United States Patent [19]

Bannister et al.

[11] **3,894,334**

[45] **July 15, 1975**

[54] **METHOD OF MANUFACTURING CONTACT SPRINGS**

[75] Inventors: **Royston Walter Bannister; Frank Taylor,** both of Kent, England

[73] Assignee: **International Standard Electric Corporation,** New York, N.Y.

[22] Filed: **May 9, 1974**

[21] Appl. No.: **468,341**

[30] **Foreign Application Priority Data**

May 31, 1973 United Kingdom 26001/73

[52] **U.S. Cl.** ..... **29/630 C**; 29/628; 29/630 R; 113/119

[51] **Int. Cl.** **H01r 9/00**

[58] **Field of Search** .. 29/628, 630 R, 630 B, 630 C, 29/203 R, 203 D, 203 S, 622, 33 R, 33 M; 72/324, 332, 338; 113/119

[56] **References Cited**

UNITED STATES PATENTS

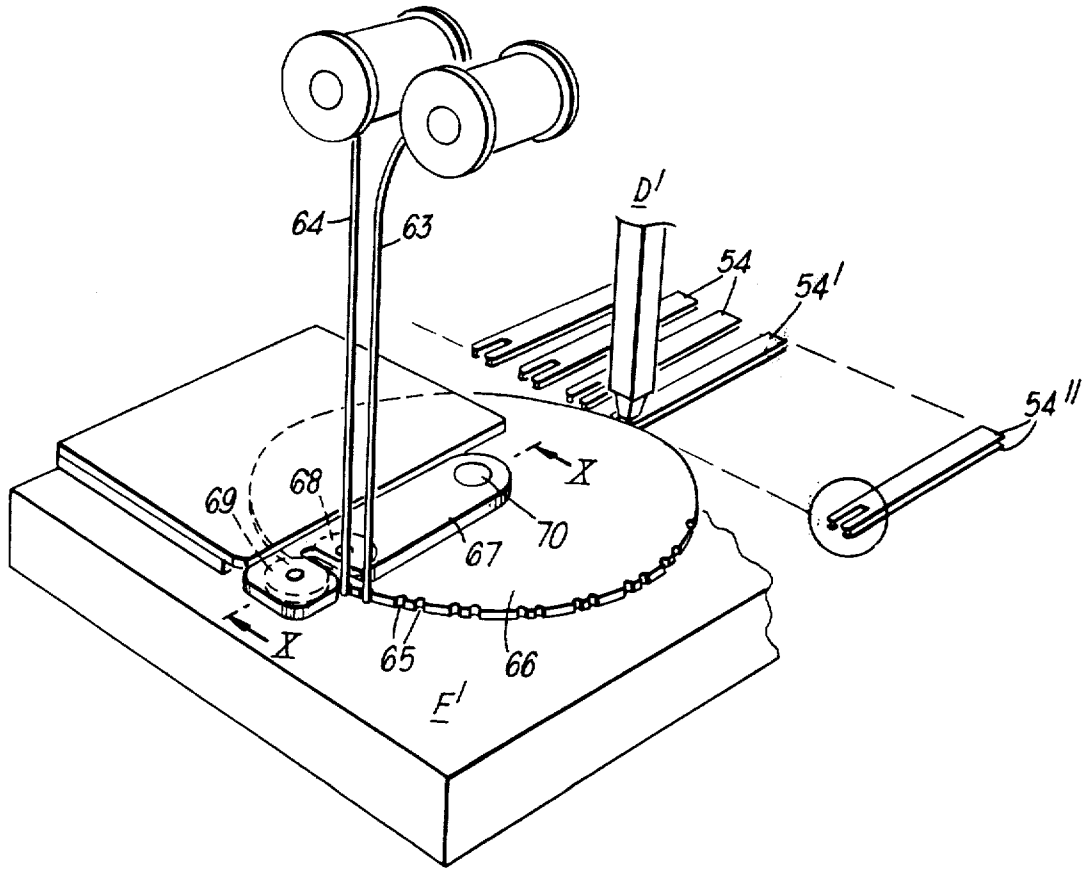
2,129,845	9/1938	King et al.	29/630 C
3,114,828	12/1963	Gannoe	29/630 C
3,229,357	1/1966	Burstin	29/630 C
3,382,575	5/1968	Gannoe	113/119
3,475,816	11/1969	Willoughby	29/630 R
3,485,994	12/1969	Swager et al.	29/630 C
3,803,711	4/1974	Dubuc et al.	29/630 C

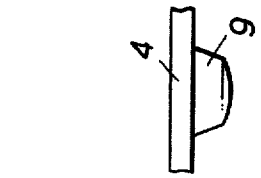
Primary Examiner—C. W. Lanham
Assistant Examiner—James R. Duzan
Attorney, Agent, or Firm—John T. O'Halloran; Menotti J. Lombardi, Jr.; Richard A. Menelly

[57] **ABSTRACT**

Method and apparatus are disclosed for welding electrical contacts onto springs. A billet of contact material is first welded to two contact springs and, after welding, is cut in two parts leaving one contact on each spring. The method provides rapid and precise means for attaching precious metal contacts to spring material.

2 Claims, 21 Drawing Figures





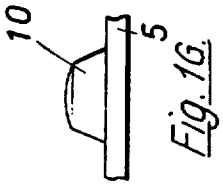
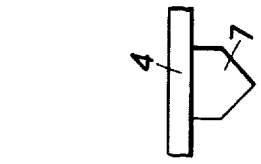


Fig. 1G.



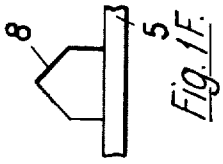


Fig. 1F.

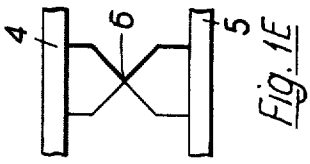


Fig. 1E

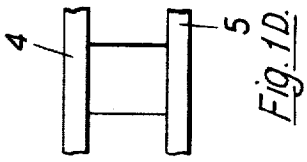


Fig. 1D.

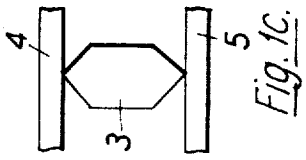


Fig. 1C.

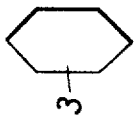


Fig. 1B.

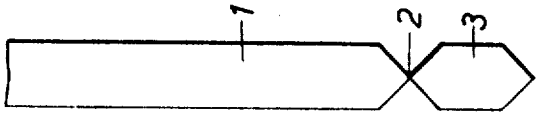


Fig. 1A.

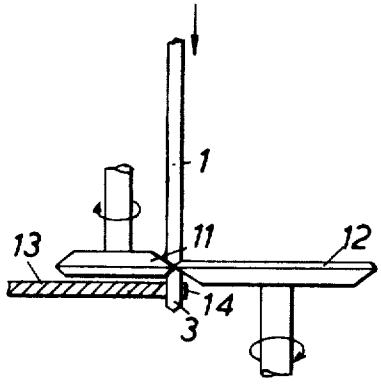


Fig. 2A.

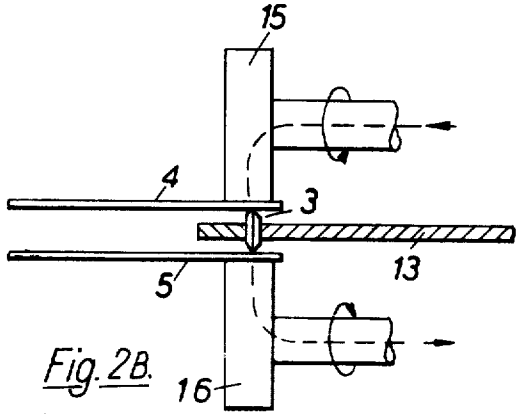


Fig. 2B.

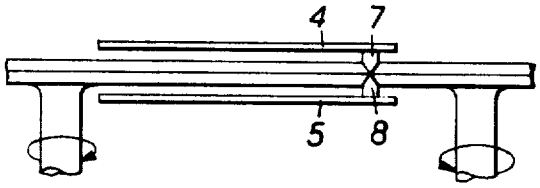


Fig. 2C.

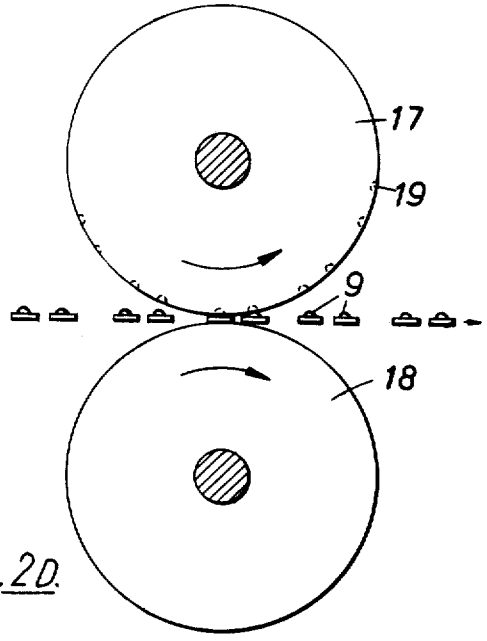


Fig. 2D.

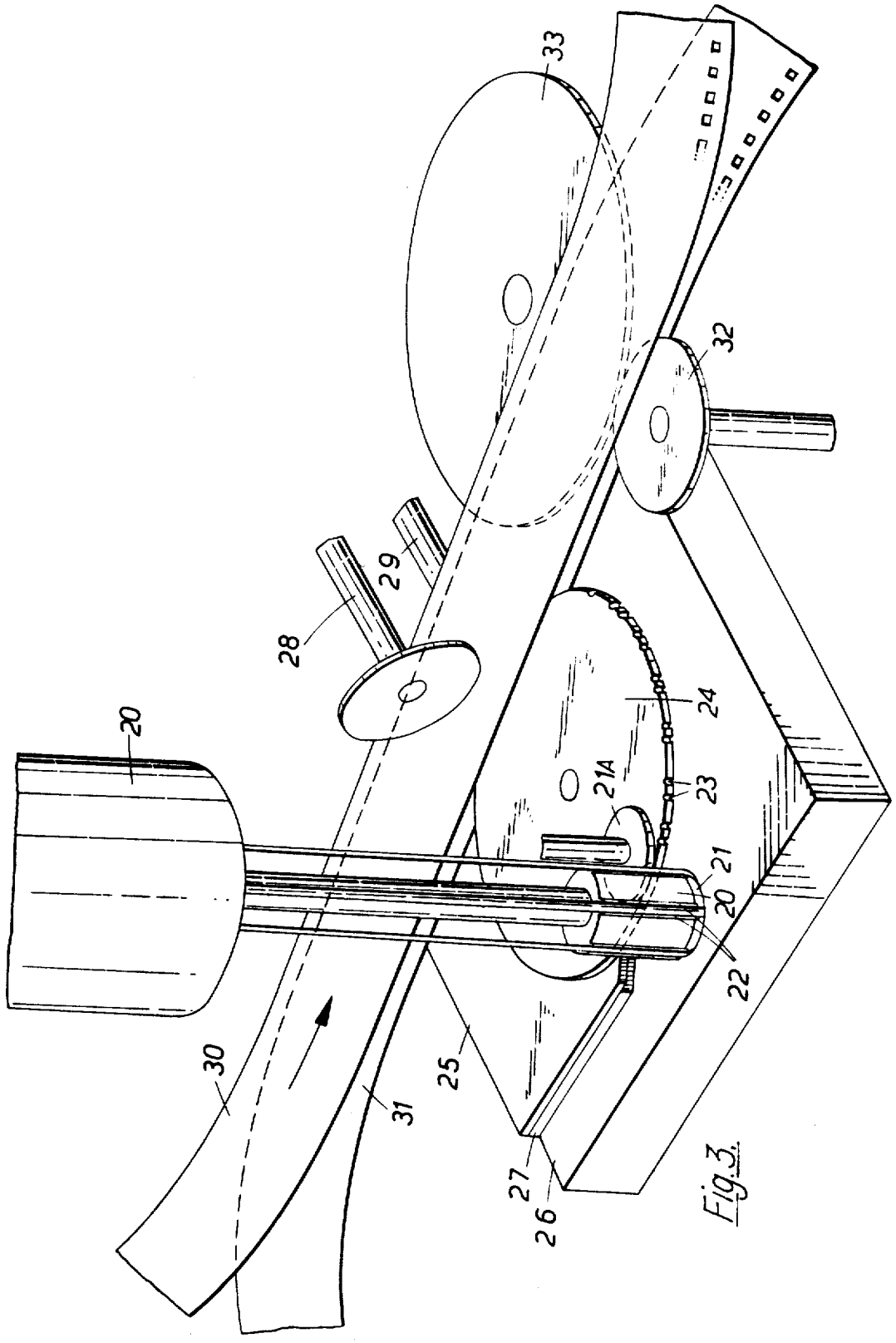


Fig.3.

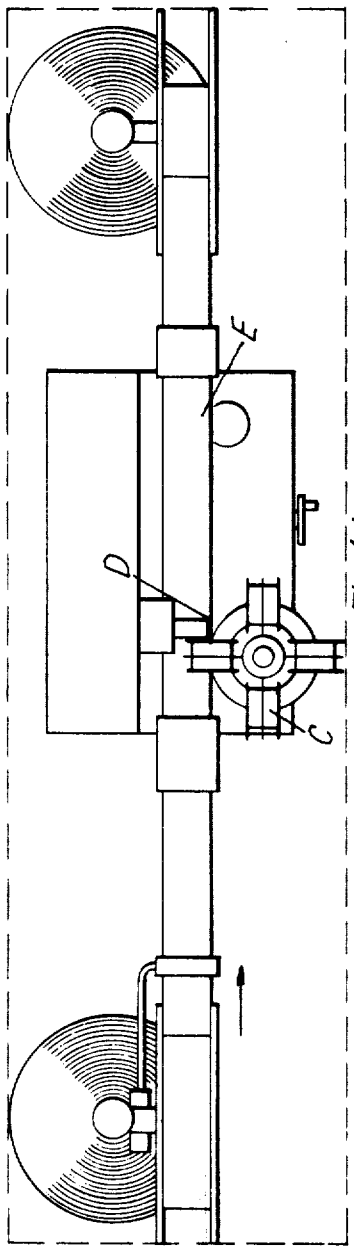


Fig. 4A.

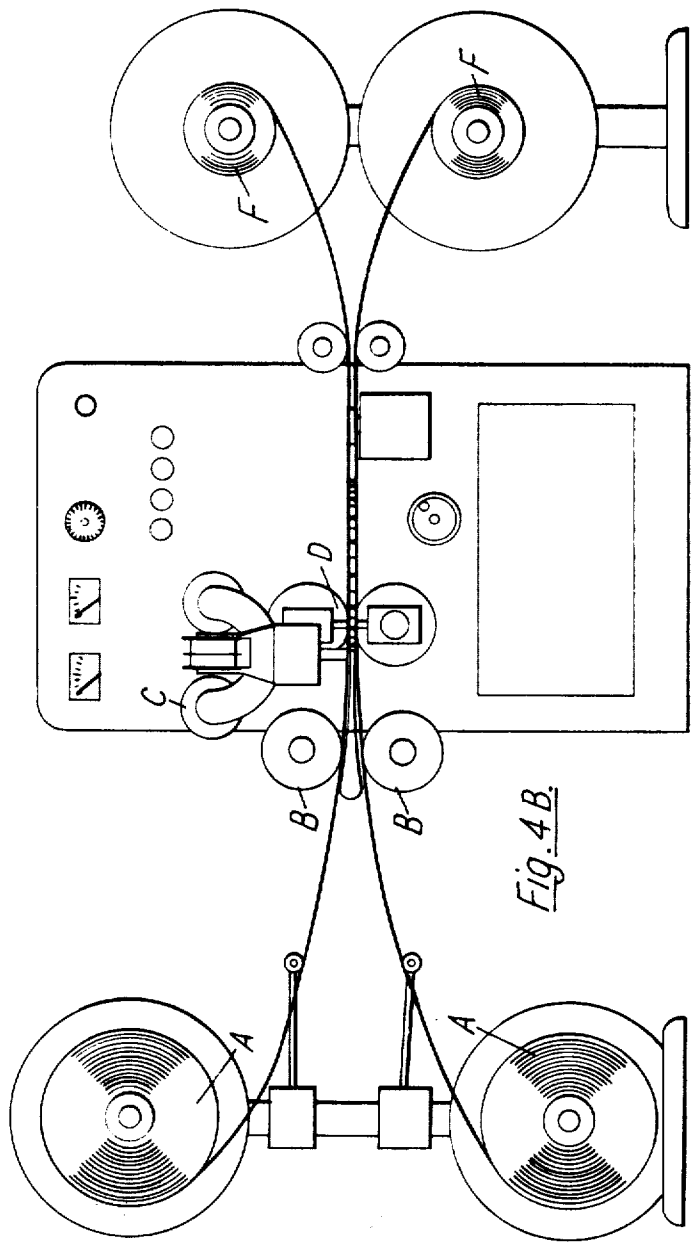


Fig. 4B.

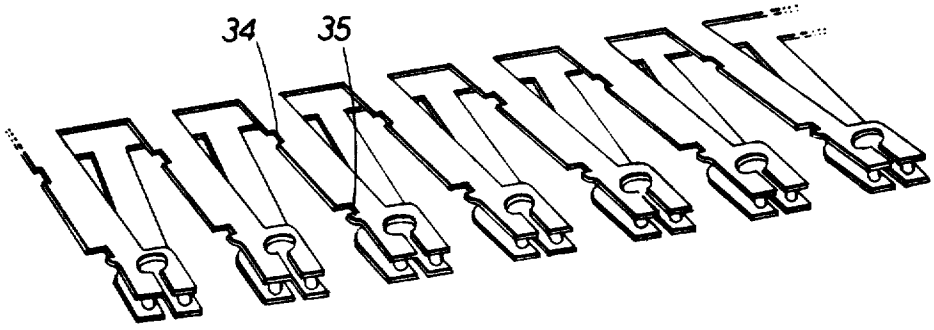


Fig. 5

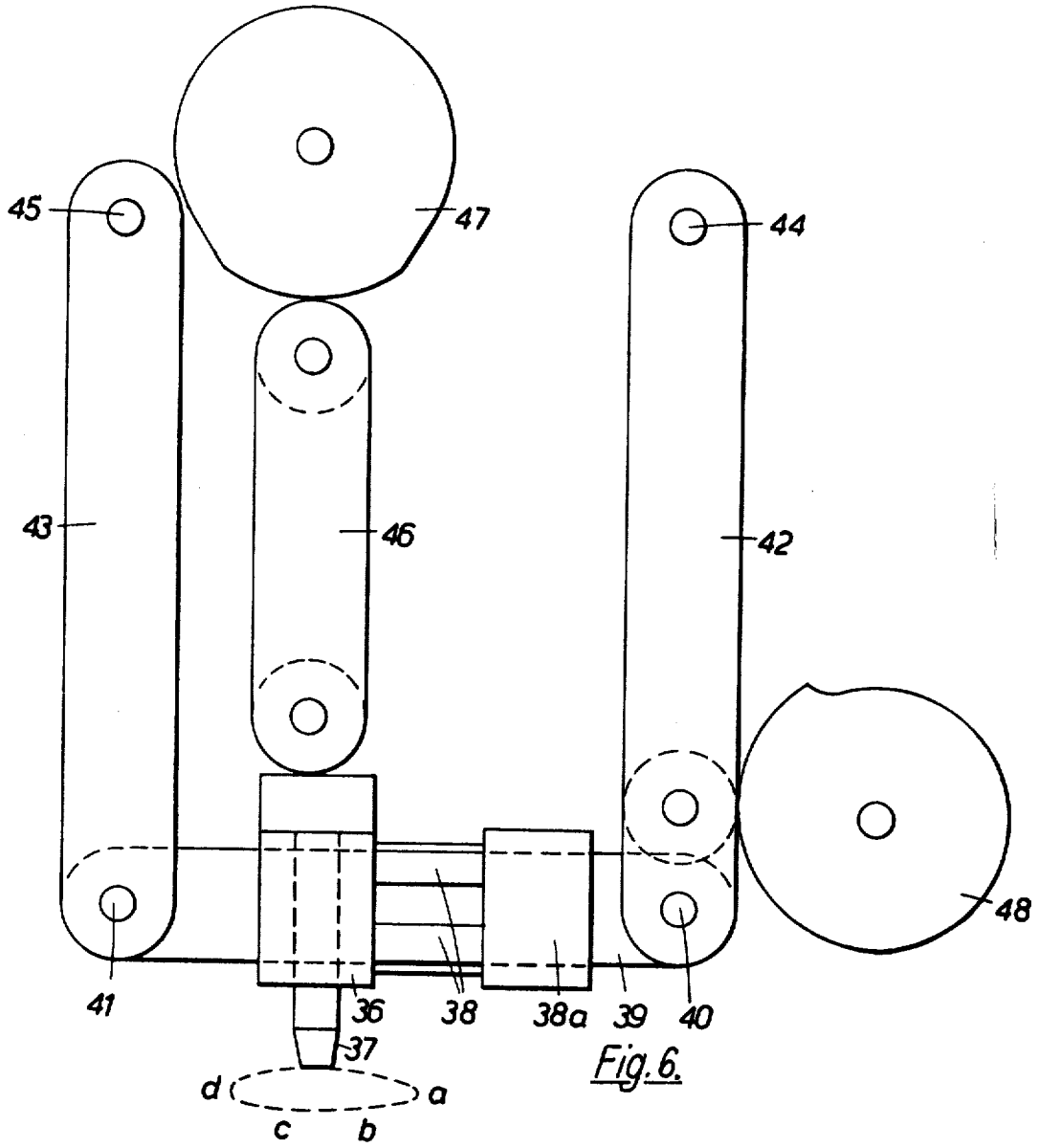


Fig. 6.

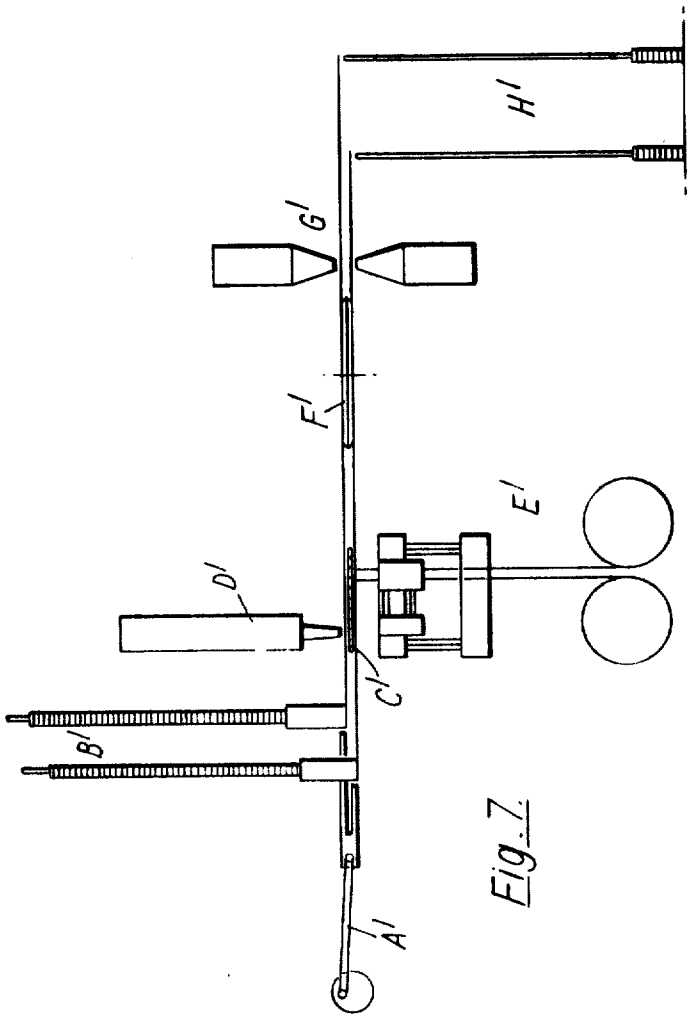


Fig. 7

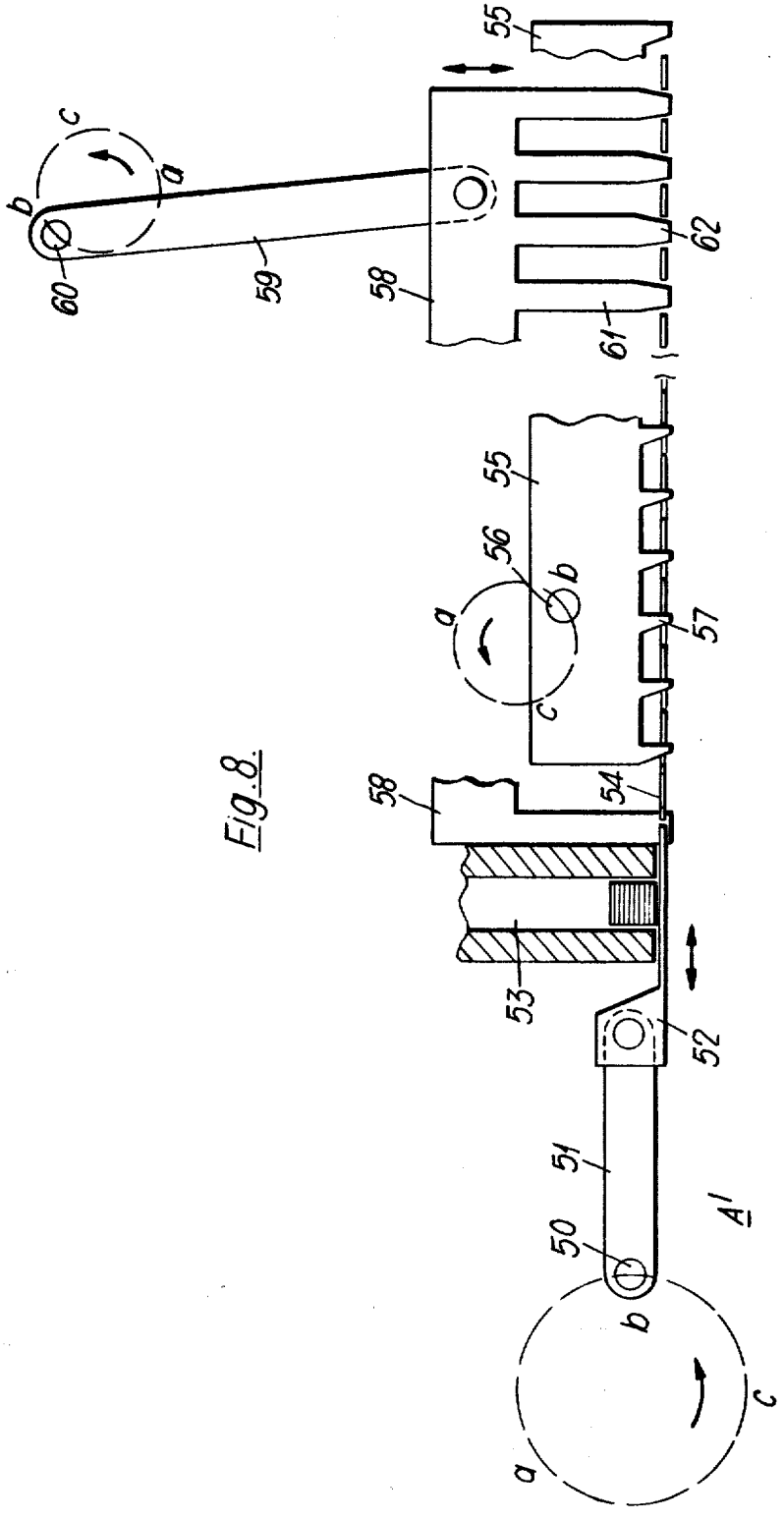


Fig.8.

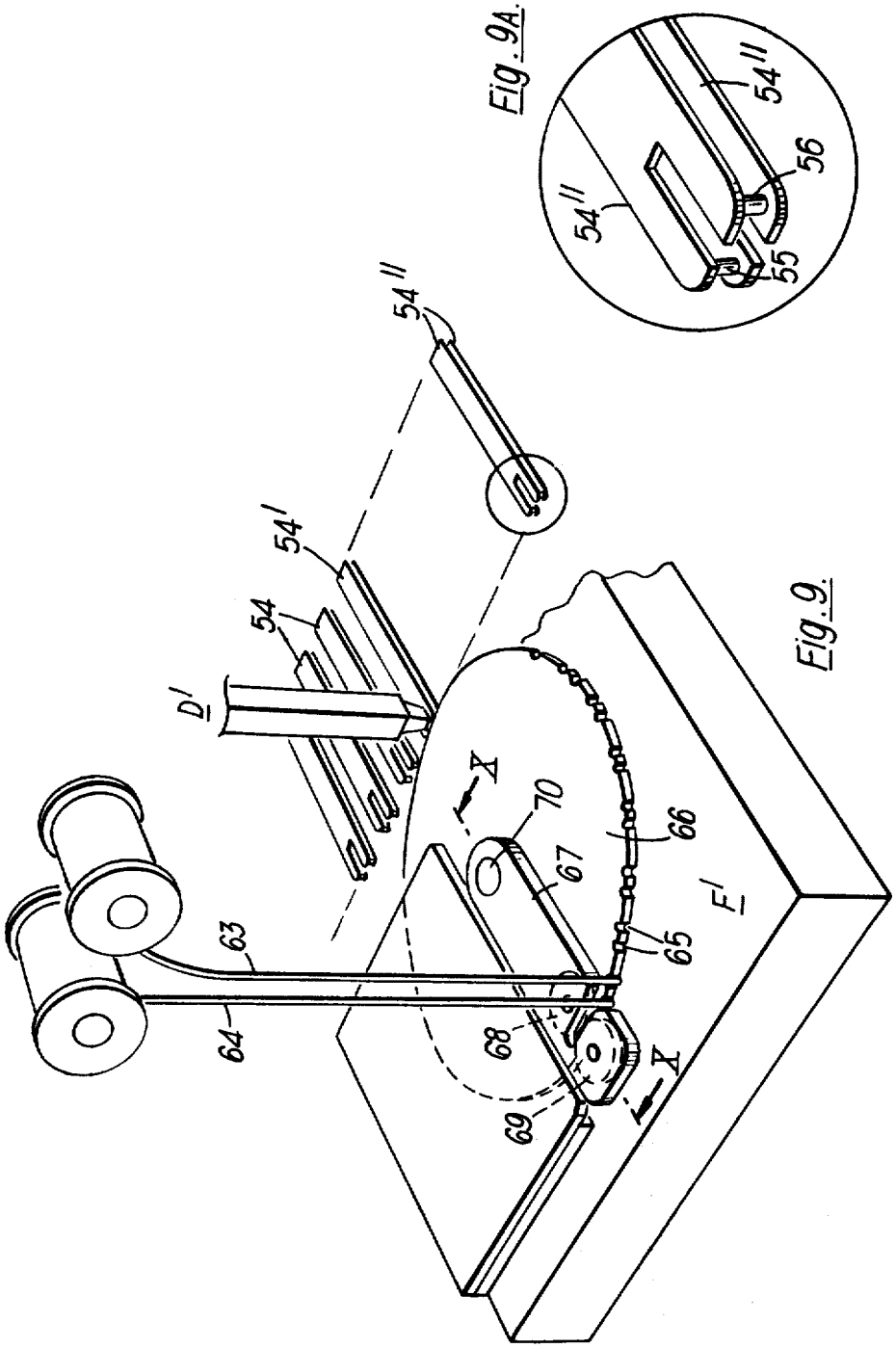


Fig. 9.

Fig. 9A.

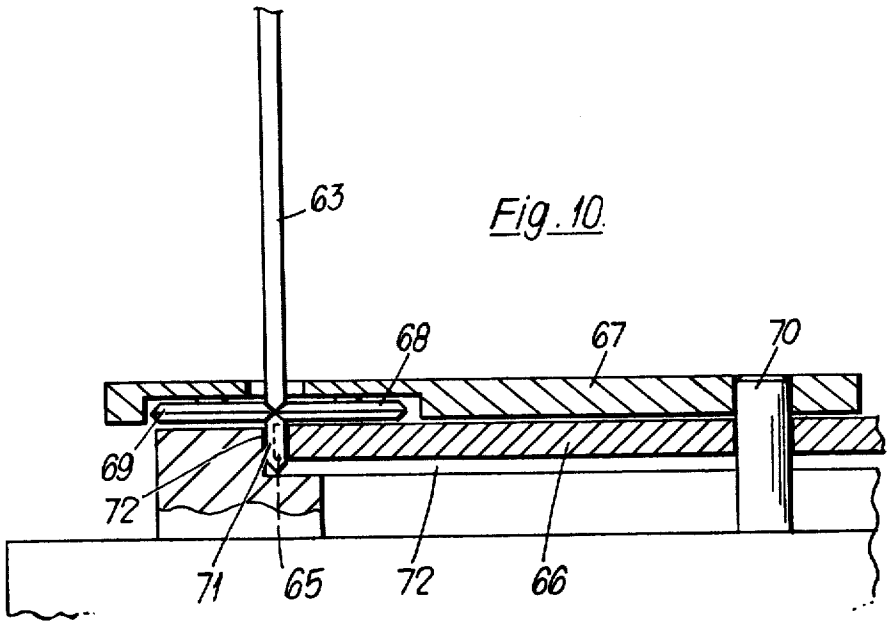


Fig. 10.

METHOD OF MANUFACTURING CONTACT SPRINGS

FIELD OF THE INVENTION

This invention relates to welding contacts on contact springs, particularly but not exclusively for telephone switching relays.

SUMMARY OF THE INVENTION

According to one aspect of the present invention there is provided a method of manufacturing contact springs by providing a billet of contact material and two springs, supporting the billet and springs so that the billet touches the two springs, passing an electric welding current to weld the billet to both springs, and then forming the billet into separate portions such that each spring is left with a contact made from the billet.

Conveniently, if each spring is bifurcated, two billets can be welded simultaneously.

According to another aspect of the present invention there is provided apparatus for manufacturing contact springs in a continuous process comprising a welding station, a cutting station and a coining station, first transfer means for transferring first and second contact springs through the stations, second transfer means for transferring a contact billet to the welding station, and holding means for holding the billet against and between opposed contact portions of the springs for welding to both springs at the welding station, the cutting and coining stations being effective to form the billet into separate portions such that each spring is left with a contact made from the billet.

Preferably the contact material is in the form of wire fed to a billet cutting station, there being a circular disc having a slotted periphery arranged to pass through said cutting station and pick up said free end portion in a peripheral slot, there being a cutter to cut a free end portion of the wire so that after cutting the billet is carried away from the cutting station in the slot towards the welding station where it is welded to the springs.

The springs are punched out of strips of contact spring material. The springs can remain integral with the respective strip, or they can be separated and stacked prior to feeding through the contact making and forming stations. The springs are fed through the contact welding station and then through a cutting station where the billet is cut so that the contact springs become separated. The springs pass through a coining station where the unfinished contacts are coined to shape. They are then stacked or if integral with the strips rewound on respective separate reels.

In order that the invention can be clearly understood reference will now be made to FIGS. 1–6 filed with the Provisional Specification and FIGS. 7–10 of the accompanying drawings, wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1A–1G illustrate schematically the billet and contact forming process according to an embodiment of the present invention;

FIGS. 2A–2D show schematically parts of an apparatus for carrying out the forming process of FIG. 1;

FIG. 3 shows schematically apparatus incorporating the parts of FIG. 2;

FIGS. 4A and 4B are respectively a plan and side view of a complete high speed contact forming and welding machine incorporating the features outlined in FIGS. 1, 2 and 3;

FIG. 5 shows in greater detail typical contact springs, during a stage of manufacture according to an embodiment of the present invention;

FIG. 6 shows a welding head arrangement suitable for use in the embodiment of FIG. 4;

FIG. 7 shows schematically an alternative embodiment of the present invention;

FIG. 8 shows in greater detail part of the embodiment of FIG. 7;

FIGS. 9 and 9A show another part of the embodiment of FIG. 7 in greater detail; and

FIG. 10 is a schematic section of part of FIG. 9 on a different scale.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, precious metal wire 1 is fed from a reel to a cutting station where a cut 2 forms a billet 3 for transfer to a welding station (FIG. 1A and FIG. 1B). The billet 3 is located between two springs 4 and 5 (FIG. 1C) and is welded to the springs 4 and 5 at the welding station (FIG. 1D).

The springs and welded billet move on to a cutting station where a cut 6 (FIG. 1E) forms the welded billet into two separate contacts 7 and 8 (FIG. 1F). The contacts are subsequently coined to produce the finished contacts 9 and 10 (FIG. 1G).

The above description and FIG. 1 describes the basic process and apparatus and further details of various other aspects of the process and apparatus will be more fully explained in the subsequent drawings.

Referring to FIG. 2, FIG. 2A shows the use of two rotating cutters 11 and 12 for cutting a billet 3 from the fed wire 1. A carrier plate 13 carries the billet in a slot 14 to a welding station illustrated schematically in FIG. 2B. Here two rolling electrodes 15 and 16 supply welding current from a supply (not shown) through the springs 4 and 5 and the billet 3 as the springs and billet pass between the rollers. From the welding station the springs and welded billet pass to a cutting station illustrated schematically in FIG. 2C where the billet is cut into the separate unfinished contacts 7 and 8.

From this cutting station the springs and unfinished contacts pass through a coining station illustrated schematically by FIG. 2D comprising two rollers 17 and 18, the roller 17 having recesses such as 19 having the shape of the finished contacts such as 9.

The springs are connected together and form part of an integral strip which is unwound from a first roller pass through the welding and forming apparatus and are wound onto a second roller (see FIGS. 3, 4 and 5).

Referring to FIG. 3 the precious metal contact wire 1 is fed from several reels of the wire (not shown) via a wire feeder 20 to a rotating wire feed turret 21 which is rotationally fast with a cutter wheel 21 (similar to wheel 11, FIG. 2A). The turret 20 carries free end portions, such as 22, into the cutting station where they are picked up by slots such as 23 in the carrier plate 24 (similar to carrier plate 13 in FIG. 2).

The cut billets are held captive in the slot such as 23 by means of a cover plate 25 and base 26 and intermediate pressure plate 27, during their transfer round to the diametrically opposed welding station illustrated schematically by rotary welding electrodes 28 and 29 (corresponding to 15 and 16 in FIG. 2). Pre-punched

strips 30 and 31 of transverse springs (such as 4 and 5, FIG. 2) are advanced through the welding station and to the cutting station represented schematically by co-operating cutter wheel 32 and 33 (corresponding to the wheels shown in FIG. 2C). Although not shown in FIG. 3 each contact could then be subjected to a coining operation as illustrated in FIG. 2D, or alternatively, could simply be rewound on take-up reels for coining elsewhere.

Referring to FIG. 4 two coils of pre-punched nickel silver strip A provide springs arranged across the strips with the contact positions along one edge. FIG. 5 shows clearly a typical spring configuration having slots 34 and 35 to engage with feed sprockets B for synchronously advancing the pre-punched strip to the welding and cutting stations. Coils C of precious metal wire (e.g. 0.85 m/m diameter) are mounted on the billet producing unit, above a wire feeder and turret such as is shown schematically in FIG. 3.

Upon starting the machine the strips feed forward in unison and at constant speed. At the same time the wires (such as 1) are fed and cut to produce billets (see FIG. 3) of a preset length. The wires are carried round in the turret and during its revolution feed forward in preparation for the next cut, while the billets are carried in the carrier plate 24 to meet the spring strip at the welding station D. The end of each individual contact spring locates in a nest (not shown) on the billet carrier plate to ensure accurate location of the billet with respect to the contact springs. When a spring and billet assembly arrives at the welding station the electrodes grip the assembly and travel with it during the welding cycle.

The two strips now joined by a billet at each contact position continue through the machine to the cutting station E where the two rotary blades cut the billets into half, thus separating the spring strips and leaving chisel-shaped contacts on each strip. The strips are then rewound onto individual take-up reels.

The final coining of the contacts can be performed at a later stage, when the strips are cut into individual springs. The welding current can be monitored as every billet is welded to give an immediate indication of the condition of the weld and the machine can be arranged to automatically stop if a fault occurs.

Referring now to FIG. 6 there is shown one embodiment of welding apparatus which would be situated above the strips of contact springs as they pass through the welding station. Below the strips would be a similar piece of welding apparatus working synchronously with the one shown.

The apparatus comprises an electrode carrier 36 carrying an electrode 37. The carrier is mounted on flexures 38 connected to a block 38*a* mounted on a beam 39. The beam 39 is pivotably connected at 40 and 41 to respective depending beams 42 and 43 pivotably connected to a frame (not shown) at 44 and 45. A compression spring arrangement 46 acts between a cam 47 and the top of the electrode carrier 36. This cam 47 imparts up and down motion to the electrode while a second cam 48 imparts horizontal motion to the electrode.

In operation the cams co-operate to drive the electrode tip 37 over the closed loop *a*, *b*, *c*, *d* indicated by the dotted line in the Figure. At *a* the electrode tip is positioned just above the tip of a contact spring about to be welded and proceeds down into contact with the strip at position *b*, through the combined action of the cams 47 and 48, spring arrangement 46 and slight flexure of the flexures 38. From *b* to *c* the electrode tip is held in contact with the spring contact and weld current is applied to weld the contact to the contact spring. At *c*, the cam 47 allows the electrode tip to rise to position *d* away from the contact spring and then cam 48 causes the tip to return through the loop back to position *a* to commence a further weld on a subsequent contact spring.

As stated above a similar apparatus would operate beneath the contact spring in a similar mode.

Referring now to FIG. 7 an alternative apparatus is shown for high speed contact welding utilizing separate contact springs, i.e. springs which are not integral with the strip from which they are punched. Referring to the drawing at the left hand end the machine comprises a double feeder unit A' which feeds two prepunched springs from the spring magazines B' to the transfer track C'. A transfer mechanism (shown more clearly in FIG. 8) moves the springs along the track to the operating stations. The first operating station is the welding heads D' (one above and one below) and, to one side of the transfer track there is the precious metal wire feed unit E' from which the individual billets are cut (shown in greater detail in FIGS. 9 and 10). Further along a splitter cut station F' separates the two springs which have been welded together via a pair of billets and the spring contacts are coined at the coining unit G'. Finally the individual springs are stacked on stacking stems H'.

This machine differs from the one described earlier also in that the welding head does not move with the contact springs neither does the precious metal wire feed unit E' rotate. This also is fixed and the whole process is a step-by-step process, the operations at the various stations taking place while the transfer of the springs has temporarily halted.

Referring now to FIG. 8 the feed of the individual contact springs is shown on a larger scale and in greater detail, although still somewhat schematically.

In FIG. 8 the initial part of the feeding unit A' comprises a rotating crank 50 with a connecting rod 51 driving a feeding tongue 52 to and fro sinusoidally. A spring magazine 53 (one of the magainzes B' in FIG. 7) feeds the springs in front of the tongue 52 which projects them forward so that the springs such as 54 become engaged by a feeding arm 55 driven in orbital fashion by a crank 56. The arm 55 has a plurality of teeth 57 which drives the springs such as 54 along by their rear edge. In order to ensure that the spacing and positioning is accurate a guiding arm 58 is driven up and down by a connecting rod 59 and a rotating crank 60. This arm 58 has a plurality of teeth 61 having tapered ends such as 62. The synchronization of the movement of the arms 55 and 58 and the tongue 52 is indicated on their respective crank positions by the letters *a*, *b* and *c*.

Although not shown a second feed of contact springs from the second of the magazines B' (FIG. 7) is positioned just below those shown in FIG. 8 and separated by the track plates. Arms similar to 55 and 58 would be positioned upside down with reference to FIG. 8 to feed the underlying row of springs in synchronism with the first row shown in FIG. 8. As illustrated in FIG. 7 the feed unit A' has two tongues (each similar to 52 in FIG. 8) for feeding from the respective magazines.

Referring now to FIG. 9 there is shown perspectively and schematically a wire feed unit E' and one of the welding heads D'. The arrangement is somewhat similar to that shown in FIG. 3 except that only two precious metal wires 63 and 64 are fed to provide the billets in pockets such as 65 in a billet carrier wheel 66. In the position shown in FIG. 9, a flying cutter arm 67 having two cutting wheels 68 and 69 will rotate anticlockwise about the pivot 70 sufficient to cut the two wires 63 and 64 just above the pockets in the wheel 66 in which the wires are positioned. The arm 67 returns then to its position shown in the Figure and the wheel 66 rotates clockwise about the pivot 70 through one step, i.e. to a position where the next pair of pockets 65 is situated beneath the wires 63 and 64 to receive the end portions of the wires.

The cut billets are carried around by the wheel 66 to the position of the welding head D'. As shown contact springs 54 are advanced so that at the welding position their contact head portions just overlie the wheel 66 to receive a pair of billets. As the contact springs are advanced to the welding position their contact tip portions ride up a ramp so that at the welding position the contact tip portions rest on the tips of the respective billets. A similar feed of contact springs is also fed just beneath those shown in FIG. 9 so that their contact tip portions overlie the other side of the wheel 66 in a corresponding position. The welding head D' welds the contact spring 54' to a corresponding spring beneath it via the two contact billets and this is shown by the reference numeral 54''.

In FIG. 9A the contact tip portions of the two contact springs 54'' held together by their welded contact billets 55 and 56 are shown in greater detail (each similar to the contact billet 3 shown in the sequency of events in FIGS. 1A–1G). A guiding and feeding arrangement (not shown in FIG. 8) would be used to guide the contact wires 63 and 64 accurately into the pockets such as 65 in the wheel 66.

The step-wise movement of the wheel 66, the motion of the cutter 67, the feed mechanism for feeding the wires 63 and 64 (not shown) and the operation of the welding heads D' would all be synchronized with the step-wise transfer motion of the contact springs 54. This of course applies to the splitter cutters F' and the coining unit G' shown in FIG. 7. All such operations are carried out while the springs or contact billets are stationary and this is one of the main distinguishing features between this arrangement and that described with reference to the earlier figures.

Referring now to FIG. 10, which is a section in the direction of the arrows on the line X—X shown in FIG. 9, but with the flying cutter arm 67 on the point of cutting a billet from the wire 63. It is emphasized that once again the drawing is mainly schematic. The cutter wheels 68 and 69 are rotated in mutually opposite directions as they approach the wire 63 so that as the wheel peripheries touch the is 63 there is little or no relative movement between the peripheries of these wheels and the wire 63. This ensures a clean cut of the wire 63 with the cutting peripheries. A billet 71 (similar to 3, 56 and 55 of the other figures) is thus cut from the wire and is held in position in the pocket 65 of the wheel 66 and a guide wall 72 ensures that the billet does not fall out of the pocket during rotation of the wheel 66 to transfer the billet to the welding station D'. The FIG. 10, being schematic, does not show associated driving gearwheels etc, which would be required to drive the cutter wheels 68 and 69 and to rotate the arm 67 and also to drive the carrier wheel 66.

The specifications of the manufacturing process and apparatus of this invention which have been described herein, are given by way of example only, and are not meant in any way to limit the scope of this invention.

What is claimed is:

1. A method of manufacturing contact springs comprising the following steps:
   a. locating a billet of contact material between two springs;
   b. supporting the billet and the springs so that the billet contacts the springs;
   c. passing an electric welding current through said contact and springs to weld the billet to both said springs; and
   d. forming the billet into two separate portions so that each spring contains a contact made from said billet.

2. The method according to claim 1 wherein said springs are bifurcated and wherein two said billets are each welded to both said springs, each said billet being subsequently formed into separate portions so that each said spring contains two contacts made from said two billets, each said one contact on each spring portion formed by the bifurcation thereof.

* * * * *