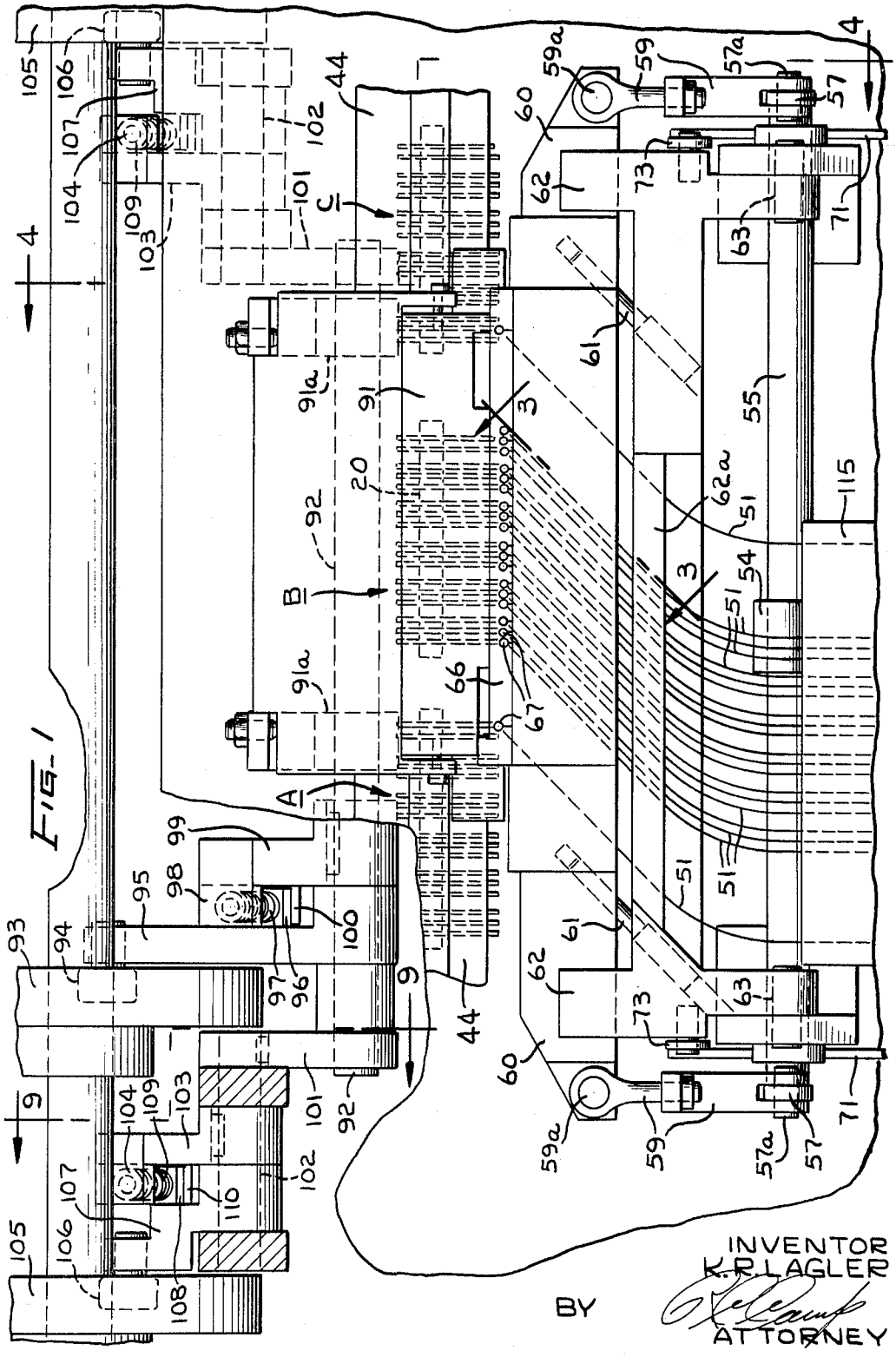
March 8, 1966 K. R. LAGLER 3,239,123

CONTACT ASSEMBLING MACHINE

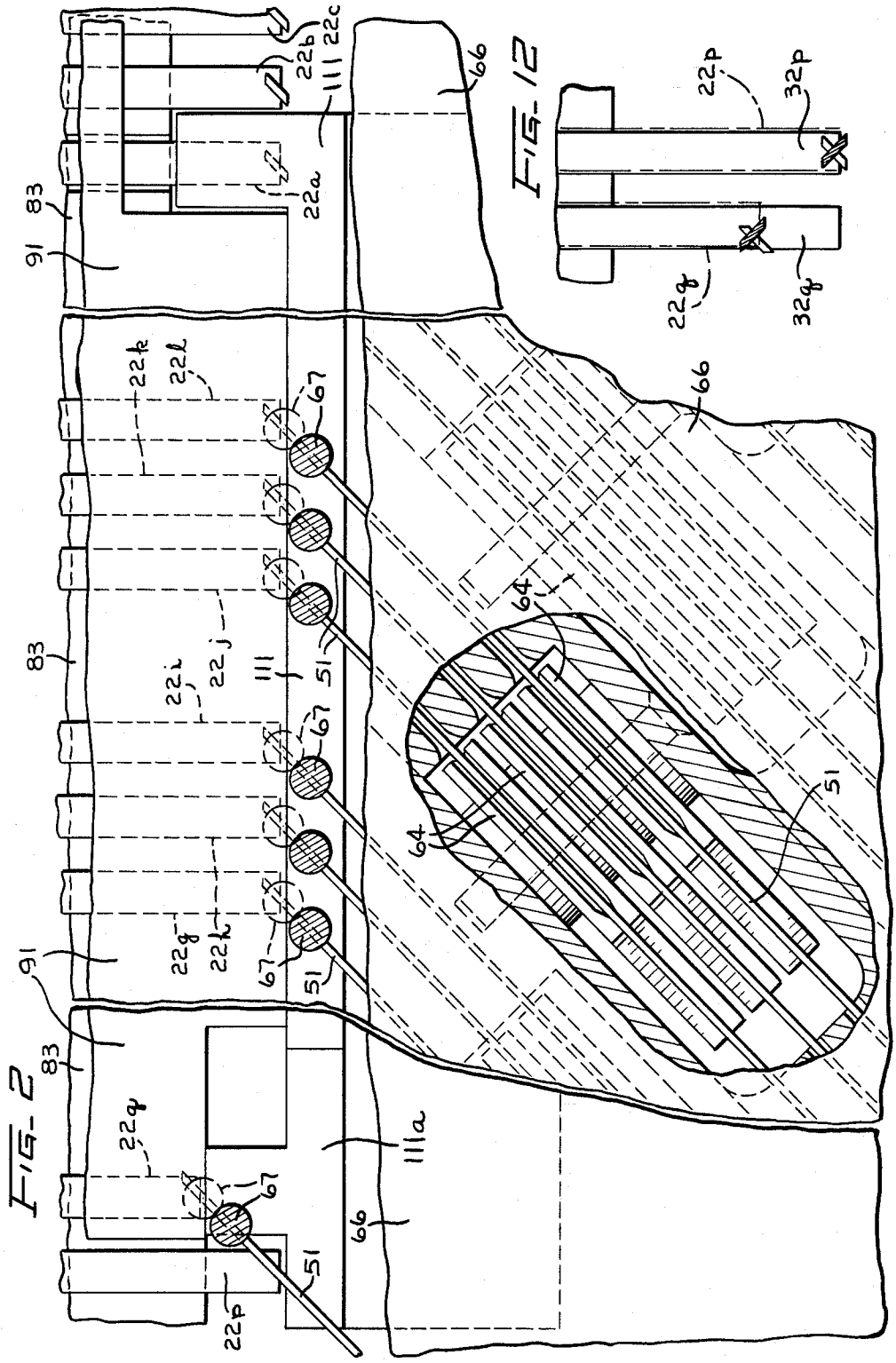
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CONTACT ASSEMBLING MACHINE

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CONTACT ASSEMBLING MACHINE

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FIG. 10

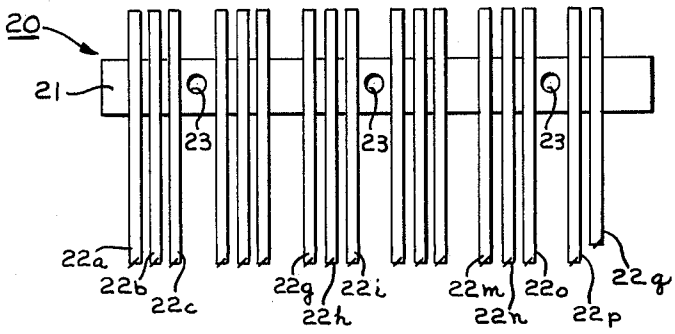


FIG. 3

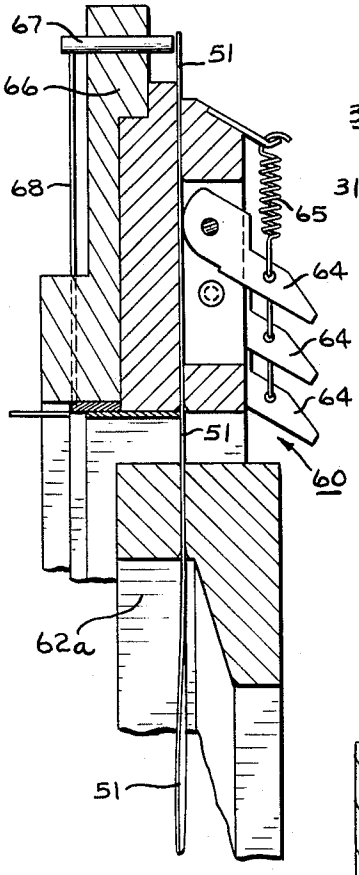


FIG. 11

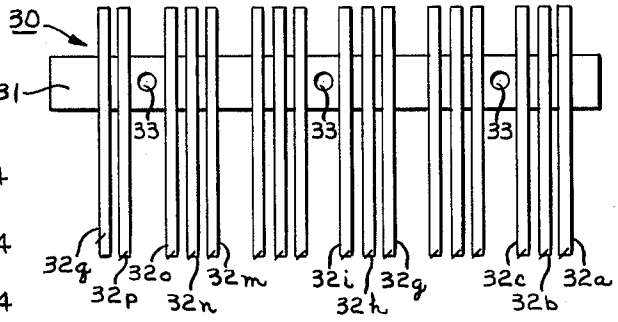
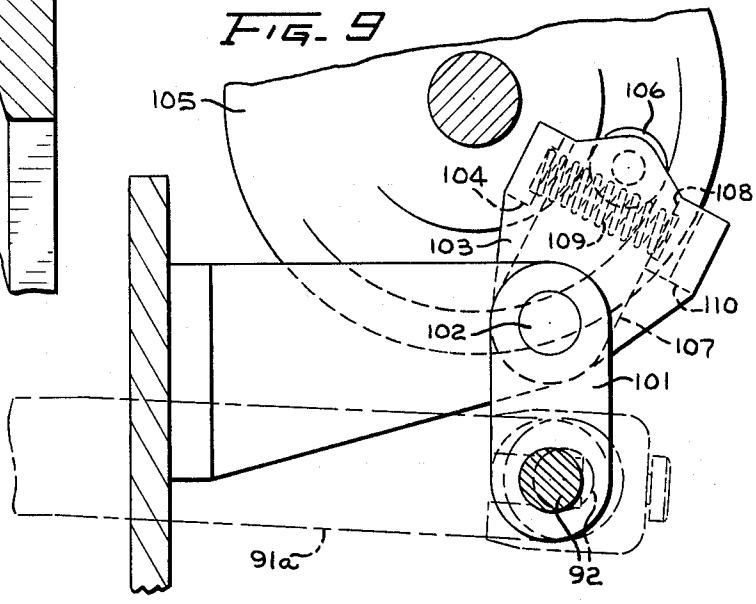


FIG. 9

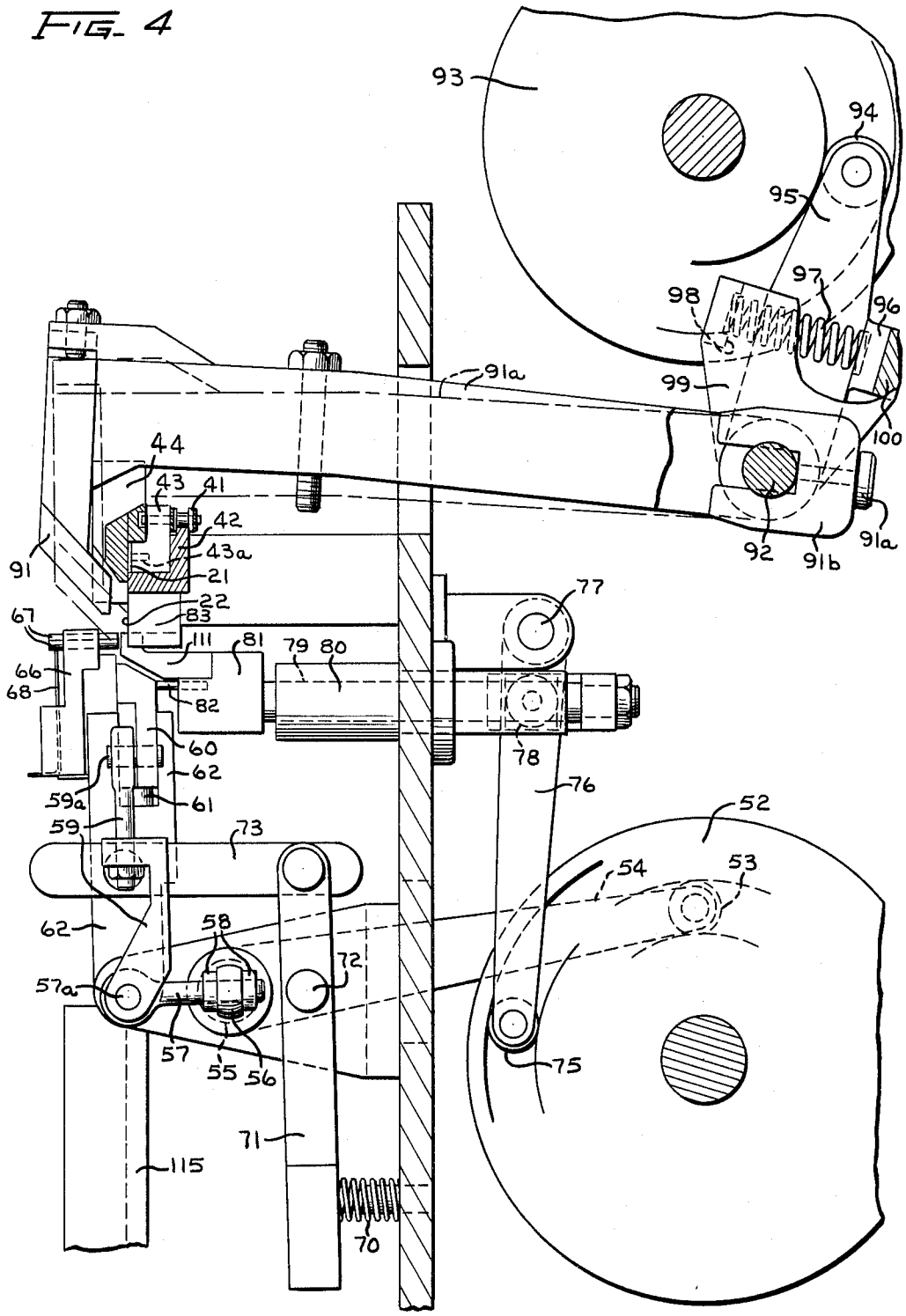


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FIG. 4



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FIG. 5

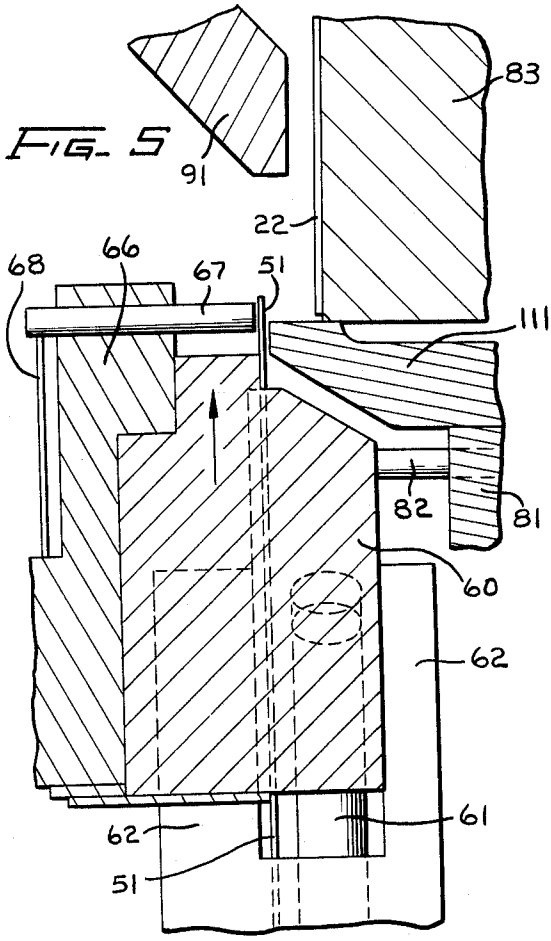


FIG. 6

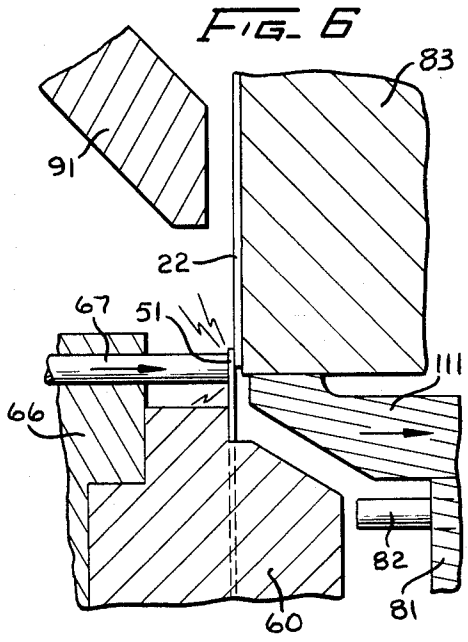


FIG. 7

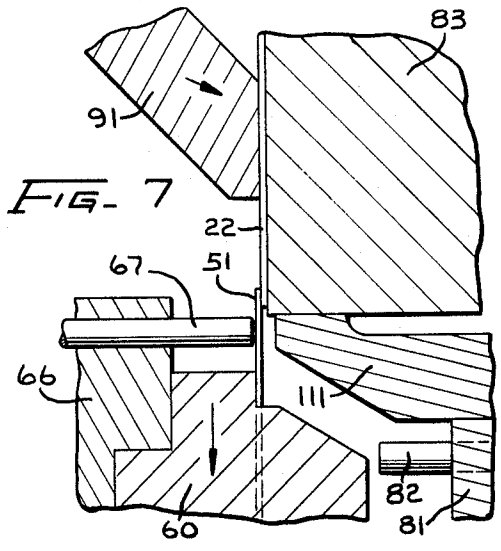
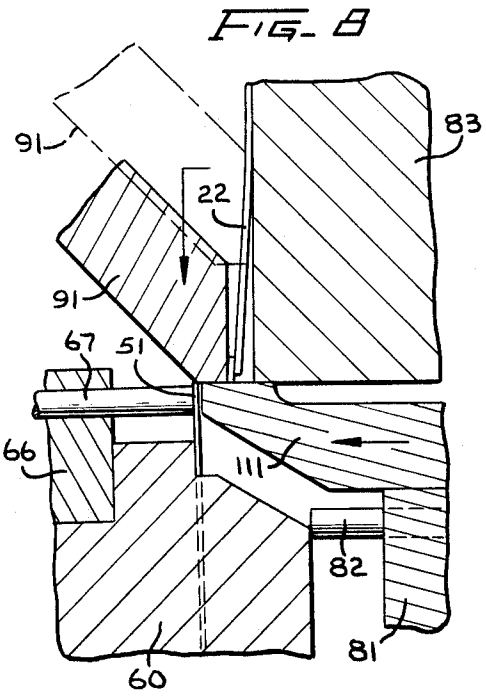


FIG. 8



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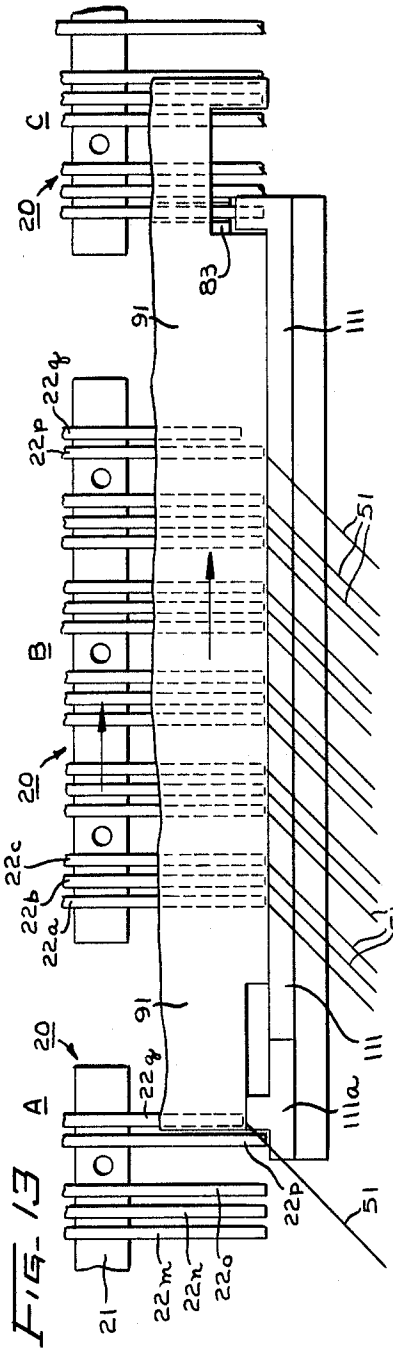


FIG. 13

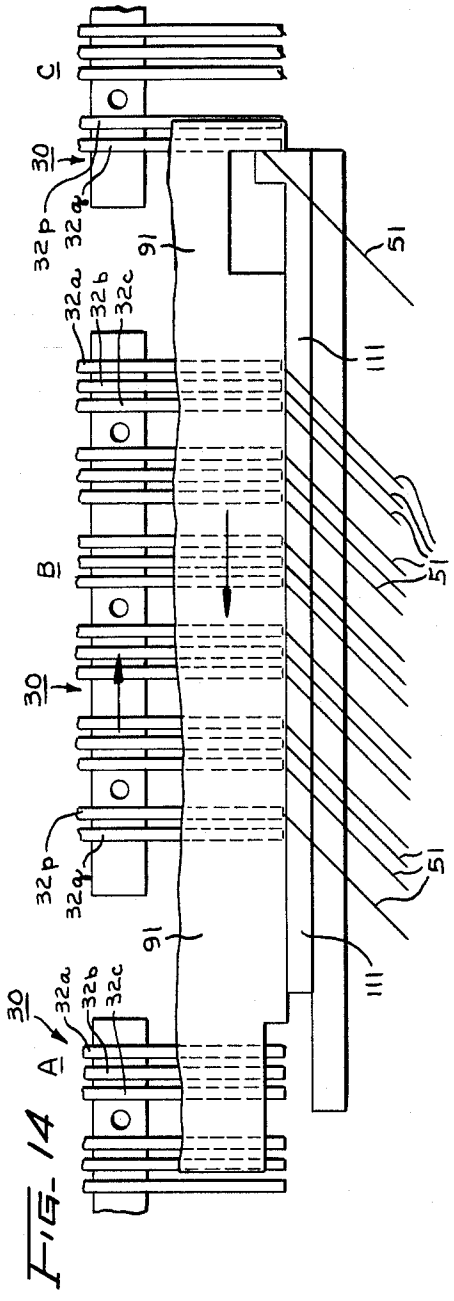


FIG. 14

United States Patent Office 3,239,123 Patented Mar. 8, 1966

3,239,123

CONTACT ASSEMBLING MACHINE

Karl R. Lagler, Indianapolis, Ind., assignor to Western Electric Company Incorporated, New York, N.Y., a corporation of New York

Filed July 17, 1964, Ser. No. 383,359
4 Claims. (Cl. 228—18)

This invention relates to a contact assembling machine, and more particularly to a machine for welding or otherwise securing tape contacts to contact springs. It is an object of the invention to provide an improved machine of that character.

In certain types of switches, whether in the form of relays or of manually operated switches, it is desired that metal tape contacts of precious or semi-precious metal be secured to the free ends of springs, the latter being in the form of a short length of either wire or leaf spring. In the completed switch, pairs of spring contacts cooperate to make and break a circuit, the springs of a pair being arranged parallel to each other such that the metal tape contacts engage each other either in the normal position of the springs or when one or both of the springs is flexed either manually or by operation of a solenoid. In one common form of such a switch, the tape contacts are thin and elongated, in which case the contacts, in the completed assembly, are arranged at an angle of 90° with respect to each other such that contact therebetween is assured in spite of manufacturing tolerances.

It is another object of the invention to provide a completely automatic machine for securing metal tape contacts to contact springs.

A further object of the invention is to provide an improved machine for assembling such contacts, which machine employs indexing apparatus to advance metal contact tapes to positions overlying contact springs and has provision for protection of the contact springs against damage during retraction of the indexing apparatus.

A further object of the invention is to provide a machine for securing metal contact tapes to both of the two cooperable contact spring assemblies of a multiple contact switch, the elongated tape contacts being so applied to the contact springs that in the completed switch the contacts are arranged at an angle of 90° with respect to each other.

Still another object of the invention is to provide a machine of the character specified immediately above wherein no adjustment is required of the tape feeding angle in the securing of contacts to the contact springs of the two cooperable contact spring assemblies.

It is another object of the invention to provide a fully automatic machine having various of the characteristics specified above while being simple in construction and efficient and reliable in operation.

In accordance with the preferred embodiment of the invention, contact tapes are advanced to positions overlying contact springs and are welded thereto at an angle of 45° with respect to the longitudinal axes of the contact springs. Two cooperating shear blades are operated to sever the tapes adjacent edges of the contact springs. Prior to the severing of the contact tapes a tape indexing head is retracted in preparation for the advancement of the tape in the succeeding cycle of operation. Since the tape advancing head exerts a substantial drag on the tapes during its retraction and since the tapes are welded to the contact springs at an angle of 45°, provision is made for momentarily clamping the contact springs firmly in position to resist bending of the springs. For this purpose, one of the shear blades is pressed resiliently but firmly against the contact springs during retraction of the tape feed head. This shear blade is arranged to be pivoted between a retracted position and a tape severing position. In order to advance the shear blade from its retracted position to a spring clamping position, provision is made for shifting of the pivotal axis of the shear blade. The machine incorporates various features which permit the welding of contact tape to both of the two contact spring assemblies of a multiple contact switch at an angle of 45° with respect to the longitudinal axes of the contact springs.

This invention, together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawings, in which

FIG. 1 is a partial front elevational view, partially broken away, of a machine embodying the present invention;

FIG. 2 is an enlarged view, partially broken away, of the central portion of the apparatus shown in FIG. 1;

FIG. 3 is an enlarged, partial cross-sectional view taken along the lines 3—3 of FIG. 1;

FIG. 4 is an enlarged, partial cross-sectional view taken along the line 4—4 of FIG. 1;

FIG. 5 is a view taken in the same plane as FIG. 4 showing tape indexing, welding, clamping and cutting apparatus in the position assumed immediately prior to the welding of contact tape to a contact spring;

FIG. 6 is a view similar to FIG. 5 but showing the tape being welded to the spring contact;

FIG. 7 is a view similar to FIGS. 5 and 6 but showing the spring contact protectively clamped during retraction of the tape indexing apparatus;

FIG. 8 is another view similar to FIGS. 5, 6 and 7 but showing the shearing of the welded tape;

FIG. 9 is a partial cross-sectional view of the machine taken along the line 9—9 of FIG. 1;

FIG. 10 is a plan view of a contact spring assembly with tape contacts welded thereto;

FIG. 11 is a similar view of a contact spring assembly with tape contacts welded thereto, this assembly being intended for inversion and face-to-face cooperation with the assembly of FIG. 10;

FIG. 12 is an enlarged view of two pairs of cooperating spring contacts, the contact springs of the cooperative assemblies being shown in solid lines and in phantom lines, and the cooperative tape contacts of the two assemblies being shown in contrasting form;

FIG. 13 is a view taken in the same plane as FIGS. 1 and 2 showing the condition of shear blades when the machine is operating on the contact spring assembly of FIG. 10; and

FIG. 14 is a view similar to FIG. 13 but showing the condition of the shear blades when the machine is operating on the contact spring assembly of FIG. 11.

The machine illustrated in FIGS. 1–9 serves to secure tape contacts to both of two cooperative contact assemblies 20 and 30 shown in FIGS. 10 and 11. These two assemblies, after the tape contacts have been secured thereto, may be brought into face-to-face relationship as part of a multiple contact switch, the elongated tape contacts of one assembly extending at an angle of 90° with respect to the tape contacts of the other assembly. The completed, multiple contact switch is a manually operable switch for use in a key set telephone, each manually operable button of the key set telephone serving to actuate one of the six groups of pairs of spring contacts.

The machine shown in FIG. 1 includes three welding stations identified as A, B, and C where lengths of metal contact tape are welded to selected contact springs of the contact spring assemblies, after which the tape is severed. Contacts are thus applied to the contact spring assemblies at station A and B or at stations B and C,

depending upon which of the two assemblies is being fed through the machine.

Referring to FIGS. 10 and 11 it may be seen that the two, cooperating assemblies are not symmetrical about a centerline. The two assemblies, therefore, present different patterns, and minor adjustments of the machine must be made to weld contacts in the two different patterns.

The assembly **20** shown in FIG. 10 includes an insulating bar **21** and seventeen contact springs identified as **22***a* through **22***q*. It will be noted that a series of holes **23** are provided in the insulating base **21** for mounting purposes. These holes are used in the assembly feeding apparatus of the machine, as described below.

The spring contact assembly **30** shown in FIG. 11, includes an insulating bar **31** and seventeen contacts identified as **32***a* through **32***q*. This assembly is also provided with mounting holes **33**.

At welding station B of FIG. 1, tape contacts are welded to the first sixteen contact springs of the assembly **20**, namely the contact springs **22***a* through **22***p*. At welding station B, tape contacts are applied alternatively to contact springs **32***a* through **32***p* of the assembly **30**. For this purpose it is necessary that there be eighteen individual welding locations at station B. In the application of contacts to the assembly **20** no welding is done at the two locations at the extreme right. In the application of contacts to the assembly **30** no welding occurs at the two locations at the extreme left.

The remaining contact of each assembly is welded at station A or station C, a contact being welded to the contact spring **22***q* at station A, or a contact being welded to the contact spring **32***q* at station C.

An important feature of the present invention is that the machine can apply contacts to both of the two assemblies **20** and **30** in such a manner that when the two assemblies are brought into face-to-face, cooperative relationship, the elongated contacts of one assembly lie at an angle of 90° with respect to the contacts of the other assembly such that effective contact engagement is assured in spite of manufacturing tolerances. Furthermore, this is accomplished without adjustment of the angle of application of the tape contacts to the two assemblies.

Conventionally, elongated contacts are applied to contact springs in two different orientations with respect to the springs. More specifically, one contact is commonly oriented in alignment with the longitudinal axis of the spring, and the other contact is arranged to extend transversely of the longitudinal axis of the spring. This results in the elongated contacts lying at an angle of 90° with respect to each other when the assemblies are brought into face-to-face, cooperative relationship. This conventional arrangement of contacts is normally effected through the use of two independent machines, since the conversion of a single machine to apply the contacts in the two different orientations would be so extensive as to make such a machine quite impractical. Where the contact springs are closely spaced, as in the assemblies **20** and **30**, the feeding of tape to all of the contact springs simultaneously would result in interference. It is conventional, therefore, to resort to the time-consuming practice of welding tape to individual contact springs sequentially.

In accordance with the present invention various provisions are made within the machine to permit the placing of the tape contacts against the contact springs at an angle of 45° with respect to the longitudinal axes of the springs. Various problems attending this arrangement, and the solutions thereto, are described below. With the elongated tape contacts arranged at 45° with respect to the longitudinal axes of the springs, the contacts of both assemblies **20** and **30** being arranged in the same orientation, reversal or inversion of one of the assemblies and arrangement of the two assemblies in cooperative face-to-face relationship brings the cooperating pairs of tape contacts into a relationship in which they extend at an angle of 90° with respect to each other, as illustrated in FIG. 12.

A conveyor is provided for advancing either of the contact spring assemblies **20** or **30** to the successive welding stations A, B and C. A portion of the conveyor can be seen in FIG. 4. A conveyor chain **41** is arranged to ride along a fixed member **42** which is secured to the frame of the machine. L-shaped lugs **43** are secured to the conveyor chain and are guided in their movement by the fixed member **42** and another fixed member **44**. A pin **43***a* projects from each lug **43** and is received within an opening **23** or **33** in the insulated support **21** or **31** of the spring contact assembly **20** or **30**.

In the drawings the machine is shown applying contacts to a succession of assemblies **20**. The insulated support **21** thereof may be seen in FIG. 4, the main length of the contacts **22** extending downward therefrom. It will be noted that the insulating support **21** is confined by the lugs **43** and the fixed members **42** and **44** such that its movement is limited to a direction longitudinal of itself.

Since the drive apparatus for the conveyor chain **41** does not of itself constitute a feature of this invention, and since it may be of any conventional form, it is not shown herein. It will, of course, be appreciated that indexing movement of the chain **41** should be in synchronism with other operating parts of the machine.

With successive spring contact assemblies **20** arranged at the three welding stations A, B and C, contact tape **51** is advanced toward the welding stations. In FIG. 4 a cam **52** is shown controlling a cam follower **53** mounted on a lever **54**. This lever is secured to a shaft **55** which can be seen also in FIG. 1.

At each end of the shaft **55** there is a tongue **56** which has an aperture for receiving a pin **57**, the pin being rotatable within the tongue but fixedly positioned with respect thereto by collars **58**.

The free ends of the pins **57** are pivotally connected to respective adjustable links **59** through pins **57***a*, and the upper ends of these links are pivotally connected to a tape feeding head **60** through pins **59***a*. It may now be seen that as the cam **52** rocks the lever **54**, the links **59** cause raising and lowering of the tape feeding head **60**. Since the pins **57** are rotatable within the tongues **56** at the ends of the shaft **55**, and since the links **59** are pivotally connected to the tape feeding head **60**, the tape feeding head **60** is free to swing to the right and left as viewed in FIG. 1.

A pair of guide rods **61** (see FIG. 1) are set in a guide member **62** (best seen in FIG. 4) and are received in openings provided in the tape feeding head **60** for that purpose. Accordingly, as the tape feeding head is raised, through operation of the cam **52**, it is guided to the right in FIG. 1 by the guide rods **61**, such that it rises at an angle of 45°. Through this arrangement vertical movement of the tape feed drive is converted to movement of the tape feed head at an angle of 45° with respect to the vertical. This is desirable as it permits the use of horizontal shafts for the driving of all cams.

The guide member **62** not only supports the guide rods **61** but also defines a slot **62***a* which slidably receives portions of the tape feeding head **60**, as shown in FIG. 4. The guide member **62** is pivotally mounted on the frame of the machine through pins **63** (see FIG. 1) which are approximately concentric with the pivotal connections of the links **59** with the pins **57**. It will be appreciated that these pivotable connections are not truly concentric since the pins **63** are secured to the frame of the machine whereas the pivotable connections between the pins **57** and the links **59** move a short distance vertically in response to rotation of the cam **52**. It will also be appreciated that precise concentricity is not required. Control of pivotal

movement of the guide member **62** and, hence, of the tape feeding head **60** is described below.

The tape feeding head **60** is shown also in FIG. 3 wherein it may be seen to carry a plurality of pawls **64** biased by springs **65**. Each of the pawls **64** serves as a one-way feed device for a strand of contact tape **51**. More specifically, as the tape feeding head **60** rises it advances the tape **51** therewith, and as the tape feeding head is lowered, the tape **51** is relatively free to remain in its advanced position. It will be appreciated that there is a pawl **64** for each strand of contact tape. The tape feeding head also carries a welding head **66** including a plurality of electrodes **67** provided with leads **68**.

As the tape feeding head rises it is necessary that the tapes be positioned slightly in front of the spring contacts, to the left as viewed in FIGS. 3 and 4, in order that the ends of the tapes may not strike the ends of the spring contacts. After the tape feeding head has been fully raised it is desirable that it be swung to the right in FIG. 4 such that the ends of the tapes may be brought into contact with the contact springs. Still further, since the welding head **66** is secured to the tape feeding head **60**, further rightward movement of the tape feeding head is desired in order to bring the welding electrodes **67** into play. It is for these reasons that the guide member **62** is made pivotable about the pins **63** of FIG. 1.

Each end of the guide member **62** is biased toward the right, as viewed in FIG. 4, by a spring **70** acting through a lever **71** pivoted at **72**, and a link **73** which is pivotally connected to the lever **71** and to the guide member **62**.

Leftward pivotal movement of the guide member **62**, against the biasing of the springs **71**, is effected by the cam **52** acting through a cam follower **75** and a lever **76** which is pivoted at **77**. The lever **76** carries a rod **78**, and the ends of the rod **78** are connected to plungers **79** (only one of which is shown) slidable in sleeves **80**. A bar **81** is connected to the forward end of each of the plungers **79**, and this bar carries a plurality of pins **82** which bear against the right-hand edge of the tape feeding head **60**.

It will be apparent that as the cam **52** rocks the lever **76** to the left in FIG. 4 the pins **82** force the tape feeding head to the left against the bias of the springs **70**. When the lever **76** is rocked to the right it withdraws the pins **82** and allows the springs **70** to advance the tape feeding head **60** to the right.

Initial rightward movement of the tape feeding head **60** places the ends of the contact tapes against the contact springs and continued movement brings the electrodes **67** into contact with the tapes. The contact springs are pressed against a stationary electrode **83** such that upon application of electric power current flows from the movable electrodes **67** through the contact tapes and the corresponding contact springs to the common stationary electrode **83**. The current is sufficient to weld the contact tapes to the corresponding contact springs.

Upon completion of the welding of the contacts, the tape feeding head **60** is pivoted to the left and lowered by the cam **52**, the pawls **64** sliding along the respective tapes which remain in their advanced positions. Shear blades are then operated to sever the tapes adjacent edges of the spring contacts.

Since the pawls **64** exert a substantial drag on the respective tapes as the tape feeding head is lowered and since the drag pulls on the contact springs at an angle of 45°, it is necessary that the contact springs be firmly clamped against the fixed electrode **83** during retraction of the tape feeding head.

In accordance with one feature of the present invention this clamping is effected through use of one of the shear blades **91**. This upper shear blade is, therefore, arranged to move from its retracted position (shown in solid lines in FIG. 4) to two different operating positions. One of these is its tape shearing position (shown in phantom lines in FIG. 4) and the other is its clamping position.

The upper shear blade is secured to a pair of arms **91***a* which are in turn secured to a shaft **92**. The shaft **92** is caused to rotate through a small angle by rotation of a cam **93**. The cam has a track which cooperates with a cam follower **94**, the cam follower being mounted at one end of an arm **95**. The other end of the arm **95** is freely rotatable about the shaft **92** but has a lug **96** which supports a spring **97**. This spring bears against a lug **98** on an arm **99** which is secured to the shaft **92**. Another lug **100** on the arm **99** limits counterclockwise rotation of the arm **99** with respect to the arm **95**.

It will now be apparent that leftward movement of the arm **95** resiliently urges counterclockwise rotation of the arm **99**, the shaft **92**, the arms **91***a* and the upper shear blade **91**. This brings the shear blade **91** to its tape shearing position, which is shown more clearly in FIG. 8.

As will be apparent upon reference to FIG. 4, the upper shear blade **91** cannot be brought to tape severing position to hold the contact springs against displacement by the retraction of the tape feeding head **60** since the shear blade **91** in such a position would conflict with the movable welding electrodes **67**. In order to employ the upper shear blade **91** for this purpose another movement is provided such that the blade may be clamped against the contact springs in a position substantially above its cutting position.

For this purpose, the shaft **92** is movably supported by and rotatable with respect to a pair of arms **101**, as shown in FIG. 9. These arms are secured to shafts **102**. Also secured to each shaft **102** is another arm **103** carrying a lug **104**. A pair of cams **105** cooperates with cam followers **106** carried at the free ends of corresponding arms **107** which are freely pivoted on the shafts **102**. Each of the arms **107** has a lug **108**, and a compression spring **109** is arranged between the lugs **104** and **108**. Another lug **110** on each of the arms **103** limits clockwise movement of the arm **107** with respect to the arm **103** as viewed in FIG. 9.

When the cams **105** move the cam followers **106** forward (to the left in FIG. 9) the arms **107**, acting through the springs **109** swing the arms **104** forward. This swings the arms **101** rearward such that the shaft **92** is displaced toward the rear and downward to the position illustrated in phantom lines in FIG. 9.

Referring now to FIG. 4, it may be seen that this rearward displacement of the shaft **92** draws the upper shear blade **91** against the contact springs **22** of the contact spring assembly **20** as illustrated in FIG. 7. By virtue of the resilience which is provided by the spring **109** (see FIG. 9) the cutter blade **91** may be pressed tightly against the spring contacts without the necessity of severe manufacturing tolerances.

Upon completion of the retraction of the tape feeding head **60**, further rotation of the cam **105** releases the clamping action of the upper shear blade **91** and returns the shear blade **91** to the position shown in FIGS. 5 and 6 and illustrated by solid lines in FIG. 4.

The upper shear blade **91** may then be moved to sever the contact tapes. Rotation of the cam **93** of FIG. 4 lowers the shear blade **91** to the position shown in FIG. 8 and illustrated in phantom lines in FIG. 1 in the manner described above. The cam **52** of FIG. 4 then advances the plungers **79** and the bar **81**. As described above, this swings the tape feeding head **60** and the welding head **66** forward. The bar **81** also carries a lower shear blade **111** which cooperates with the upper cutter blade **91** to sever the contact tapes immediately adjacent edges of the contact springs, also shown in FIG. 8.

Another problem attending the application of contact tape to the springs at an angle of 45° with respect to the longitudinal axes of the springs arises from the fact that the rolls of tape are preferably rotatable about horizontal axes. With this preferred arrangement, the tapes reach the machine traveling vertically and must be turned through an angle of 45°. Furthermore, the tape, which

is commonly substantially wider than it is thick (.038" by .019" in one application) must, in effect, be turned edgewise. This tends to produce substantial binding of the tape.

In the illustrated embodiment of the invention effective edgewise turning of the tape is accomplished without actual edgewise bending of the tape. As the tapes approach the machine from below they pass through suitable grooves in a fixed block 115 seen in FIG. 1. Above this block and spaced from it is a bar 62*a* which forms a part of the guide 62. The bar 62*a* also has grooves for receiving the individual tapes.

Between the block 115 and the bar 62*a* the tapes are suspended freely. Accordingly, edgewise turning of the tapes induces twisting of the tapes through an angle of approximately 90° and bending of the tapes in the normal direction, followed by twisting of the tapes back to their original planes. Free suspension of the tapes thus permits edgewise turning of the tapes without the binding which would necessarily accompany edgewise bending of the tapes.

The apparatus has been described to this point as adjusted to handle the spring contact assembly 20 of FIG. 10. Certain minor adjustments are required in order to adapt the machine to handle the assembly 30 of FIG. 11.

One adjustment which is required is the activating of the two welding heads at the extreme right at station B and the deactuating of the two welding heads at the extreme left of station B. Also, the welding head at station C must be activated and the welding head at station A must be deactuated. This adjustment can readily be accomplished through the operation of switches. Since the control circuitry does not of itself constitute a feature of the present invention and may be conventional in form it is not shown or described in detail herein.

No adjustment of the tape feed mechanism is required. When the tape feeding head 60 retracts, those tapes whose free ends have not been welded to a contact spring are drawn downward with the head, and are later advanced to their original positions. These tapes will, therefore, merely be shifted back and forth rather than being indexed. As explained above, no change is required in the angle of the tapes relative to the axes of the contact springs.

Relative to the cutting of the tape subsequent to welding, provision is made for shifting of the upper shear blade 91. Referring to FIGS. 13 and 14, it may be seen that the upper shear blade 91 is in its rightward position when the machine is handling the assemblies 20, and in its leftward position when handling the assemblies 30. With the upper shear blade in its rightward position, as shown in FIG. 13, provision is made for severing tape at station A after it has been welded to spring contact 22*q*. At station C the common electrode or backup plate 83 is notched to permit rearward movement of the contact spring 22*a* such that the upward protrusion at the righthand end of the lower shear blade 111 does not damage this contact spring.

With the upper shear blade 91 moved to its leftward position as shown in FIG. 14, provision is made at station C for the severing of tape which has been welded to the contact spring 32*q*. More specifically, the upward protrusion at the righthand end of the lower shear blade 111 cooperates with a downwardly extending righthand portion of the upper shear blade 91. At station A, damage to the contact springs 32*a* and 32*b* is avoided by the removal of a portion 111*a* of the lower shear blade 111.

Provision for the lateral shifting of the upper shear blade 91 is shown in part in FIG. 4. The righthand ends of the arms 91*a* are secured to the shaft 92 only indirectly, the arms having circular openings which freely receive the shaft. The arms 91*a* are releasably secured to the shaft 92 through use of a clamp 91*b*. Each of the arms 91*a* has a groove in its upper surface and a groove in its lower surface for receiving the two arms of the clamp 91*b*.

At two points along the length of the shaft 92 there are flat spots whose axial and radial dimensions are such as to receive the arms of the clamp 91 snugly. When the upper shear blade 91 is in one of its operating positions the clamp 91*b* may be inserted in the grooves in one of the arms 91*a* and engage one pair of flat spots on the shaft 92. A screw 91*c* is inserted through the clamp 91*b* and into a threaded opening in the shaft 92 to hold the clamp in place. Since the clamp engages flat spots on the shaft 92 it is non-rotatable with respect thereto, and since the arms of the clamp 91*b* are arranged in the upper and lower grooves in one of the arms 91*a*, the upper shear blade 91 is non-rotatable with respect to both the clamp 91*b* and the shaft 92.

When the upper shear blade 91 is in its other operating position, the arms of the clamp 91*b* may be inserted in the grooves in the other one of the arms 91*a* and engage the other pair of flat spots on the shaft 92. Since the manner of securing the arms 91*a* of the upper shear blade 91 to the shaft 92 does not of itself constitute a feature of the present invention, and since the apparatus for this purpose may be of various forms obvious to those skilled in the art, it is not shown or described in detail herein.

While operation of the apparatus is believed to be apparent from the above description, a brief resumé of operation is given below, primarily in the interest of clarifying the sequence.

Let it be assumed that the machine is in adjustment for the handling of the contact spring assemblies 20 of FIG. 10 and that an assembly has been advanced to each of the stations A, B and C. Rotation of the cam 52 of FIG. 4, acting through the cam follower 53, raises the tape feeding head 60 and the welding head 66, the tape feeding head guide 62 being tipped forward, or to the left in FIG. 4. This advances the ends of the tapes to positions overlying the contact springs 22*a* through 22*p* at station B and the contact spring 22*q* of the trailing assembly at station A. The tape feeding head 60 and the shear blades 91 and 111 are then in the position illustrated in FIG. 5.

The cam 52 then operates through the cam follower 75 to withdraw the bar 81 such that the springs 70 may force the ends of the tapes against the contact springs and force the welding electrodes against the tapes. This condition is illustrated in FIG. 6. The electrodes are then electrically actuated to effect the welding of the tapes to the contact springs. Electrical actuation of the electrodes may, of course, be accomplished automatically by obvious means.

The cams 105 of FIG. 9 then draw the shaft 92 to the right such that the upper shear blade 91 is brought into firm engagement with portions of the contact springs immediately above the tapes.

Further rotation of the cam 52 of FIG. 4 lowers the tape feed head, the pawls 64 thereof sliding along the tapes. Bending of the contact springs to which the tapes have just been welded is avoided by the clamping of the contact springs against the common electrode 83 by the upper shear blade 91. This condition is illustrated in FIG. 7.

Further rotation of the cams 105 of FIG. 9 moves the upper shear blade 91 forward to its normal, retracted position, shown in solid lines in FIG. 4.

At this time, the cam 93 of FIG. 4 pivots the upper shear blade about the shaft 92 such that the upper shear blade is lowered to its cutting position. The cam 52 of FIG. 4, operating through the cam follower 75, then advances the bar 81 and the lower shear blade 111 to sever the tapes in the manner illustrated in FIG. 8. This also tilts the tape feed heads 60 to the left, as viewed in FIG. 4, in readiness for the next cycle of operation. Prior to the next cycle the conveyor chain 41 indexes all of the

contact spring assemblies 20 one station to the right as viewed in FIG. 1.

Apparatus has now been described for welding elongated bits of contact tape to the contact springs of the two contact spring assemblies of a multiple contact switch, the operation being fully automatic. The machine is arranged to permit adjustment such that either of the two cooperative contact spring assemblies of the complete multiple contact switch can be handled, even though the pattern of contact springs is non-symmetrical about a centerline. The machine is so arranged that no adjustment is required in the angle of application of the elongated tape contacts to the contact springs of the two assemblies in order that the elongated contacts may lie at an angle of 90° with respect to each other when the two contact assemblies are brought into face-to-face cooperative relationship. This effect is accomplished through the securing of the tape contacts to the contact springs at an angle of 45° with respect to the longitudinal axis of the contact springs and through providing the machine with various features which permit such application of the tapes to the springs.

While one embodiment of the invention has been disclosed, many modifications will be apparent, and it is intended that the invention be interpreted as including all modifications which fall within the true spirit and scope of the invention.

What is claimed is:

1. In a machine for applying metal tape contacts to contact springs:

alternately advancing and retracting indexing means for advancing one end of a metal contact tape to a position overlying a contact spring;

means for securing the end of the contact tape to the contact spring;

first and second cutter blades; and

blade actuating means for clamping one of said blades against the contact spring during retraction of said indexing means to prevent bending of the contact spring, and for moving said one blade to sever the tape in cooperation with the other of said blades following retraction of said indexing means.

2. Apparatus as specified in claim 1, wherein said blade actuating means includes means for pivoting said one blade about a shaft between a retracted position and a tape cutting position, and means for moving the shaft to advance said one blade from its retracted position to a tape clamping position.

3. Apparatus for applying lengths of metal contact tape to contact springs of two cooperable contact spring assemblies of a multiple contact switch, which comprises:

means for advancing successive contact spring assemblies to a welding station;

means for welding the contact tapes to the contact springs;

means for severing the contact tapes adjacent the edges of the contact springs; and

indexing means for advancing metal contact tapes toward the welding station prior to operation of said welding means and for arranging the free ends of the tapes in positions overlying the contact springs at an angle of 45° with respect to the length of the contact springs whereby cooperable contacts of the completed assemblies extend at an angle of 90° with respect to each other when the two assemblies are arranged in cooperative, face-to-face relationship.

4. Apparatus for applying a length of metal contact tape to contact springs of two cooperable contact spring assemblies of a multiple contact switch, which comprises:

means for advancing successive contact spring assemblies to a welding station;

alternately advancing and retracting indexing means for advancing metal contact tapes toward the welding station and for arranging the free end of each tape in a position overlying a contact spring;

means for welding the contact tapes to the contact spring;

first and second cutter blades; and

blade actuating means for clamping one of said blades against the contact springs during retraction of said indexing means to prevent bending of the contact springs, and for moving said one blade to sever the tape in cooperation with the other of said blades following retraction of said indexing means;

said indexing means arranging the contact tapes at an angle of 45° with respect to the length of the spring contacts whereby cooperable contacts extend at an angle of 90° with respect to each other when the two assemblies are arranged in cooperative, face-to-face relationship.

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