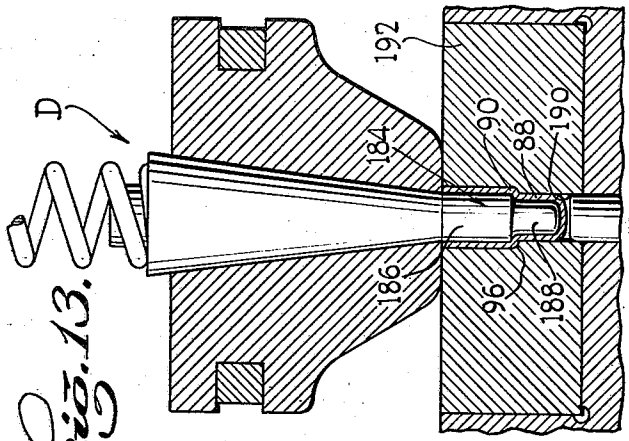


Fig. 13.

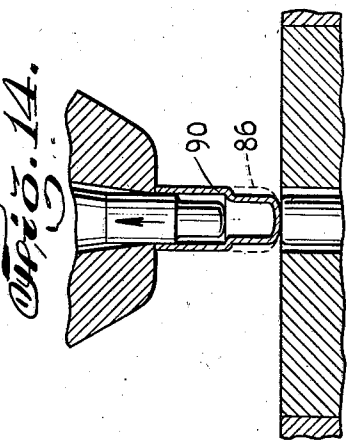


Fig. 14.

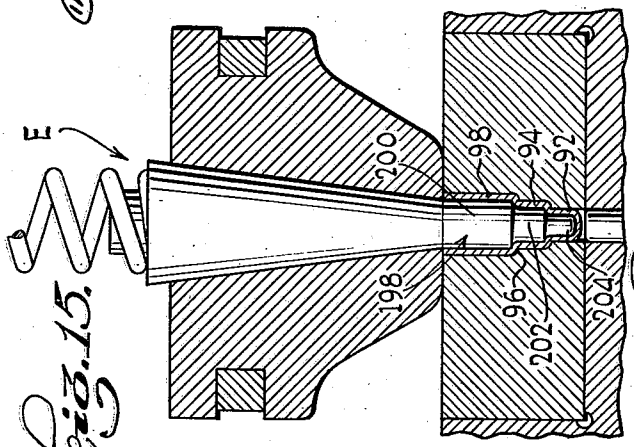


Fig. 15.

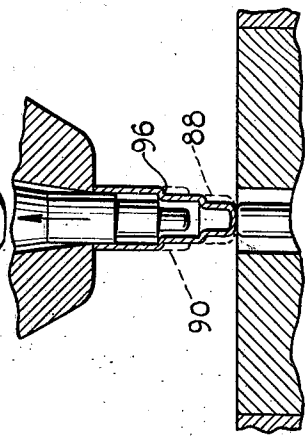


Fig. 16.

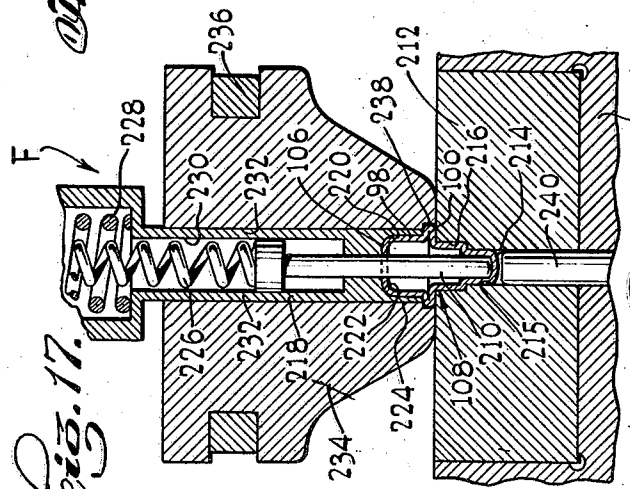


Fig. 17.

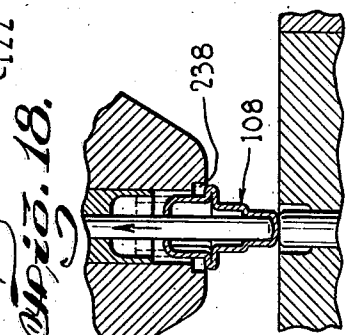


Fig. 18.

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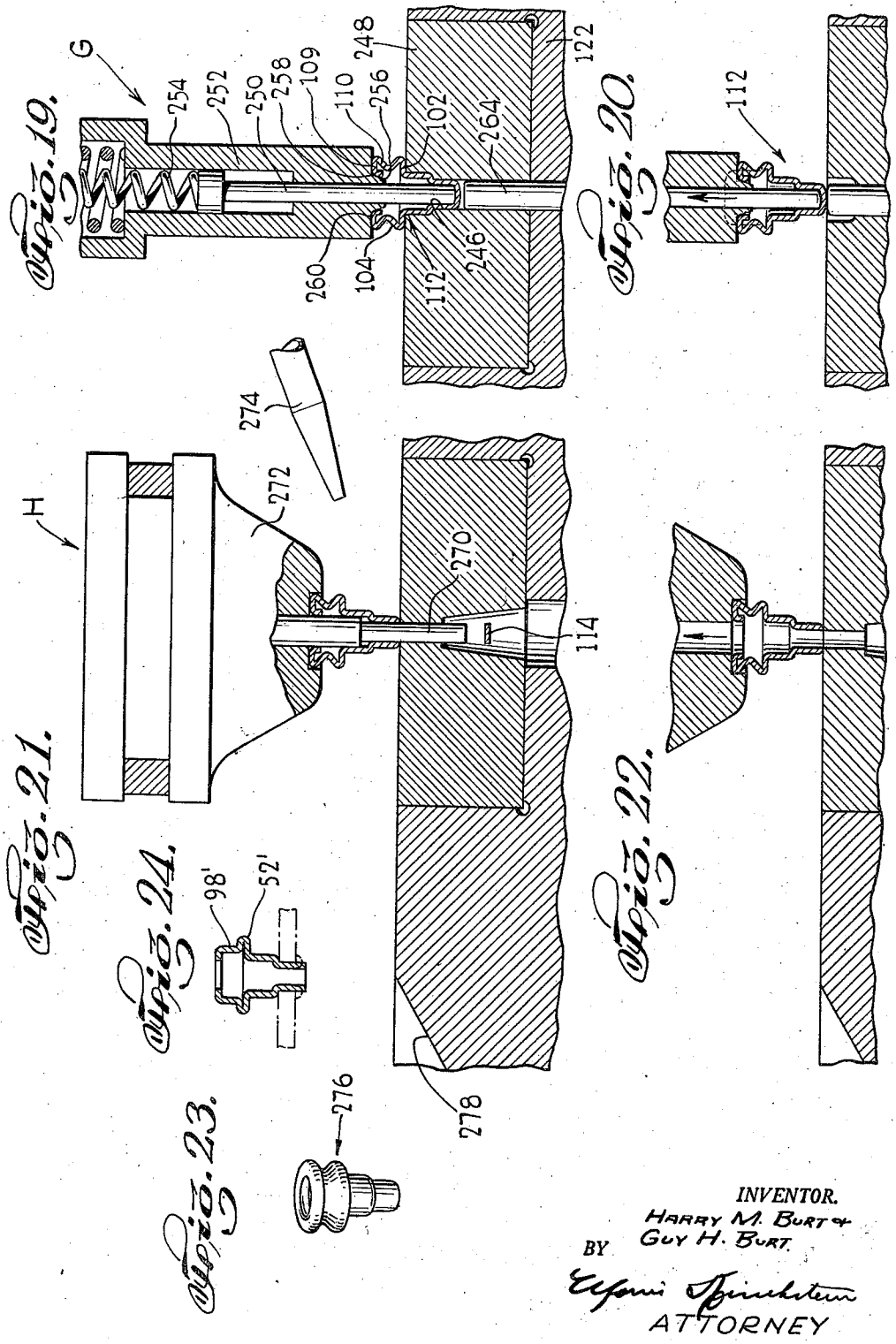
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METHOD OF FABRICATING CONTACTS FOR FLUORESCENT STARTER SWITCHES

Filed July 8, 1944 4 Sheets-Sheet 4



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2,434,905

UNITED STATES PATENT OFFICE

2,434,905

METHOD OF FABRICATING CONTACTS FOR FLUORESCENT STARTER SWITCHES

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Application July 8, 1944, Serial No. 544,120

5 Claims. (Cl. 113—119)

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This invention relates to a method of fabricating electrical contacts for fluorescent starter. More particularly, the invention is concerned with contacts of the character described which are fabricated from sheet metal stock, the term "sheet metal" being used herein to include flat, bent, curved, tubular and variously shaped lengths and pieces of thin self-form-maintaining material.

Heretofore, contacts for starter switches have been fabricated conventionally, by turning down solid metal stock, for example, by removing metal from a section of a rod in a screw machine, to impart the desired shape thereto. This practice has been assiduously followed due, principally, to the peculiar shape of most starter switch contacts. Such shape consists of (1) a cylindrical shank long enough to extend through the base of a starter switch socket, (2) a cylindrical extension on one end of the shank of smaller diameter than the shank and long enough to project through a starter switch base with its free end upset into engagement therewith, and (3) a pair of transverse spaced flanges at the other end of the shank to couple with a resilient blade in the socket and secure the starter switch against undesired displacement. The flange intermediate the ends of the contact has been the principal reason heretofore for making said contacts by machining. In some contacts, an axial bore is provided into which an electric lead from the interior of the switch may be inserted and secured by the introduction of fusible electrically conductive material, e. g., solder, from the outside of the switch. In solid contacts, the tubular extension is recessed to facilitate upsetting and making an electric connection to the starter switch.

The formation of these contacts by metal removing operations has been attended by substantial expense because much of the solid stock had to be removed when forming a contact. This entailed the purchase of metal which eventually had to be removed as scrap in expensive machining operations.

It is an object of the present invention to provide a method for manufacturing an intermediately flanged contact such as described in which the major portion of the scrap, if any, is removed, before the contact is formed, by a simple operation, such as shearing, to provide a work blank which can be fabricated into the desired shape with the subsequent removal of little or no scrap.

Another object of the invention is to provide a method for manufacturing a sheet metal contact of the character described on an economical, rapid, mass-production basis.

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Other objects of this invention will in part be obvious and in part hereinafter pointed out.

The invention accordingly consists in the features of construction, combinations of elements, arrangement of parts and performance of operations which will be exemplified in the constructions and methods hereinafter described, and of which the scope of application will be indicated in the appended claims.

In the accompanying drawings, in which are shown various possible embodiments of this invention and wherein like numbers refer to like parts,

Fig. 1 is a bottom plan view of a starter switch socket having disposed therein a starter switch with contacts made in accordance with our invention;

Fig. 2 is a sectional view taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a bottom plan view of the switch alone;

Fig. 4 is an enlarged sectional view of the novel switch contact, taken substantially along the line 4—4 of Fig. 3;

Fig. 5 is a side elevational view in partial section of an eyelet machine tooled up to make said contact;

Fig. 6 is a plan view of the bed of the machine;

Figs. 7 and 8 are enlarged fragmentary sectional views of the blanking dies at successive stages of their operation;

Figs. 9 and 10 are similar views of the cup forming dies;

Figs. 11 and 12 are similar views of the deep drawing dies;

Figs. 13 and 14 are similar views of the two-step forming dies;

Figs. 15 and 16 are similar views of the three-step forming dies;

Figs. 17 and 18 are similar views of the intermediate flange forming dies;

Figs. 19 and 20 are similar views of the top flange forming dies;

Figs. 21 and 22 are similar views of the piercing dies;

Fig. 23 is a perspective view of a fully formed sheet metal contact made in accordance with our invention; and

Fig. 24 is a view similar to Fig. 4 of a modified form of sheet metal contact likewise made in accordance with the invention and in which the only flange is one intermediate the ends of the contact.

In general, we carry out the stated objects of

the invention by first forming a sheet metal tube in any conventional manner, for example, by cupping and deep drawing, extrusion, or any well known tube forming method. A tubular element, or portion of the tube having a length corresponding to that of the tubular element, is then operated upon to impart thereto a shape consisting of a plurality of integrally connected coaxial tubular steps of different diameters, that is, in each tubular element at least two tubular steps of uniform diameter are provided, adjacent steps being of different diameters. If three steps are employed, the slenderest step may have a length and diameter corresponding to the tubular extension (2) which is used to secure the contact to a starter switch. The step of intermediate breadth may have a diameter and length the same as that of the hollow tubular shank (1) in the finished contact. The tubular step of greatest diameter may have a length such that when further operated upon to provide the necessary flange or flanges, the contact will be of the right overall length. The difference in diameters between the second and third steps provides a shoulder intermediate the two steps which enables us to form the intermediate flange in a novel manner.

After the tubular element or portion consisting of a plurality of tubular steps is formed, one of the steps, and preferably the larger of two adjacent steps, is axially compressed against an abutment member at the shoulder between said two steps. During this compression, the portion of the tubular element spaced from the shoulder is laterally, externally supported, leaving only a short portion, no greater than the diameter of the step, adjoining the shoulder laterally unsupported. The overall length of the laterally supported and unsupported portions of the compressed step is so proportioned relative to the diameter of said step, that this step will act as a pure compression member rather than as a column under axial compression and will tend to bulge outwardly rather than buckle, particularly when partially laterally supported as described. We prefer for this ratio of length to diameter of the compressed step not to exceed 3 and best results are obtained when said ratio does not exceed 1.5. According to the invention, the bulging movement of the laterally unsupported portion of said step is confined and directed to force said portion to assume the desired configuration of a double-walled intermediate flange.

While the intermediate flange is being formed, the free end of the compressed step may be curled over and subsequently, if desired, said step may again be compressed, this time without any external lateral support whatsoever, the dies employed in compression being so shaped as to force the curled portion outwardly to provide a double-walled end flange spaced from the aforesaid intermediate flange.

Finally, the bottom of the cup which is integral with the slenderest tubular step is pierced, so that a lead from the starter switch may be inserted therethrough; also, so that this opened end may be spun over or riveted onto a supporting member, e. g., a fibre disc or plastic can.

Referring now to the drawings, and more particularly to Figs. 1 through 4, we have there shown a sheet metal contact **30** made in accordance with the invention. Said contact is furnished as a part of a starter switch **32** which may be of any conventional construction and is housed in a suitable container, such as a plastic can or the

light sheet metal can **34** whose ears **36** are inturned to secure the can to an insulating disc **38**. The can houses a suitable switch, not shown, which may be adapted to close and open a starting circuit for a fluorescent electric discharge lamp. Said switch is connected in the starting circuit by a pair of lead wires **40**.

The contact **30** is made from light, electrically conductive sheet metal, for example 22 gauge brass, and is generally tubular in shape so as to provide a continuous bore from end to end. The shank of the contact consists of a seamless tubular step **42** to which there is integrally connected another seamless tubular step **44** of smaller diameter. This latter step extends through an aperture **46** in the base of the insulating disc **38** or, if a plastic can is employed, through an aperture in the bottom wall thereof. The step **44** is of sufficient length to permit the free end thereof to extend into the interior of the can **34**, where it is spun over, eyeleted or riveted to form a bead **48** which is clenched tightly against the inner surface of the disc **38** or container. At the other end of the shank we provide a third seamless tubular step **50** of larger diameter than the shank **42**. The tubular step **50** includes two flanges, one flange **52** immediately adjacent an end of the shank **42** and the other flange **54** spaced from said first flange. Between the two flanges the third step **50** has a constricted portion **56** which is of greater diameter than that of the shank **42**. The free end of the third step **50** has a portion **57** which is perpendicular to the longitudinal axis of the contact **30** and an inturned retroverted portion **58** which provides a smooth surface at the exposed end of the contact. After a contact **30** is secured to a disc **38** or plastic can, one of the lead wires **40** is inserted therein from the inner surface of the disc **38** or can, this lead wire only extending partly through the contact as indicated in Fig. 4 or the lead wire is extended completely therethrough and the protruding portion cut off. The disc or can is then inverted to place the flange **54** uppermost and a fused electrically conductive material of low melting point, e. g., solder **60**, is poured in to firmly hold the lead wire in place.

A contact of the shape described is adapted to be used in any conventional present day socket for a fluorescent starter switch such, for example, as the socket **62** shown in Figs. 1 and 2. This socket may be of the type shown and described in Letters Patent No. 2,280,747, issued August 21, 1942, and consists of side walls **64** and an intermediate transverse partition **66** which serves as the socket base. Said partition has a pair of arcuate concentric keyhole slots **68** formed therein in which the contacts **30** are adapted to be received. On the under surface of the base **66**, are a pair of lobster claw contacts **70** whose spring fingers **72** are adapted to resiliently grasp the contacts **30** when they are at the narrow end of the keyhole slots **68**. It will be noted that the fingers **72** are so located that they will engage the contacts **30** between the two flanges **52**, **54**. This prevents the starter switch from shifting axially until the same has been rotated out of engagement with the fingers.

The steps for fabricating a sheet metal contact such as just described are shown in Figs. 5 and 7 through 22. First, a circular disc or work blank **80** (Figs. 7 and 8) is blanked out of a sheet metal strip **82** which is fed from a reel (not shown) of such material. This disc is then formed into a large cup **84** (Fig. 9) of a diameter greater than that of any of the tubular steps later to be formed.

Next, the cup is stripped (Fig. 10) from the cup forming dies. From this stage the large cup is transferred to a set of drawing dies (Fig. 11) which reduce the diameter and increase the length of the cup 84 to provide a cup 86 whose diameter is approximately equal to that of the third or largest tubular step and is, therefore, also approximately equal to the diameter of the constricted portion 56 between the two flanges 52, 54 ultimately to be formed.

The cup 86 is then stripped (Fig. 12) from the drawing dies and introduced to the two-step forming dies (Fig. 13) at which time the intermediate step 88 is impressed therein, the diameter of this step being approximately equal to that of the shank 42. The cup-like element 90 with the two steps provided therein is stripped (Fig. 14) from the two-step forming dies and transferred to the three-step forming dies (Fig. 15) in which the last step 92 is drawn, the diameter of this step being equal to that of the tubular contact extension 44 and the length thereof being greater than the thickness of the disc 38 or base of the plastic container. The diameter of all the steps may be brought to their correct dimensions in the three-step forming dies.

It will be noticed that the step 88 in the element 90 is of such length that when the smallest step 92 is subsequently formed at the bottom thereof, the resulting intermediate step 94 and end step 92 are equal to the lengths of the tubular shank 42 and unspun tubular extension 44, respectively.

Next, the cup comprising three tubular steps is stripped (Fig. 16) from the three-step forming dies and shifted to the intermediate flange forming dies.

It may be mentioned at this point that the preceding operations are conventional per se; that is, it is well known to blank out work pieces which are subsequently formed into cups having tubular steps of different diameters, and it will, therefore, be realized that the tubular element having a plurality of tubular steps of different diameters may be formed in accordance with well known practices other than those disclosed. For example, more or less than the five steps illustrated may be used to make the three-step tubular element. Thus, the blank 80 may be cut out and the cup 86 drawn in the same operation by a subpress die. Likewise, the three tubular steps all may be formed at once. Alternatively, the drawing and step forming operations may be extended over more than the four steps indicated in order to reduce the strain to which the sheet metal is subjected in any one operation. However, the actual form imparted by these operations, to wit, at least two tubular steps of different diameters, is of particular importance in accomplishing the formation of the intermediate flange as will now be seen.

After its fabrication, the three-step cup is fed to intermediate flange forming dies in which the shoulder 96 between the largest tubular step 98 and intermediate tubular step 94 is seated on an abutment member (Fig. 17) which affords lateral support for the intermediate step but none for the largest step. Said largest step is now subjected to axial compression and at the same time the upper portion thereof is externally laterally supported, i. e., the external surfaces of its side walls are supported. Because of the relative dimensions of the length and diameter of the third step, in the ratio of approximately 1.25:1, said step acts as a pure compression member rather than

a column, and will bulge where it is laterally unsupported—in this instance, adjacent the shoulder 96. Compression may continue until the laterally supported part of the step 98 abuts against the shoulder 96. This will cause the bulged out portion to form a double-walled bead 100 at the shoulder 96 between the undeformed portion of the large step 98 and the intermediate step 94.

For divers commercial reasons, the bead 100, which in the finished contact comprises the flange 52, may be made to assume any one of various shapes. Thus, in Fig. 17, we have shown the flange as comprising a flat double-walled ring, due to the fact that the bulged out bead is confined and directed into such a shape. If it is not desired to employ a flat flange, the bottom of the undeformed portion of the large step 98 need not be pressed against the shoulder 96 but can be left spaced a slight distance thereabove. In such case and with the aid of confining die portions of the proper shape, the intermediate flange may be given a truncated conical configuration such as shown in Fig. 19, the shoulder 102 being transverse to the longitudinal axis of the contact and projecting further than the shoulder 96 of the simple three-step cup. The side walls 104 of said flange taper upwardly to provide the shape illustrated rather than extending perpendicular to the longitudinal axis of the contact as is the case in the bead 100. It will thus be appreciated that the specific contour of the intermediate flange can be varied at will and will depend in each instance upon the particular shape desired. It is even possible to have the shoulder 102 flare upwardly by providing a conical seat for the shoulder 96 of the requisite negative configuration.

The essential elements of this stage of our invention are seating an end of one of two adjacent tubular steps of different diameters against an abutment member and axially compressing said one step while leaving a portion thereof laterally unconfined so as to cause a localized bulge to be formed at said unconfined portion where a flange is to be located. In addition, said bulge is preferably confined and forced into a desired and predetermined contour.

At the time the intermediate flange is formed, we may also curl in the upper or free end of the large tubular step 98 to provide an inturned single-walled flange 106 (Fig. 17).

Next, the partially formed contact 108 is stripped (Fig. 18) from the intermediate flange forming dies and transferred to the top flange forming dies (Fig. 19) where the curled in portion 106 is retroverted and the large step 98 subjected to compression without lateral confinement. This causes the upper part of the said large step to bulge out, said bulged out portion being directed into the desired shape of the double-walled flange 54. This end flange forms at the required place, firstly, because the lower part of the third step 98 is reinforced against bulging by the previously formed bead 100, and, secondly, since the dies are so shaped as to force the upper portion of said step outwardly. The effect of forming the end flange 54 is to provide the constricted portion 56 between the two flanges. The upper flange normally assumes an inverted truncated conical shape, such as that indicated, with a flat top 109 and tapering side walls 110. However, if it is desired to have the flange 54 in the shape of a flat double-walled ring such as the bead 100 shown in Fig. 17, a suitable abutment member may be inserted at the con-

stricted portion 56 to press the flange 54 flat as was the case with the ring 100. After stripping (Fig. 20) from the upper flange forming dies, the almost completely formed contact 112 is moved to piercing dies (Fig. 21) which punch out the bottom 114 of the cup and leave the finished contact ready for insertion in an aperture 46 in an insulating disc 38. Said finished contact is shown in Fig. 23.

It will be appreciated that the foregoing operations performed upon tubular sheet metal stock are extremely economical both as to time required and the amount of material which has to be removed so that the contacts can be made at much greater speed and less expense than contacts of a similar shape heretofore made in a screw machine.

Various forms of apparatus may be employed to carry out the operations above described. There is illustrated and will now be described in detail one specific form of apparatus which will operate in a highly satisfactory and consistent manner.

Said apparatus comprises a multiple press 120, of the type known in the trade as an eyelet machine, and includes a bed 122 having eight plungers (not shown), all carried above the bed in a single frame. Each of the plungers is adapted to cause the performance of a separate operation upon the work piece in properly timed relationship. The contact in its various stages of fabrication is moved from plunger to plunger by a transfer slide 124 (shown in plan in Fig. 6) comprising a pair of parallel side bars 126. At each station of the machine, where some operation, for example, blanking, cupping, drawing, stepping or flanging, is performed the bars 126 are provided with a pair of fingers, such as the fingers 128, 130, at the blanking station. The fingers are pivotally mounted on the bars and are resiliently urged toward each other by springs 132. Each pair of finger tips is shaped to negatively conform to the external contour of the blank or partially formed contact at the station with which they are associated. Suitable means (not shown) is provided to reciprocate the side bars 126 a distance equal to the uniform space between the adjacent plungers in a certain timed relationship to the operation of the dies, as will soon be more fully explained.

As illustrated, the eyelet machine has seven stations denominated A to H. These are: the blanking station A, the cupping station B, the drawing station C, the two-step forming station D, the three-step forming station E, the intermediate flange forming station F, the top flange forming station G, and the piercing station H.

The blanking operation, hereinbefore described, is performed at station A. This station includes blanking dies comprising an anvil 134 (Figs. 5, 7 and 8) and a punch 136 which is reciprocated by the first plunger. The top surface of the anvil has a groove 138 formed therein to receive and guide the intermittently fed stock strip 82 which is slidably retained in position by a cover plate 140. The blanking punch 136 cooperates with registered apertures 142, 144 in the cover plate and anvil, respectively, to cut a circular work piece 80 from the stock strip 82 and deposit it upon a hardened steel block 148 set into the bed 122 of the machine. The punch 136 is resiliently driven through a spring (not shown) by its associated plunger so that the blank 80 can be firmly pressed against the block 148 subsequent to shearing thereof from the stock strip 82. After the blank 80 has been severed and while the plunger associated with the punch 136 is retracting, the punch remains in contact with said blank until the pair of fingers 128, 130 at the blanking station A are moved into position by retraction of the transfer slide to grasp said blank. The timing of the machine is such that subsequent to engagement of the fingers 128, 130 with said blank, the punch 136 will lift clear thereof. The stock strip 82 is stripped from the punch 136 by the cover plate 140. When the punch 136 reaches the top of its stroke, the transfer slide will shift the flat blank 80 from station A to station B and center said blank with respect to the cupping dies at this latter station.

At station B (Figs. 5, 9 and 10) the blank 80 is cupped. The dies at this station include a hardened steel block 150 having an aperture 152 over which the blank 80 is centered by the transfer slide. Said blank is forced into the aperture by a hardened steel cupping pin 154 coaxially disposed with respect to the aperture and having a diameter smaller than that of the aperture by an amount double the thickness of the stock 82 being cupped. The pin 154 depends from a tapered plug 156 which is driven from its associated plunger through a spring 158. It will be apparent that when this plunger moves the plug and pin down, the blank 80 will be resiliently pressed into shape of the cup 84.

The relative timing of the transfer slide and second plunger is such that the first pair of fingers 128, 130 associated with station A will hold the flat blank 80 at station B until said blank is engaged by the descending pin 154. Immediately subsequent to this, the blank is released by the transfer slide which, however, does not retract fully at such time to bring the fingers back to the preceding station, but stops with said fingers intermediate the two stations in order to permit the operations performed at said stations to be carried out before the article being worked is grasped by the fingers.

The cup 84 is stripped from the block 150 by a knock-out pin 160 which works in the aperture 152 and whose operation is so timed that it will force the cup 84 upwardly as the pin 154 retracts.

It is also necessary to employ a mechanism to remove the cup 84 from the pin 154, and to this end, we provide a stripping thimble 162 having a central conical aperture 164 in which the tapered plug 156 is seated during the down-stroke of the pin 154. The thimble has an external annular groove 166 in which the bifurcated arms 168 of a stripping lever are disposed. Said lever is operated by a conventional cam (not shown) which causes the thimble to move in the following fashion: the thimble rises with the tapered plug 156 until the cup 84 is completely ejected from the aperture 152 by the knock-out pin 160. Then the thimble stops, although the pin continues to rise, thereby stripping the cup off said pin. As the cup 84 is stripped, it is grasped by a second set of transfer fingers 170, 172 associated with station B, these fingers serving to hold the cup after it has been fully stripped. Now the thimble is lifted and the transfer slide advances, causing said fingers to move the cup 84 to station C where it is centered with respect to the dies at this station. The operative cam for the stripping fork does not prevent downward movement of said thimble so that it is depressed on the down-stroke of the plug 156.

The dies at stations C, D and E are, in general, similar to those just described in detail in con-

nection with station B, the only difference between them being in the shapes of the various forming pins and the matching apertures in the blocks which are set into the bed.

At station C the drawing pin 174 (Figs. 5, 11 and 12) has a smaller diameter than the cupping pin 154 at station B and the aperture 176 in the block 178 at station C is correspondingly smaller to provide clearance between the pin and said aperture equal to the thickness of the blank stock 82. The transfer fingers 180, 182 at station C have their tips contoured to receive the slender cup formed at this station. The relative timing of the thimble 184, pin 174, and transfer fingers for said station is the same as that of the like elements at station B.

The two-step forming pin 184 (Figs. 5, 13 and 14) at station D has an upper portion 186 of the same diameter as that of the drawing pin 174. However, this portion is shorter than said drawing pin and has depending from its lower end a thinner pin 188 which is adapted to form the intermediate tubular portion 88. The aperture 190 in the block 192 negatively conforms to the configuration of the pin 184, being slightly larger to accommodate the thickness of the stock. Due to the difference in the diameters of the pin portions 186, 188, the shoulder 96 is formed in the tubular blank 90 intermediate the largest tubular step from which the flanges later will be fashioned and the intermediate tubular step 88, a portion of which will form the contact shank 42 and a portion of which will be drawn to provide the slenderest tubular step 44 at station E. Transfer fingers 194, 196 shift the two-step tubular blank from station D to the centered position shown in dotted lines (Fig. 16) at station E, where, as at previous stations, the tubular blank is held by the transfer fingers until initially engaged by the descending forming pin.

At station E (Figs. 5, 15 and 16) the forming pin 198 is in three sections—200, 202 and 204—of successively smaller diameters in order to fabricate the three-step blank heretofore described.

It may be mentioned at this time that the foregoing mechanisms for making the three-step tubular blank are described only by way of illustration and that other well known mechanisms as, for example, a rolling mill could be equally well employed.

Transfer fingers 206, 208 shift the three-step blank to station F (Figs. 5, 17 and 18) and hold same there in centered position until the smallest step 92 is engaged by a pressure finger 210. The dies at station F are designed to form the lower flange or bead 100 intermediate the two ends of the contact. Said dies comprise a hardened steel block 212 set into the bed of the machine and having an aperture 214 consisting of a lower portion 215 which is adapted to snugly receive the lower tubular step 92 and an upper portion 216 which is adapted to snugly receive the intermediate tubular portion 94, the shoulder 96 between these portions being seated at the base of the upper portion 216. This construction permits the upper and broadest tubular section 98 to wholly protrude from the block 212 when the three-piece blank is fully seated in the aperture 214 by the pressure finger 210. The reciprocating compression die 218 at station F has a hollow lower end 220 which is adapted to fit around the sides of the upper tubular portion 98. The top of the hollow portion is rounded at 222 adjacent the side walls thereof to curl in the top of the tubular portion 98 during the down-stroke of said die until the edges of the aperture at the top of the partially formed contact abut against the pressure finger 210, as best shown in Fig. 17. As the curled in portions 106 reach the foregoing position, the full compressive effort of the die is applied to the side walls of the upper tubular portion 98. Due to the fact that said tubular portion is only about 1.25 times as long as it is wide, it acts as a pure compression member and tends to bulge outwardly. However, the major portion of the side walls of said portion are externally laterally supported by the side walls 224 of the compression die 218 which define the hollow lower portion thereof. This leaves laterally unsupported a short part of the tubular portion adjacent the shoulder 96; said unsupported part buckles outwardly near the end of the down-stroke of the die 218 to form the double-walled bead 100.

In Fig. 17 the stroke of the die 218 has been illustrated as of such nature as to force the upper and lower walls of the bead together so as to form a flat ring-like double-walled projecting flange. This stroke, however, may be slightly shorter and the tip of the die 218 provided with a beveled seat, if desired, to impart to the bead 100 the truncated conical shape illustrated in Figs. 19 through 23.

It will be noted that the pressure finger 210 is backed by a spring 226 weaker than the spring 228 operating the die 218, so that the pressure finger holds its position as the bead is being formed. The pressure finger spring is set into a cavity 230 in the upper part of the die 218. The die 218 has a cylindrical outer contour and slides freely in a central bore 232 of a thimble 234 at station F, said thimble being driven positively into engagement with the block 212 by a cam which moves the forked stripper arm carrying the bifurcated fingers 236. The lower end of said thimble has an enlarged recess 238 to accommodate the periphery of the flange 100 and aid in imparting the desired contour thereto by forming the outer portion of the confined space into which the bulge is directed.

After the partially formed contact pin 108 has had the intermediate flange 100 formed thereon, it is ejected from the aperture 214 by knock-out pin 240 and grasped by transfer fingers 242, 244 before being stripped from the pressure finger 210 and die 218 by the thimble 234. Said transfer fingers thereupon shift the contact element 238 to station G.

At station G (Figs. 5, 19 and 20) the element 108 is centered over an aperture 246 in a hardened steel block 248 set into the bed 122. Said aperture has an enlarged upper portion to receive the contact shank 42 and a smaller lower portion to receive the smallest tubular step 44, the bead 100 resting upon the upper surface of the block 248. The element 108 is seated in the aperture 246 by a pressure finger 250 which is slidably mounted in a compression die 252 and urged to outthrust position by a spring 254. The lower end of said die has a coaxial annular nib 256 which is adapted to inturn the central curled-in portion 106 and thus provide a smooth external surface on the exposed end of the contact pin. Said nib is connected by an annular fillet 258 to the flat base 260 of the die which, subsequent to the inturning action just mentioned, engages the curled-in portion and compresses the upper tubular step 98 in which the intermediate bead 100 has already been formed. The presence of this bead restricts to the upper portion of the large tubular step 98 the bulging effect caused by the

compression effected at station G. More particularly, this bulging effect is concentrated at the extreme top of said tubular step by virtue of the fillet 258 and flat base 260 which direct the walls of said step outwardly at such point. It will be noted that said base is wide enough to fully cover the upper flange 54 formed at station G. This construction enables the shape of the flat top 57 of the contact to be positively controlled. The portion of the contact connecting the flat top 57 with the constricted portion 56 takes on an inverted truncated roughly conical outline since the shapes of its two ends are fixed one by the top of the bead 100 and the other by the enlarged diameter of the rim of the contact top 57. The actual dimensions of the upper double-walled contact flange 54 are controlled by adjusting the stroke of the compression die 252 so that it will only descend far enough to force said upper flange out to its desired maximum outer diameter. No stripping thimble is employed at station G. However, a knock-out pin 264 is used to eject said element. The transfer fingers 266, 268 at station G grasp said contact element after it has been ejected and while it is still held in position by the pressure finger 250.

Subsequent to removal of the pressure finger, the contact element is advanced by the transfer slide to station H (Figs. 5, 21 and 22) where a conventional shearing pin 270 knocks out the base 114 of the element 112 while said element is still in the transfer fingers 266, 268. The fingers 266, 268 retract while the contact element is retained by the shearing pin and said element is stripped from the shearing pin by a thimble 272. A jet of air issuing from a nozzle 274 blows the completed contact element 276 to the discharge end 278 of the machine, after which it is placed in proper position on a base disc 38 or plastic can and has the bead 48 spun over to hold it in position.

It will be appreciated that a contact made in the aforesaid manner can be turned out in large quantities at a low cost and at great speed and, therefore, represents a marked improvement over the previous fabrication of somewhat similar contacts by screw machine.

The shape of the contact may be varied substantially without departing from the spirit of the invention, for example, the top flange 54 may be omitted, as shown in Fig. 24. A contact of such shape is manufactured by omitting station G. Said contact cannot be accidentally displaced since the upper tubular step 98' will be resiliently gripped by the socket fingers 72 and be disposed in indentations at the tips thereof. The intermediate flange 52' will lie between the socket partition 66 and socket fingers.

It will thus be seen that we have provided a method for making contacts, which achieves the several objects of the invention, and which is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiments above set forth, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim as new and desire to secure by Letters Patent:

1. A method of fabricating an open-ended tubular sheet metal contact for a fluorescent starter switch, said method including the steps

of forming two integrally connected tubular sheet metal steps of different diameters and axially compressing, against the shoulder interconnecting the steps, the larger step while externally laterally supporting the side walls of said compressed step except at a circumferential zone immediately adjacent and including said shoulder, whereby said walls will locally bulge out at said zone to form a double-walled flange in said compressed step, one of whose walls includes said shoulder.

2. A method of fabricating an open-ended tubular sheet metal contact for a fluorescent starter switch, said method including the steps of forming two integrally connected tubular sheet metal steps of different diameters, axially compressing, against the shoulder interconnecting the steps, the larger step while externally laterally supporting the side walls of said compressed step except at a circumferential zone immediately adjacent and including said shoulder, whereby said walls will locally bulge out at said zone to form a double-walled flange in said compressed step, one of whose walls includes said shoulder, and subsequently axially compressing said larger step without laterally confining the same, and while expanding said step adjacent its free end which is remote from the shoulder, to form a second flange on the free end of said step spaced from the first named flange by an annular groove.

3. A method of fabricating an open-ended tubular sheet metal contact for a fluorescent starter switch, said method including the steps of providing a sheet metal blank, drawing said blank into a cup including three tubular interconnected steps of progressively increasing uniform diameters, axially compressing the largest of the steps against the shoulder between said largest and intermediate steps while laterally confining said largest step at a circumferential zone spaced from said shoulder, leaving unconfined the circumferential zone immediately adjacent and including said shoulder, whereby said largest step will locally bulge out at said latter zone to form a double-walled flange in said compressed step, one of whose walls includes said shoulder, and shearing away the bottom of said cup.

4. A method of fabricating an open-ended tubular sheet metal contact for a fluorescent starter switch, said method including the steps of providing a sheet metal blank, drawing said blank into a cup including three tubular interconnected steps of progressively increasing uniform diameters, axially compressing the largest of the steps against the shoulder between said largest and intermediate steps while laterally confining said largest step at a circumferential zone spaced from said shoulder, leaving unconfined the circumferential done immediately adjacent and including said shoulder, whereby said largest step will locally bulge out at said latter zone to form a double-walled flange in said compressed step, one of whose walls includes said shoulder, subsequently axially compressing said largest step without laterally confining the same, and while expanding said step adjacent its free end which is remote from the shoulder, whereby to form another double-walled flange in said largest step adjacent the free end thereof and spaced from the first named flange by an annular groove, and shearing away the bottom of said cup.

5. A method of fabricating an open-ended tu-

bular sheet metal contact for a fluorescent starter switch, said method including the steps of forming two integrally connected tubular sheet metal steps of different diameters, axially compressing, against the shoulder interconnecting the steps, the larger step while externally supporting the side walls of said compressed step except at a circumferential zone immediately adjacent and including said shoulder, whereby said walls will locally bulge out at said zone to form a double-walled flange in said compressed step, one of whose walls includes said shoulder, curling in the end of said step remote from said shoulder, and subsequently axially compressing said larger step without laterally confining the same and while turning the curled in portion and internally supporting said turned in portion whereby said end will expand to form a second flange spaced from the first named flange by an annular groove.

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