

Nov. 12, 1963

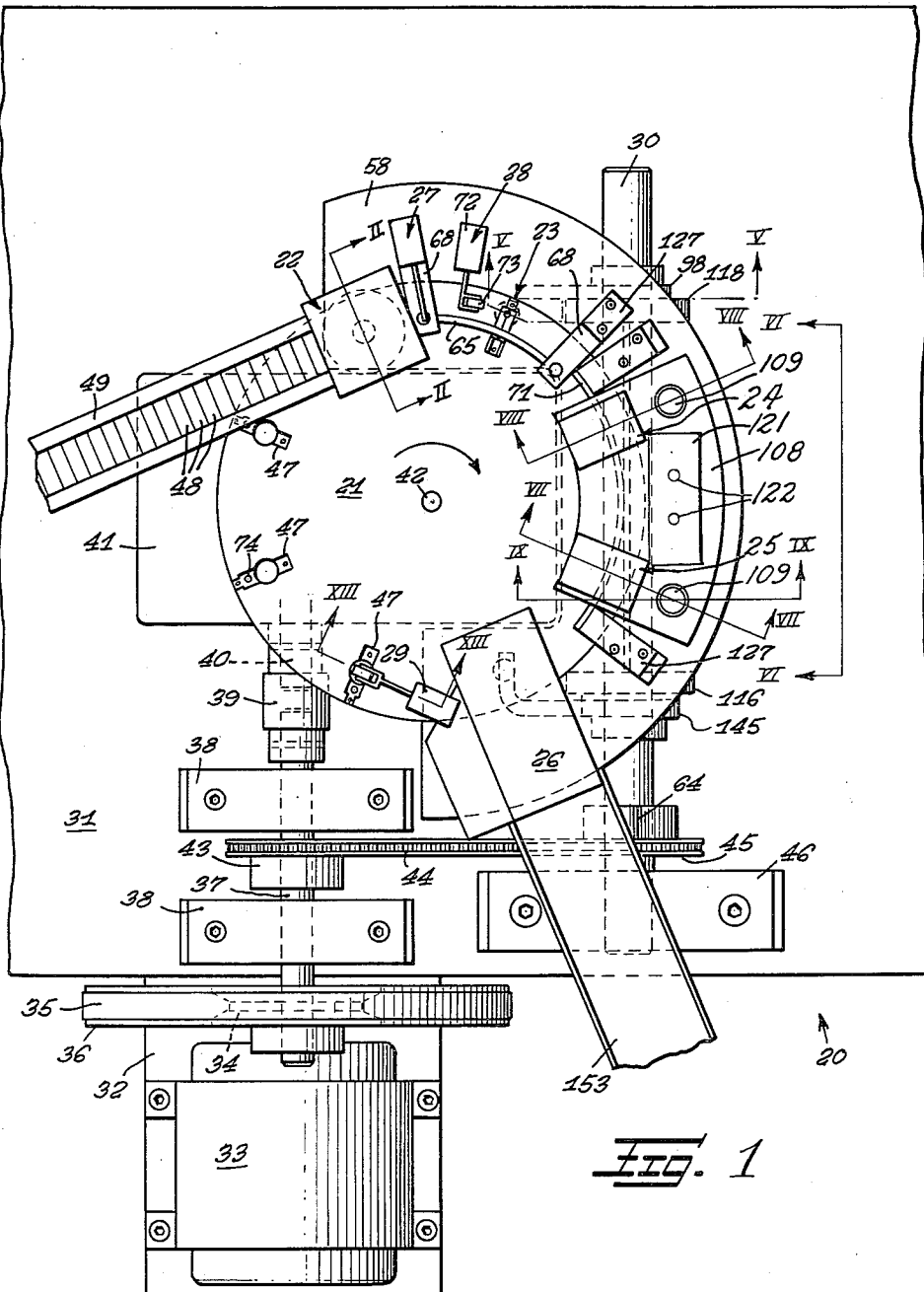
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3,110,201

AUTOMATIC CONTACT FORMING MACHINE

Filed Jan. 26, 1960

8 Sheets-Sheet 1



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AUTOMATIC CONTACT FORMING MACHINE

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8 Sheets-Sheet 2

Fig. 2

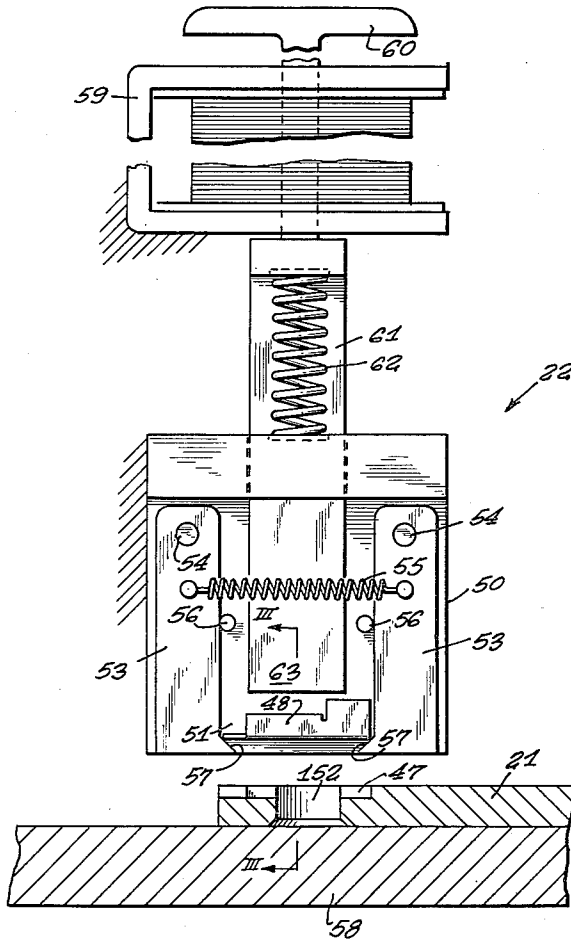


Fig. 4

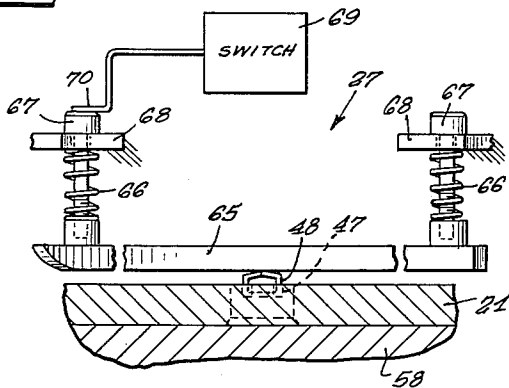
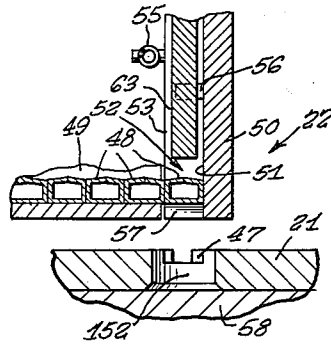


Fig. 3



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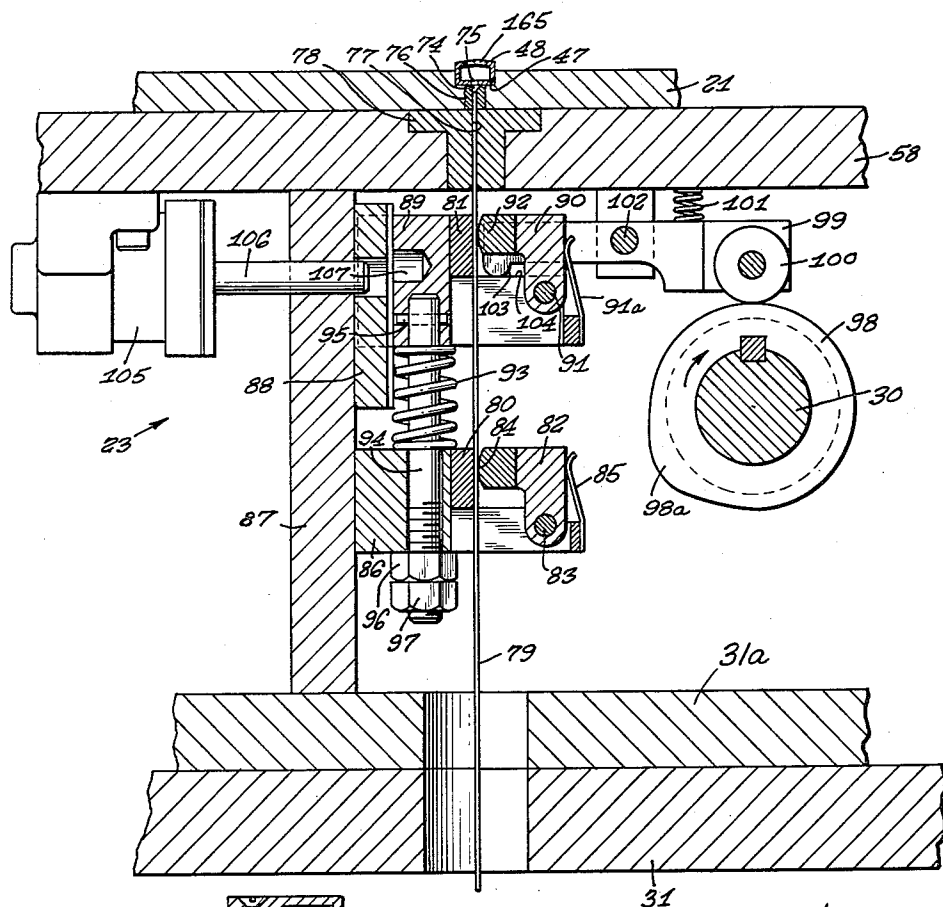


FIG. 5

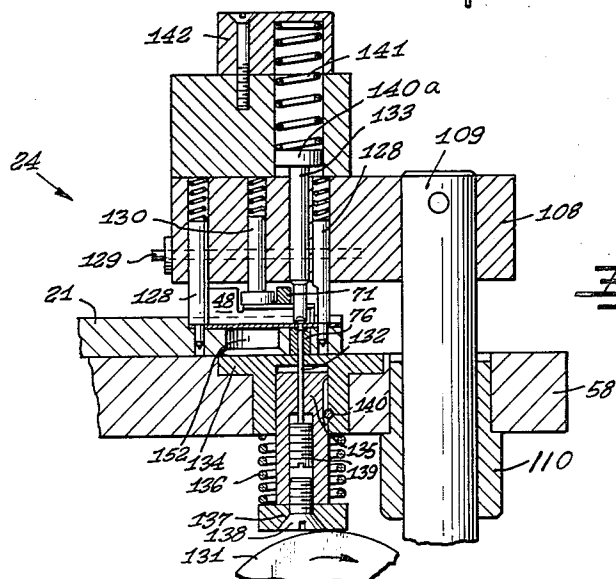


FIG. 8

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AUTOMATIC CONTACT FORMING MACHINE

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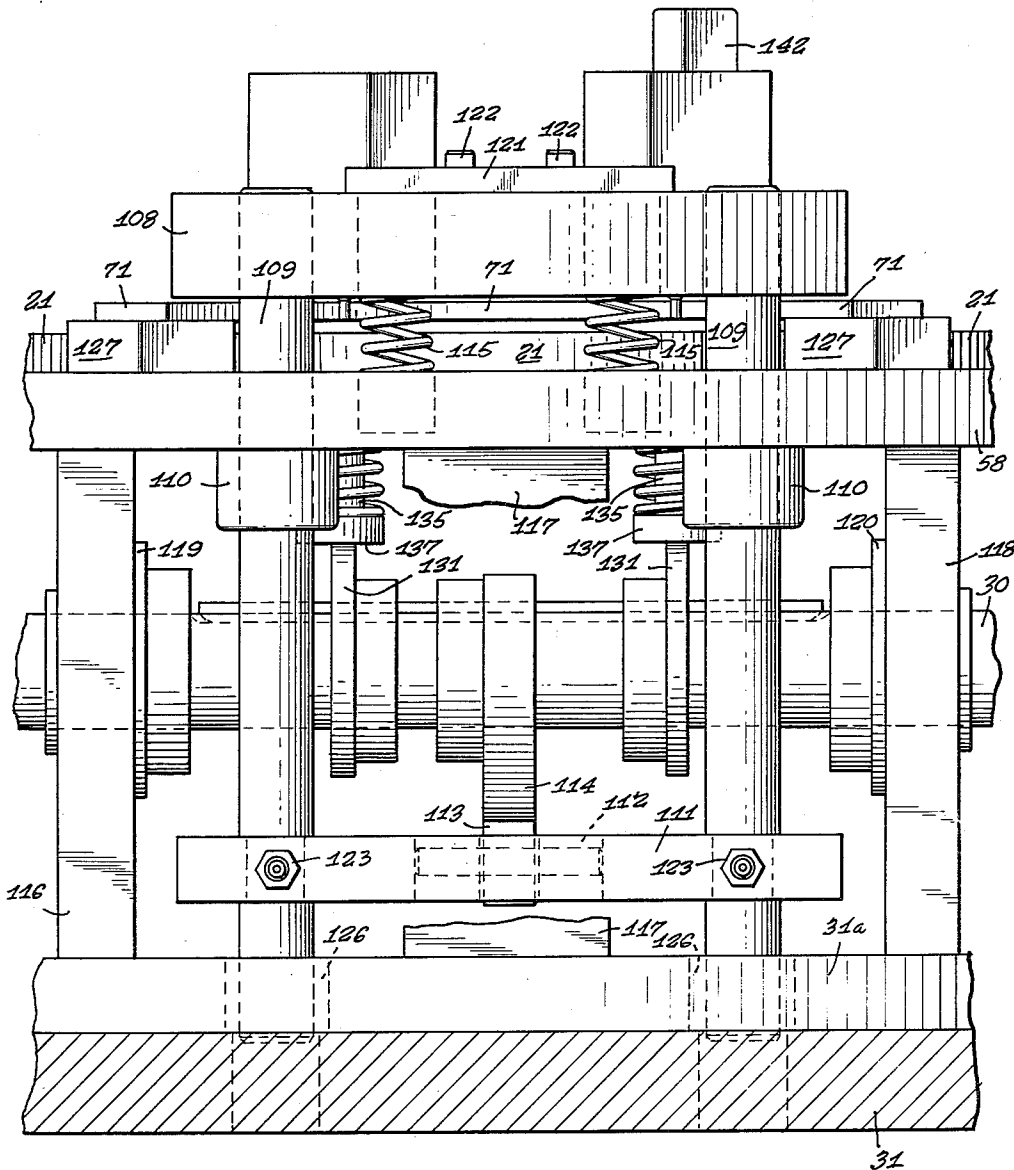


FIG. 6

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AUTOMATIC CONTACT FORMING MACHINE

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Fig. 7

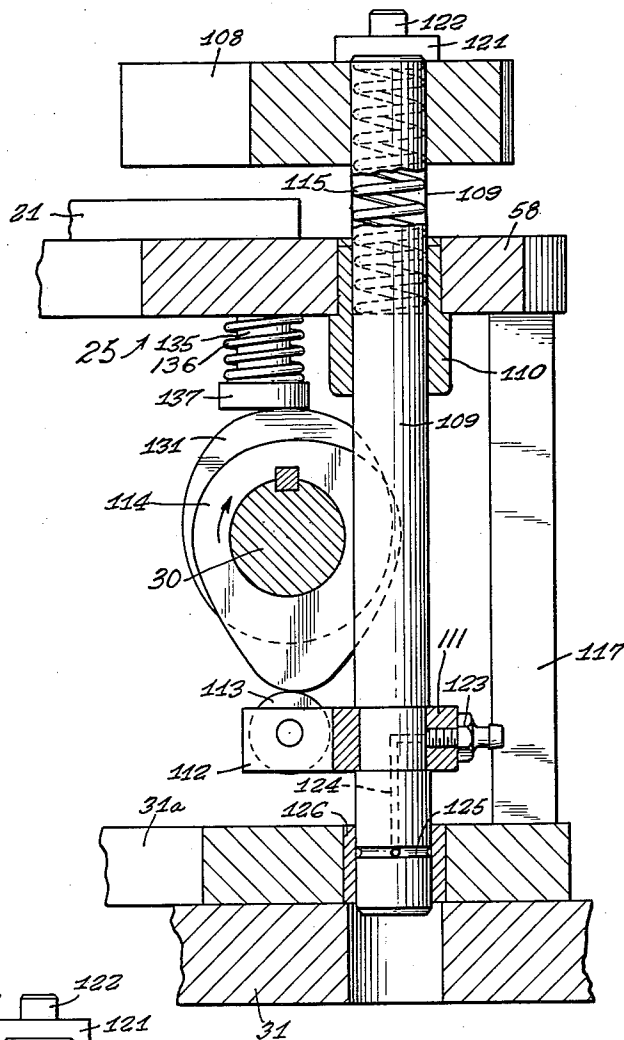
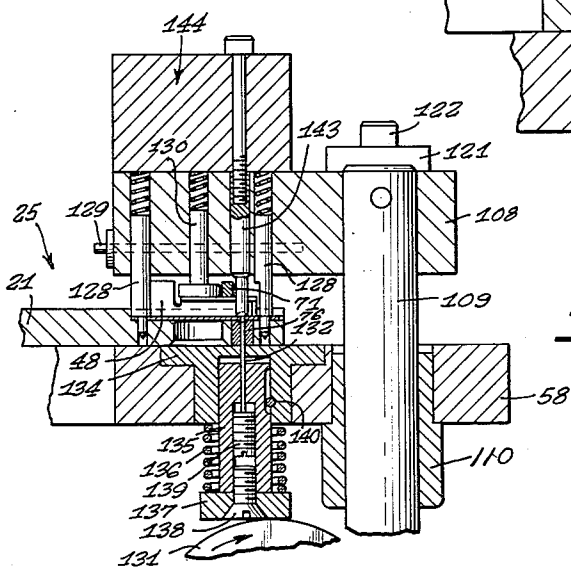


Fig. 9



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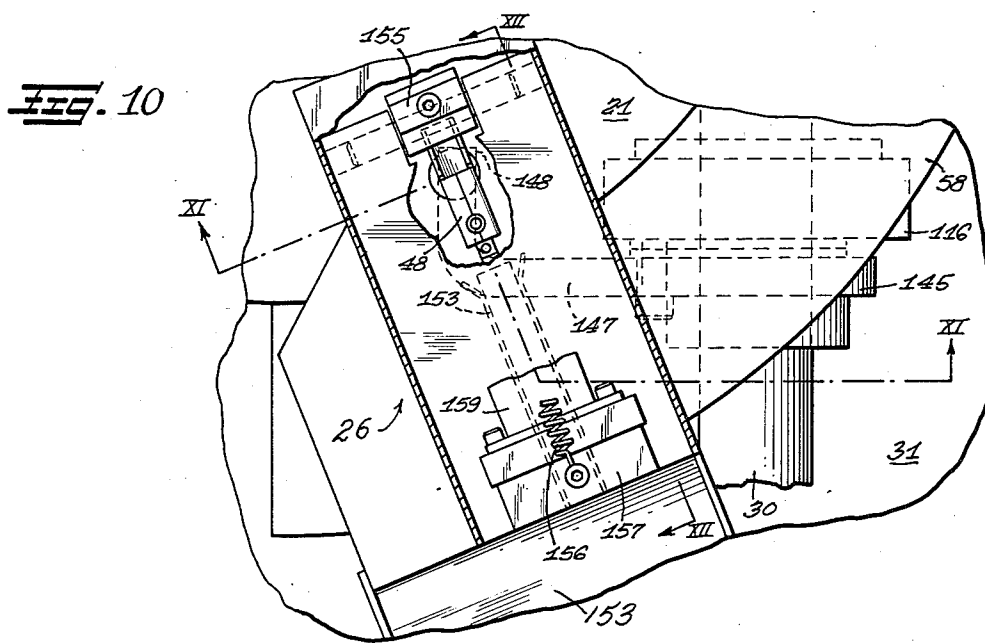
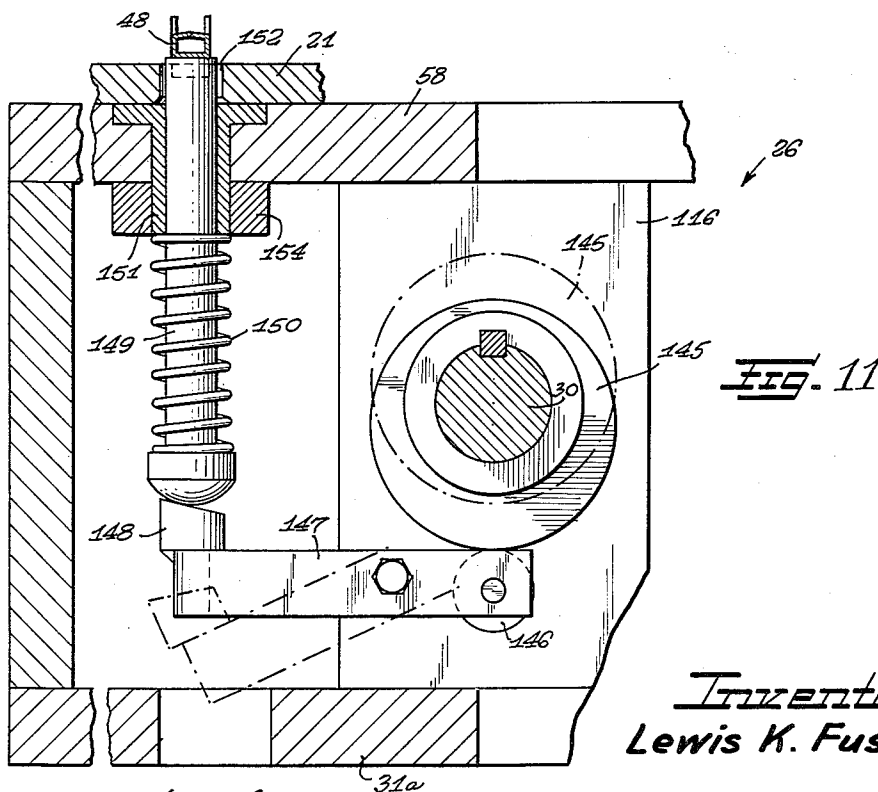
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AUTOMATIC CONTACT FORMING MACHINE

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8 Sheets-Sheet 6



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AUTOMATIC CONTACT FORMING MACHINE

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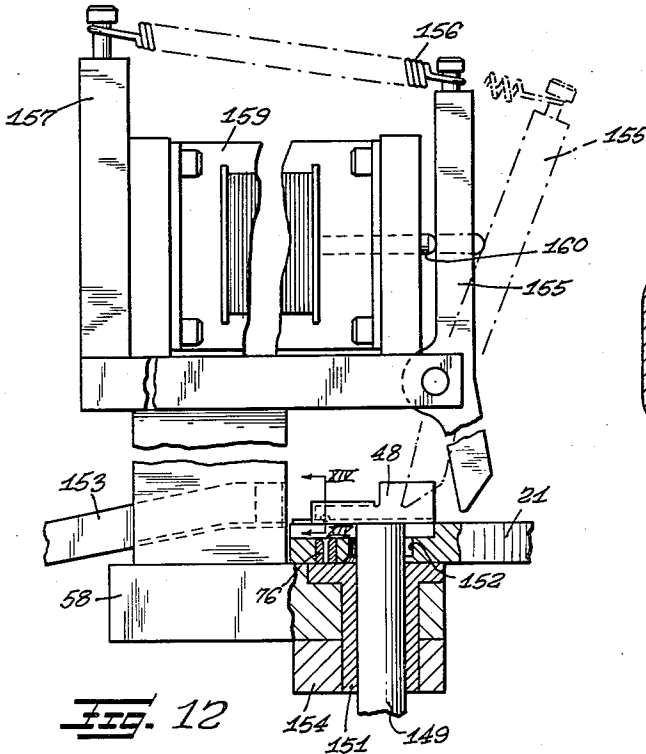


Fig. 12

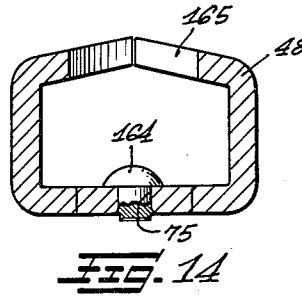


Fig. 14

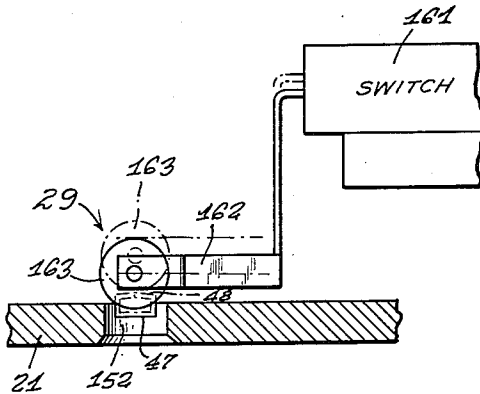


Fig. 13

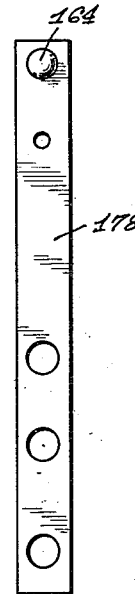


Fig. 15

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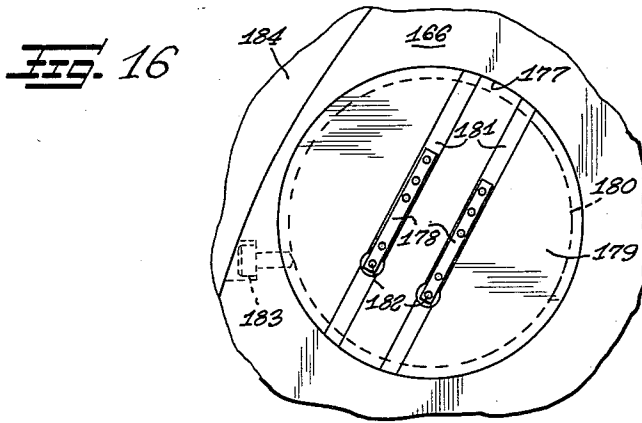
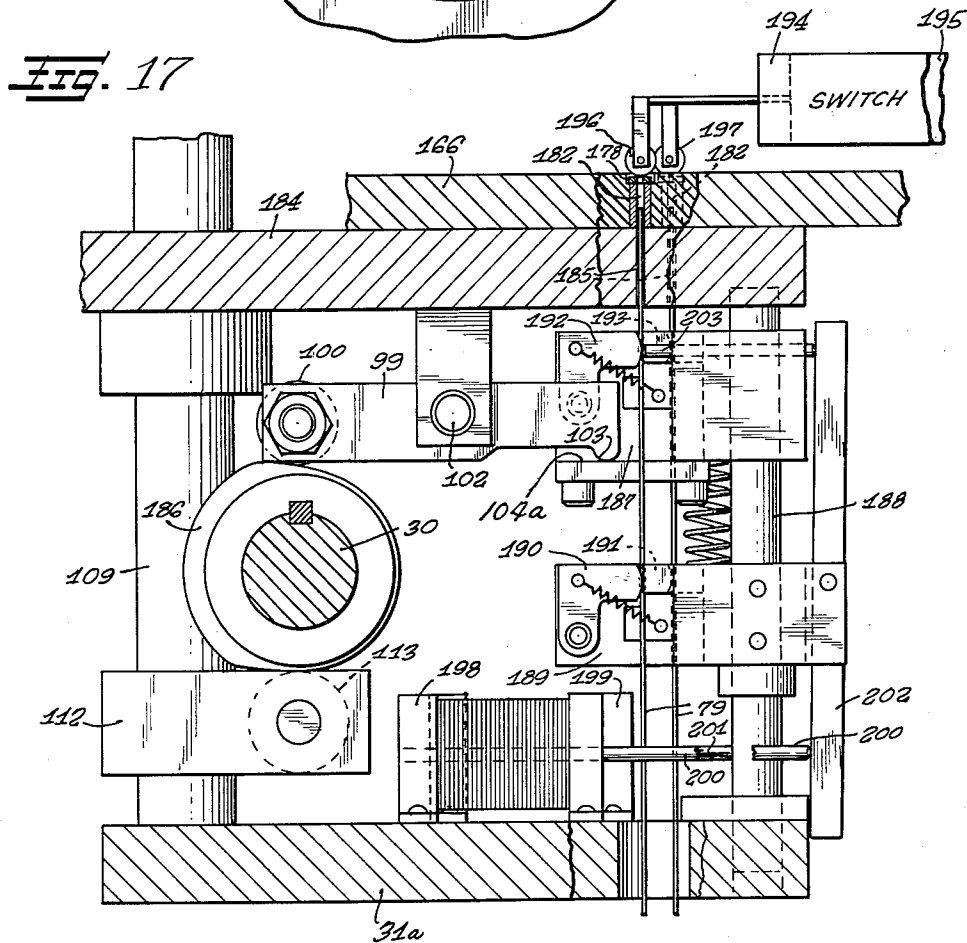
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AUTOMATIC CONTACT FORMING MACHINE

Filed Jan. 26, 1960

8 Sheets-Sheet 8



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AUTOMATIC CONTACT FORMING MACHINE
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 Company, Chicago, Ill., a corporation of Delaware
 Filed Jan. 26, 1960, Ser. No. 4,790
 3 Claims. (Cl. 78-17)

This invention relates generally to automatic contact forming machines, and more specifically to an improved machine for forming contacts directly onto their supporting member, such contacts being made from a supply of contact wire.

Although the principles of the present invention may be included in various contact forming machines adapted to form a contact on various types of supporting or conductive members, a particularly useful application is made in a contact forming machine adapted to form a contact on the inside of an apertured generally tubular member. Prior contact forming machines which operate automatically have had various disadvantages. Some of them employ a means for feeding a supply of individual contacts. Such contacts may have become scratched, corroded, or otherwise damaged so that after installation, less than ideal performance will result. Some of the prior contact forming devices have used excessively complicated linkages and mechanisms at the various stations thereof, a fact which renders such devices more subject to wear, renders them needful of an excessive amount of lubrication and adjustment, and on the whole renders them more unreliable. Further, prior devices have a tendency to damage themselves or to produce a series of defective parts once a malfunction has occurred. Still further, certain prior devices have required the use of auxiliary apparatus, such as a large reciprocating press, in the operation of the same.

The present invention contemplates the utilization of simplified mechanisms and linkages driven from a common source of power, which thereby requires no auxiliary apparatus. Since simplified structure has been provided, the need for maintenance, lubrication, and repair has been minimized, the likelihood of wear and breakage has been reduced, and a more reliable machine has therefore been provided. The present invention further contemplates the utilization of means for sensing improper feeding and ejecting, such means being operative to take appropriate corrective action automatically.

Accordingly, it is an object of the present invention to provide a simplified automatic contact forming machine.

Another object of the present invention is to provide an automatic contact forming machine capable of operation without attention for extended periods of time, with a minimum of maintenance, repair, and other service.

Yet another object of the present invention is to provide an automatic contact forming machine driven from a single source of power.

A still further object of the present invention is to provide an automatic contact forming machine which is of such construction that it can be readily adapted for forming contacts on different styles of conductive or supporting members.

Many other advantages, features and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description and the accompanying sheets of drawings in which a preferred structural embodiment incorporating the principles of the present invention is shown by way of illustrative example.

On the drawings:

FIGURE 1 is a top view of an automatic contact forming machine provided in accordance with the principles of the present invention;

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FIGURE 2 is an enlarged fragmentary view, partly in cross section, taken generally along the line II—II of FIGURE 1, and representing a feed station to provide a supply of parts to the machine;

5 FIGURE 3 is a fragmentary cross-sectional view taken generally along the line III—III of FIGURE 2;

FIGURE 4 is an enlarged side view, partly in cross section and partly broken away, of details shown in FIGURE 1;

10 FIGURE 5 is an enlarged cross-sectional view, partly in elevation, taken generally along the line V—V of FIGURE 1, showing a mechanism for feeding contact wire;

FIGURE 6 is an enlarged fragmentary view, taken along line VI—VI of FIGURE 1, and showing mechanism for contact forming;

15 FIGURE 7 is a fragmentary enlarged cross-sectional view taken generally along line VII—VII of FIGURE 1, and providing a further view of the structure shown in FIGURE 6;

20 FIGURE 8 is an enlarged fragmentary cross-sectional view, taken along line VIII—VIII of FIGURE 1, and showing further details of the structure in FIGURE 6;

FIGURE 9 is a fragmentary enlarged view, taken along line IX—IX of FIGURE 1, and showing still further details of the structure shown in FIGURE 6;

25 FIGURE 10 is an enlarged fragmentary portion of FIGURE 1, with parts broken away to show further details, representing a portion of the ejection station;

FIGURE 11 is a fragmentary view taken generally along line XI—XI of FIGURE 10, and showing details obscured in FIGURE 10;

30 FIGURE 12 is a view taken generally along line XII—XII of FIGURE 10, with parts broken away and cross sectioned;

35 FIGURE 13 is an enlarged view, partly in section, taken along line XIII—XIII of FIGURE 1, and showing a checking mechanism;

FIGURE 14 is an enlarged cross-sectional view of the finished member, taken at line XIV—XIV of FIGURE 12;

40 FIGURE 15 is a view of a finished member of blade construction;

FIGURE 16 is a fragmentary top view of modified structure for supporting the members to be worked upon; and

45 FIGURE 17 is a modified form of mechanism adapted to feed two contact wires.

As shown on the drawings:

50 The principles of this invention are particularly useful when embodied in an automatic contact forming machine such as illustrated in FIGURE 1, generally indicated by the numeral 20. This machine is adapted to form contacts automatically on apertured conductive members, and to that end includes an indexable turntable or index

55 dial 21 which is rotatable in a step-by-step manner adjacent to a series of stations each provided with a mechanism for acting on the part or member to be provided with a contact. These stations include a member feed station 22, a contact wire feed station 23, a contact forming station 24, a contact finishing, shaping, or dressing station 25, and a member ejection station 26. The machine 20 also includes means generally indicated at 27,

28 and 29 for checking that conductive members are being properly fed and ejected. The stations 23-26 are each powered by a cam shaft 30 which is common to each of said stations 23-26, and whose movements are synchronized with the movements of the turntable 21.

60 More specifically, the machine 20 includes a base 31 supported on legs (not shown) having a sub-base 32 on which a drive motor 33 is supported. The motor 33 is provided with conventional motor-starting controls includ-

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ing a motor relay (not shown). The motor 33 has a pulley 34 connected by a belt 35 to a larger pulley 36 corotatably supported by a shaft 37 which is journaled in bearings 38, 38. The inner end of the shaft 37 is connected by a coupling device 39 to the input 40 of a conventional indexing mechanism 41, the output of which includes a shaft 42 which corotatably supports the turntable 21 for rotation about the axis of the shaft 42. In the instant machine, eight revolutions of the input shaft 40 effects one revolution of the turntable 21, and although the shaft 40 is continuously rotated by the motor 33, the shaft 42 makes eight distinct intermittent equi-angular movements such that there is a dwell period between each of these movements. The details of the means 41 which rotate the turntable 21 in a step-by-step manner are well known and do not form a part of this invention, an example of the same being those commercially made and sold by Special Tool Engineering Co. of Chicago, Illinois.

The shaft 37 also carries and drives a sprocket wheel 43 connected by a link chain 44 to a second sprocket wheel 45 corotatably secured to the shaft 30. In this embodiment, the effective size of the sprocket wheels 43 and 45 is the same so that for each revolution of the shaft 37, the shaft 30 is also rotated by exactly one revolution. One of the sprocket wheels 43, 45 is adjustably secured to its shaft so that the angular position of the shaft 30 may be adjusted with respect to the dwell position or angular position of the turntable 21. The shaft 30, like the shaft 37, is rotatably journaled in bearings 46 supported by the base 31.

The turntable 21 is provided with a plurality of angularly spaced pockets 47, the illustrated embodiment having eight such pockets. Each of these pockets is so shaped and sized as to receive and support one of the conductive members 48 which is to be provided with a contact as it is passed by the turntable 21 to the various work stations.

A supply of apertured conductive members 48 is delivered by a chute 49 in oriented fashion to the member feed station 22, the mechanism of which is shown more clearly in FIGURES 2 and 3. As the turntable 21 is rotated, each of the pockets 47 is successively brought to a halt in alignment with the feed mechanism at the feed station. The chute 49 has a horizontally directed discharge end shown in FIGURE 3 which terminates at the station 22 in vertically spaced relation above the pocket 47 in the turntable 21. The members 48 are biased as by the weight of other members behind them so that they move to the right, such movement being arrested by a stop plate 50 having a vertical stop face 51 spaced from the end of the chute 49 and thereby defining a space 52 directly above the pocket 47. Within the space 52, there is provided a pair of pawls 53, 53 each pivotally supported by a pin 54 secured to the plate 50. The pawls 53 are yieldably biased toward each other by an extension spring 55 secured thereto, the pawls being limited in movement toward each other by stop pins 56. Each of the pawls 53 has a generally upwardly directed cam surface 57 which jointly provide vertical support for the endmost conductive member 48.

A fixed plate 58 is disposed and supported beneath the turntable 21 in a manner to be described and also provides support for the stop plate 50, such support being schematically shown in FIGURE 2. The fixed plate 58 also provides support for a solenoid 59 having a magnetic reciprocable plunger 60 coupled to a vertically reciprocable plunger 61 which is guided by the stop plate 50 in a suitable aperture and which is upwardly biased by a spring 62, the plunger 61 extending into the space 52 between the pawls 53, 53 so that when it is moved downwardly by the plunger 60 of the solenoid 59, it may act on a member 48 to urge the pawls 53, 53 apart, to thereby release the member 48, and to load the member 48 into the pocket 47 therebeneath. This mechanism normally feeds or disposes a conductive member 48 into each pocket 47 as it passes therebeneath. As the member 48 is so released, the next member 48 moves into engagement with a vertical face 63

on the plunger 61 and remains in engagement therewith until the plunger 61 is retracted. The electric solenoid 59 is energized by a switch (not shown) which is actuated by a cam surface 64 on the sprocket wheel 45 shown in FIGURE 1.

Upon completion of the loading step, the turntable 21 is automatically indexed or advanced to the next station, namely the contact wire feed station 23. However, en route to this station, the means 27 and the means 28 check to see that the pocket 47 has been properly filled. As best seen in FIGURE 4, the means 27 includes an arcuate bar 65 which is downwardly biased by a pair of springs 66, 66 to a position proximate the member 48. The vertical position of the arcuate bar 65, when free, is determined by a pair of screws 67, 67 adjustably engageable therewith and extending slidably through rigid support means 68 carried by the fixed plate 58. A switch 69 is provided with an actuating lever 70 which engages with one of the screws 67 for being raised by such screw in response to upward movement of the arcuate bar 65. The switch 69 is connected into the relay circuit of the motor 33 so that if the bar 65 is raised, the motor 33 is instantly shut off. If a member 48 is too high, if it is partially overhanging the edge of the pocket 47, or the like, the added effective height would serve to raise the arcuate bar 65 thereby opening the switch 69 which electrically is in the control circuit for the motor 33. By resetting the screws 67 and the position of the switch 69, members having a different height may be accommodated by the same machine. This type of malfunction, while possible, is ordinarily infrequent, and the resulting delay in correcting the condition and restarting the machine manually is of a minor nature, and involves somewhat less time and effort than would be spent in possibly repairing the machine or sorting out possibly damaged members 48. The bar 65 extends centrally over each pocket 47 as it passes thereby and also serves to hold the member 48 in its pocket from the moment that it leaves the feed station 22. The bar 65 is functionally contiguous with a second arcuate bar 71 shown in FIGURE 1 and described further herein. Thus it can be seen that the means 27 is responsive to an improperly fed member 48 and is operative to effect disabling of the machine 20 before the improperly fed pocket or member reaches the contact wire feed station 23.

The means 28 shown in FIGURE 1 is constructed substantially similar to other structures shown in FIGURE 13, which other structure includes a switch 72 having a roller-actuator 73. The roller of the means 28 is disposed to roll across each of the members 48 before they reach the contact wire feed station 23. However, if the pocket 47 is empty, the roller drops momentarily into the pocket to close the switch of the means 28 which then energizes a solenoid valve (not shown) which directs compressed air to the contact wire feed station 23 to disable it in a manner presently to be described. Once the switch of the means 28 has been closed to energize the disabling circuit, the circuit remains closed until opened by a further switch actuated by the cam 64. It is thus apparent that the means 28 is also responsive to an improperly fed contact, namely no contact at all, and that the means 28 is operative to effect a disabling in the machine before the improperly fed pocket reaches the wire feed station 23.

When no excessively protruding member 48 has actuated the means 27, and when no empty pocket 47 has actuated the means 28, the pocket 47 arrives with its member 48 at the wire feed station 23, the structure of which is best seen in FIGURE 5. Each pocket 47 of the turntable 21 is provided with a vertical passageway 74 which registers with an aperture 75 in the member 48 in which the contact is desired to be formed. The passageway 74 is disposed in a die or bushing 76 which is fixedly carried by the turntable 21, its lower face being coplanar with the lower face of the turntable, the lower

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end of the passageway 74 thus defining severing means in the nature of a shearing edge on the turntable. Since the turntable is rotatable, the shearing edge thus defined may be said to be movable in response to rotational indexing movement of the turntable. The fixed plate 58 is also provided with a passageway 77 which is disposed in a fixed die or bushing 78, the upper surface of which is disposed directly beneath and arranged substantially coplanar with the lower face or surface of the turntable. The passageway 77 in the stationary die or bushing 78 registers with the passageway 74, and its upper end thus defines severing means in the nature of a shearing edge which is fixedly disposed at the station 23. It is to be noted that the shear edges and passageways defining the same register with each other throughout the entire dwell period of the turntable 21.

Other structure is provided which is adapted to normally advance or feed an increment of contact wire into the movable die 76 in the turntable from the stationary die 78 therebelow during each dwell period of the turntable. To this end, a supply of contact wire 79, such as of silver, is directed upwardly through apertures in the base 31 adjacent to a fixed shoe 80 and a movable shoe 81 up into the stationary bushing 78. The faces of the shoes 80, 81 are substantially aligned with the edge of the passageway 77.

A wedge member 82 pivotally supported about a fixed axis 83 is constructed in the form of a bell crank having a portion 84 in contact with the wire 79 which, under the influence of a spring 85, resiliently biases the contact wire 79 against the shoe 80 at a point between the fixed axis 83 and the turntable 21 to grip the wire in a manner which prevents downward movement of the same, but which permits upward wire movement. The stationary or fixed shoe 80 and the wedge member 82 are thus supported on a common bracket 86 secured in any convenient manner to a spacer 87 which is one of the supports for the fixed plate 58. The bracket 86 is apertured and receives structure presently to be described. Above the bracket 86 there is a stationary vertical slide member 88 which receives and supports a movable member 89 thereon, the elements 88, 89 having a dove tail connection therebetween in this embodiment. The movable member 89 supports the movable shoe 81 and also supports a wedge member 90 pivotally supported by a pin 91 having a movable axis which can reciprocate with the movable shoe 81. The wedge member 90, like the wedge member 82, is resiliently biased by a spring 91a so that its portion 92 resiliently biases the contact wire 79 against the movable shoe 81 at a point intermediate the movable axis or pin 91 and the turntable 21. This creates a grip on the wire which causes the wire 79 to be raised in response to upward movement of the movable member 89, and which enables the wedge member 90 to allow slippage in response to downward movement thereof. The movable member 89 is biased upwardly by a compression spring 93 acting between the stationary bracket 86 and the member 89. The upward movement of the member 89 is limited by a stud 94 secured by a pin 95 to the member 89, and having a threaded end extending through the aperture in the fixed bracket 86 on which an adjustment nut 96 and a jam nut 97 are secured. The position of the adjustment nut 96 determines the length of the increment of wire which is advanced per stroke into the bushing 76 in the turntable 21.

As the shaft 30 is rotated, a cam 98 keyed thereto raises one end of a first class lever 99 by acting on a roller 100 carried thereby, the roller-end of the lever 99 being biased against the cam 98 by a spring 101. The lever 99 is pivoted about a pin 102 having an axis which is fixedly supported with respect to the fixed plate 58. The other end of the lever 99 includes an arcuate surface 103 which has engagement with an upwardly directed surface 104 on the movable member 89. Each time that the cam rise 98a raises the roller 100, the curved portion

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103 lowers the member 89 against the force of the spring 93 by an amount determined by the position of the nut 96 to grasp the wire 79 at a point below its previous grasping point, and as the roller 100 rides down the slope of the portion 98a of the cam 98, an increment of the wire 79 is advanced upwardly into the bushing 78. It is to be noted that the length of wire increment so advanced is such that the upper end of the wire is spaced from the member 48. It is thus apparent that the means 23 provides and disposes an increment of wire 79 in the turntable passageway 74 in vertically spaced relation to the member 48. In response to the next indexing movement of the turntable 21, the wire increment is sheared off so that its lower end rests on the upper face or surface of the fixed plate 58. From this station to the next, the plate 58 is imperforate below the passageway 74 so that the upper surface of the fixed plate 58 supports the wire increment. It will be noted that the mechanical linkage which includes the lever 99 is the sole means for operating the wire feed mechanism, and that but a single cam on the shaft 30 is employed.

Each time that the shaft 30 makes one revolution, the wedges 82, 90 alternately release their grip on the wire, the wedge 90 doing so when it moves away from the turntable 21, i.e. downwardly, and the wedge 82 doing so when the wedge 90 moves in an opposite direction. Thus an increment of wire is normally advanced for every revolution of the shaft 30. However, if an empty pocket 47 is being indexed to the station 23, the means 23 will have come into action as already described. By this action, a supply of compressed air is directed to a single-acting spring-return pneumatic actuator 105 having a rod 106 which is then projected into a recess 107 in the movable member 89. This interaction holds the movable member 89 in a retracted position and effects a disengagement between the curved surface 103 and the surface 104, so that the lever 99 may continue to rock, but without effect. It will be noted that the location of the sensing means 28 is such that an empty pocket reaches it before it reaches the station 23. The difference in angular position is needed to allow for the time lag inherent in operating the actuator 105. At the proper moment, the air is released from the actuator 105 as already described, thereby readying the station for the next filled pocket or readying it to be again disabled in the event that the pockets be empty. It is particularly advantageous feature of this invention that the wire increment is severed in response to turntable indexing, since this eliminates need for special linkage to perform this function. It is a further important feature of this invention that the feed mechanism may be disabled automatically in the absence of members 48. It is also advantageous that the fixed plate 58 supports the wire increment so that no preliminary holding operation is needed for the same.

In combination with this feature, the pocket 47 is next indexed directly to that station which does a substantial amount of the contact forming. This station, as indicated at 24 in FIGURE 1, and the mechanism for the same, is shown in FIGURES 6-9.

Referring first to FIGURE 6, a generally horizontal drive plate 108 is disposed in overhanging relation to the turntable 21. To support and reciprocate the plate 108, there are a pair of rods 109 provided which are securely attached to the plate 108 in any convenient manner. Each of the rods 109 extends through a slide bearing or bushing 110 carried by the fixed plate 58, and each rod 109 terminates in a lower end slidably guided in a lower fixed plate 31a, which is fixed to the base 31. A bracket 111 is rigidly secured to each of the rods 109 at a point below the height of the shaft 30, the bracket 111 being provided with an extension 112 which is bifurcated and rotatably supports a roller 113 for engagement with the lower surface of a cam 114 keyed to the shaft 30. The drive plate 108 and the de-

scribed drive mechanism is thus movable as a unit and is resiliently biased in an upward direction by a plurality of springs 115 acting between the fixed plate 58 and the drive plate 108. The structure thus far described in FIGURE 6 is used for both the forming mechanism at the station indicated at 24 and for the finishing or shaping mechanism indicated at the station 25. This structure, as will presently be seen, effects a simplification wherein a single cam is used to drive structure associated with each of two stations, and by which the need for any external drive means, such as a press ram, has been eliminated.

FIGURE 6 also illustrates a series of additional spacers 116, 117, and 118 which provide support for the fixed plate 58 with respect to the lower plate 31a and the base 31. (The lower plate 31a does not show on FIGURE 1 since it is substantially of the same configuration as the plate 58.) The spacers 116 and 118 are adapted as at 119 and 120 to provide more bearing support for the shaft 30. A cap 121 secured by screws 122 retains the springs 115 in position, and renders them accessible for easy maintenance.

Referring to FIGURE 7, wherein for clarity most details of FIGURES 8 and 9 have been omitted, it will be noted that the bracket 112 is provided with a grease fitting 123 for each rod 109 which communicates with a passageway 124 leading to a grease groove 125 disposed within a bearing insert 126.

Referring again to FIGURES 1 and 6, the arcuate bar 71 is supported at each end thereof by a block 127 so that the bar or bar portion 71 extends centrally over the pockets 47, close to the member 48, to hold the members 48 in the pockets continually during work and indexing. The bar 71 also performs a stripping function presently to be described.

Referring now to FIGURE 8, the detailed structure at the station 24 will be described. At this station, structure is provided which acts on the wire increment to form it into a contact secured to the conductive member 48, and of the proper shape. To this end, the mechanism at the station 24 includes a pair of reciprocable downwardly directed locator pins 128, 128 having a pilot portion which passes through locating apertures in the apertured member 48 and into corresponding apertures in each pocket 47 of the turntable 21. The pins 128 are downwardly biased by springs and are retained against ejection by a pin 129 which permits captive reciprocation of the pins 128. The pins 128 provide horizontal holding of the member 48 with respect to the turntable 21. The hold down means 130 may also be provided to supplement the downward force against the member 48 so that a tight fit is created between its lower surface and the upper surface of the die 76. The hold down means is likewise spring-biased and retained by the pin 129 for a limited reciprocation with respect to the drive plate 108. The arcuate bar 71 acts to hold the member 48 in the pocket 47 at the station 24, and to insure that the locator means or pins 128, 128 are stripped from the member 48 at the completion of the operation.

It is apparent that the cam 114 acts to lower the drive plate 108 to thus first hold the member 48 securely. Thereafter, a cam 131 raises a reciprocably guided pin 132 which has a contact-wire engaging portion that lifts the wire increment up through the aperture 75 in the member 48. The upper end of the wire increment engages within a conical tip of a member engaging element 133, and as the downward movement of the drive plate 108 continues, the wire increment is forced by the conical tip into substantially the desired configuration.

The pin 132 is continually operative to back up the wire increment in opposition to the means 133 which acts in the opposite direction on the wire increment, and continues to move upwardly as needed to force substantially all of the wire increment through or into the aperture in the member 48.

To accomplish this result, the fixed plate 58 is provided with a bushing or pin guide 134 which receives the upper end of a pin holder 135 which is resiliently biased by a spring 136 so that its head portion 137 engages the periphery of the cam 131. The head portion 137 is held in position by a screw 138, the removal of which gives access to a threaded body 139 carried on the end of the pin 132 for adjusting its effective length. A pin 140 is provided as shown to render the pin 132 reciprocable to a limited axial extent, with respect to the fixed plate 58.

In this embodiment, the element 133 which has the hollow tip is provided with a head 140a biased by a spring 141 retained by a cap and screw assembly 142. The downward travel of the drive plate 108 is such that the member engaging portion 133 of the mechanism will in fact engage the member prior to the end of the stroke of the drive plate 108, and the spring 141 thereby allows for overtravel of the drive plate 108. It will be appreciated that under certain circumstances the resilient backing for the contact forming portion 133 may be omitted.

It is thus seen that the cam 131 cooperates with the pin 132 which engages the wire increment and which is disposed between the turntable 21 and the shaft 30 to drive such pin 132 for further cooperation with the member engaging portion 133 to form substantially the completed contact on the member 48. Upon the completion of such operation, the cam 131 permits the spring 136 to retract the pin 132, and the cam 114 permits the springs 115 to retract the drive plate 108, after which the turntable 21 is indexed to the next station 25.

Referring now to FIGURE 9, the operation of this station and its structure will be explained. As the member 48 arrives to the station 25, it will be appreciated that the contact forming is substantially completed. However, this station is provided so that the work load on the preceding station may be lessened, and so that the contact surface may be provided with a properly finished, dressed, or shaped configuration. Since most of the components are identical to that shown in FIGURE 9, similar reference characters have been provided. However, in place of the element 133, an element 143 has been provided to engage the member 48 and its contact, the conical member engaging portion of which is shaped and finished so as to provide the proper shape and finish to the contact. At this station, no back-up spring is provided and the element 143 is held in position by a cap and screw assembly 144 secured to the drive plate 108 in any convenient manner. For a further description of the structure and operation of this station, attention is invited to the foregoing paragraphs pertaining to FIGURE 8.

It is emphasized that the drive plate 108 is common to both of the stations 24 and 25 and that no separate press is needed for the operation of the same. By this structure, a detached increment of contact wire can be handled while it is loose without preliminary attachment to the member 48. It is also emphasized that the arcuate bar 71 again keeps the member 48 in the pocket 47 during indexing, and assists in stripping the member 48 from various elements at each of these work stations.

Referring further to FIGURES 9 and 1, upon retraction of the pin 132 and the elements carried by the drive plate 108, the turntable 21 indexes the finished conductive member 48 to the ejection station 26. As best seen in FIGURE 11, the ejection station includes a cam 145 keyed to the shaft 30, the cam 145 being operative on a roller 146 carried by a pivoted lever 147 which has a laterally extending arm 148 engageable with a downwardly biased ejector pin 149. The downward bias is provided by a spring 150 acting between the head of the ejector pin 149 and a bushing 151 which guides the ejector pin 149. The spring 150 thus normally holds the ejector pin 149 in a retracted position until the rise

on the cam 145 acting through the linkage 146—148 raises the ejector pin 149 so that it projects through the bushing 151 above the upper surface of the fixed plate 58 and through a relatively large opening 152 in the pocket 47, to thereby raise the finished member 48 from the turntable 21. An air blast at this point may be utilized in combination with the ejector pin 149 to discharge the member 48 from the machine 20 through a chute 153. The bushing 151 may be retained in any convenient manner, the instant embodiment including a retainer plate 154 secured thereto by conventional means.

It is emphasized that the use of a common drive as the sole means for several of these described stations provides a simplification of structure which is one of the particular advantages of this invention.

When the finished conductive member 48 arrives at the ejection station 26, it will be appreciated that the newly formed contact thereon is exceedingly clean. The additional use of air may be objectionable since the air may contain contact contaminants. If such be the case, an electro-mechanical kick-out mechanism may be additionally employed with the ejection means at the ejection station. Such a device is shown in FIGURES 10 and 12 and includes in this embodiment a first class lever 155 biased to the position shown in solid lines by a spring 156 acting between one end thereof and a rigid support 157 secured to the fixed plate 58. A solenoid 159 of the type which forces a plunger 160 outwardly in response to energization thereof is employed, and when energized, the plunger 160 causes the lever 155 to rock rapidly to the position shown in broken lines and to thereby engage the finished member 48 with its opposite end, giving it a lateral kick, radially of the turntable 21 and into the discharge chute 153. The solenoid 159 is connected electrically in parallel with the solenoid 59 shown in FIGURE 2 so that both of the solenoids 59 and 159 are simultaneously energized by the action of the cam track 64 shown in FIGURE 1.

When the pocket 47 has been emptied at the ejection station 26, the turntable 21 again indexes. Before the emptied pocket 47 again reaches the member feeding station 22, a test structure such as illustrated in FIGURE 13 is employed. This structure includes a switch 161 having an actuator 162 provided with a roller 163 engageable with the turntable 21. So long as the roller 163 rolls along the surface of the turntable 21 or falls into an empty pocket 47, this mechanism performs no function. But if a member 48 be left in the pocket 47 as shown in broken lines, then the roller 163 will be raised as also shown in broken lines to actuate the switch 161. The switch 161 is connected into the relay circuit of the motor 33 in such a manner that if the switch 161 is actuated, the motor 33 is immediately stopped so that an attendant can remove the member 48 which was not ejected. It will be appreciated that because of the structure of the ejection mechanism, such an eventuality is relatively remote. However, a determination is nevertheless made which serves as a check against certain types of breakage and malfunction. If a member 48 be present, the machine is therefore shut down so as to prevent jamming at the next station.

In FIGURE 14, there is shown an enlarged cross-sectional view of the finished member 48, provided with a contact 164 by a contact forming machine such as that disclosed herein. In this instance, the member 48 comprises a tubular part wherein the contact 164 is formed in the aperture 75. Another aligned aperture 165 permitted the entry of the elements 133 and 143, and no other element was needed to be disposed within the interior of the member 48. The instant structure not only represents a substantial simplification, but is particularly suited for performing this type of contact formation, in addition to forming contacts on conventional strips such as shown in FIGURE 15. The contact 164 in FIGURE 14 has thus been formed by means for acting on a loose wire

increment to form the wire increment into a contact which is properly shaped and disposed on the conductive member. The result shown in FIGURE 14 has been accomplished without touching of the contact by any handling mechanism after it has been shaped, it has been installed in a protected location, its finish is fresh and hence oxide-free, and it is mechanically protected against nicking etc. by bulk handling methods. Since the wire was of a smaller diameter prior to the contact formation than was the aperture 75, an inherent feature of this structure is that fresh raw unoxidized silver is in direct engagement therewith, thereby minimizing the electrical resistance therebetween.

Referring now to FIGURES 16 and 17, there is shown a modification which permits additional conductive members to be handled at each of the stations at the same time. It will be appreciated that structure such as shown in FIGURES 8, 9, 11, and 13 may be adapted to act on two members at the same time at each station using no additional drive means, or to employ two rollers 163 for the structure shown in FIGURE 13. Similarly, a feed mechanism such as shown at station 22 may be provided at one of the unused stations shown in FIGURE 1. However, some modification of the turntable and of the contact wire feed mechanism is needed. In FIGURE 16, a turntable 166 has been provided with a recess 177 which is larger than either conductive member 178, and within which there is disposed a holder 179 which may be shouldered as at 180 if desired. The holder 179 is provided with one or more upwardly opening pockets 181 arranged in a group consisting of two pockets in this example, which group is angularly spaced from other pockets on the turntable 166. The turntable holder 179 is provided with vertical passageways 182 therethrough. The turntable holder 179 is also provided with suitable locator and ejection openings similar to those previously described. Means are also provided for rigidly securing the holder 179 in the recess 177, such means in this embodiment comprising a set screw 183 which insures joint movement between the holder 179 and the turntable 166.

Referring now to FIGURE 17, certain components thereof may be employed in common with the structure shown in FIGURE 5, and therefore similar reference numerals have been assigned. In this embodiment, the turntable 166 rotates above a fixed plate 184 which is provided with two vertical passageways 185 to register respectively with the vertical passageways 182 in the turntable 166. Two contact wires 79 are fed through the passageways 185, 185 substantially in the manner already described. However, the means for feeding the same and disabling the feeding mechanism differs in structure.

A cam 186 carried by the shaft 30 rocks the lever 99 as before so that a movable bracket 187 is caused to reciprocate vertically. The movable bracket 187 is slidably guided on a pair of cylindrical guide members 188, one disposed behind the other in this view. Below the movable bracket 187 there is a fixed bracket 189 supported on the cylindrical guide members 188 in a fixed position. The fixed bracket 189 supports a fixed-axis wedge member 190, corresponding to the wedge member 82 previously described, and a second fixed-axis wedge member 191 on the opposite side of the bracket 189 for acting on the second wire. In like fashion, the movable bracket 187 is provided with a movable-axis wedge member 192, which corresponds to the wedge member 90 described above, and a second movable-axis wedge member 193 disposed on the opposite side of the movable bracket 187. As described above, the movable bracket 187 is adjustably biased in an upward direction so that the engagement surface 104a is in engagement with the arcuate surface 103 on the lever 99.

Electrical means including switches 194 and 195 are respectively provided with roller-type actuators 196, 197 which individually may drop into either of the pockets 181 in the absence of a conductive member 178 therein.

This causes the corresponding switch 194 or 195 to close and to energize a corresponding solenoid 198, 199, respectively having plungers 200 and 201 for acting individually on a lever such as 202. The lever for the solenoid 199 is obscured by the lever 202 and is identical in construction. The movable wedge members 192, 193 are each provided with a pin 203 actuated by the corresponding lever 202 which pivots counterclockwise as shown in response to energization of the corresponding solenoid 198, 199. Thus either of the solenoids may be individually or jointly energized to move the corresponding movable wedge members away from the contact wire and hence remove any bias of the wire against the corresponding shoe so that the movable member 187 may reciprocate ineffectually during such time that the solenoid is energized.

In this embodiment, as in the first, each of the wedge members is resiliently biased against a corresponding shoe at a point intermediate its pivotal axis and the turntable 166 to grip the wire to permit one way movement only.

It is thus apparent that a structure has been provided which is responsive to either of the pockets having no conductive member therein, and operative to effect disabling of that portion of the wire feed mechanism while only the empty pocket is at the wire feed station. Since the wire advancing function has been disabled, temporarily, no increment of wire will be fed into the turntable and sheared off thereby unless a conductive member 178 is present. It is also apparent that the feed mechanism for each wire is driven by a single continuously reciprocating member and that said member or assembly may be automatically partially disabled and restored so that the mechanism will normally advance or feed an increment of contact wire into the movable dies in the turntable from the stationary die therebelow during the dwell period. The instant modification suggests how a relatively versatile device may be rendered even more flexible as to utility.

Although various minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such embodiments as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. In an automatic machine for forming contacts on apertured conductive members, the combination comprising: a turntable having a plurality of angularly spaced pockets each adapted to receive and support one of the apertured conductive members, said turntable being rotatable about its axis in a step-by-step manner to dispose each of said pockets successively into a position of dwell at each of a plurality of work stations; one of the stations being a member-feed station at which each of said pockets is normally fed a conductive member; another of said stations, separated from said one station by a plurality of intermediately disposed work stations, being a member-ejection station at which each of said pockets is normally emptied; at least one of the work stations including reciprocable downwardly directed locator means adapted to pass through the conductive member remotely from its contact location; and an arcuate bar extending centrally over each of said pockets at said intermediately disposed work stations, and disposed closely to the conductive members in such pockets, said bar being continually operative to hold the conductive members in such pockets during work on such members and during turntable indexing, and to strip the conductive member from said locator means.

2. In an automatic machine for forming contacts on apertured conductive members, the combination comprising: a turntable having a plurality of angularly spaced pockets each adapted to receive and support one of the apertured conductive members, said turntable being rotatable about its axis in a step-by-step manner to dispose each of said pockets successively into a position of dwell at each of a plurality of work stations; a continually rotatable shaft synchronized with the rotation of said turntable and disposed therebeneath and having a series of cams each corotatable therewith; one of said stations including a contact forming mechanism and a second of said stations including a contact finishing mechanism; each of said forming and finishing mechanisms including a reciprocable member-engaging portion disposed above said turntable and carried by an upwardly biased common drive plate; means rigidly attached to the drive plate adjacent to the periphery of the turntable and adapted to extend beneath and to be driven by one of said series of cams for reciprocating said drive plate; and each of said mechanisms including a reciprocably guided contact-wire engaging portion disposed intermediate said turntable and said shaft, and each adapted to be reciprocated by other cams of said series of cams in a manner to cooperate with said member-engaging portions, respectively.

3. In an automatic machine for forming contacts on apertured conductive members, the combination comprising: a turntable having a plurality of angularly spaced pockets each adapted to receive and support one of the apertured conductive members, said turntable being rotatable about its axis in a step-by-step manner to dispose each of said pockets successively into a position of dwell at each of a plurality of work stations, said turntable having a vertical passageway extending through each of said pockets; one of said stations including means for disposing one of the members in one of said pockets; another of said stations including means for providing and disposing a detached increment of wire in said turntable passageway in vertically spaced relation to the conductive member; and a third of said stations including reciprocably driven means for acting on the lower end of the detached wire increment for raising the wire increment partially through the aperture in the member, and additional means having a hollow tip engageable with the upper end of the wire increment for forcing it substantially into the desired configuration, said raising means for said detached wire increment being continually operative to back up the wire increment in opposition to said additional means.

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