A machine-tool module for inserting and staking very small and lightweight contacts in a support member such as an electrical switch finger is disclosed and claimed. The device comprises a rotatable escapement element having a transporter adapted to receive a contact at an escapement receiving position from a first guide. The escapement element bearing the contact then rotates between the receiving position and an escapement delivery position to deliver the contact to a second guide. An impeller system urges the contact along the second guide to the contact installation point. A fluid pressure differential across the contact when the contact is in the guide impels the contact to move along the guide.
Fig. 10

Fig. 11
MACHINE TOOL FOR ASSEMBLING AND INSTALLING VERY SMALL AND LIGHTWEIGHT PARTS

[0001] The present invention relates to punch press equipment and more particularly to a modular punch press station and its operation.

[0002] U.S. Pat. No. 5,218,756 describes and claims a modular punch press device which is especially adapted to feed, guide and insert a rivet-like electrical contact into a supporting metal piece. In this device, when a punch pin hammer forces the contact against an opposing anvil, the contact stem is deformed and staked in and to the support piece.

[0003] The modular punch press device or station described in the '756 patent is especially useful for assembling and installing small, light-weight rivet-like electrical contacts in the longitudinally extended fingers of an electrical finger contact switch. These contact switches, which are themselves relatively small, are used in a myriad of applications such as automobile electrical systems.

[0004] Some forms of these electrical contacts can be very small and light in weight. For example, some of these contacts handled by the equipment embodying the disclosure and invention of the '756 patent weigh only about 0.0001 pound; i.e. 9,900 of these contacts weigh only about 1 pound. Typically, the head diameter of one of these contacts is about 0.125 inch; the shank diameter is about half that, or about 0.062 inch. The head thickness may be from 0.021 inches to 0.035 inches, and the shank length may be from 0.031 inches to 0.070 inches.

[0005] Experience and experimentation have shown that there are lower limits to the size and weight of the electrical contacts which can be reliably and rapidly handled by the equipment described and claimed in the '756 patent. At present, when electrical contacts which are smaller and lighter than these lower limits are to be installed in electrical switch fingers or other support pieces, those contacts must be installed and secured in and on the fingers by laborious, slow and expensive manual operations.

[0006] It is accordingly the general object of this invention to provide punch press equipment which will reliably, rapidly and inexpensively install extremely small, lightweight contacts in support members such as fingers for electrical contact finger switches. Some of these contacts may be approximately one-half the size and weight of the contacts described above. These extra-small contacts may each have a head diameter of approximately 0.062 inch; a shank diameter of 0.035 inch; a head thickness of 0.030 inch and a shank length of 0.050 inch. And these contacts are light in weight: approximately 11,400 of these contacts collectively weigh approximately 1 pound. These small, lightweight contacts contemplated here are so small in size and so light in weight that they cannot be effectively, reliably and rapidly handled by previously known automated punch press equipment.

[0007] Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings. Throughout the drawings, like reference numerals refer to like parts.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is an isometric view of a preferred embodiment of the invention and adjacent equipment.

[0009] FIG. 1A is an elevational view of an un-staked rivet-like contact.

[0010] FIG. 1B is a sectional view of a contact staked in and on a support element such as an electrical switch finger.

[0011] FIG. 2 is a top plan view of equipment embodying the invention.

[0012] FIG. 3 is an elevational view in partial section showing the equipment and apparatus of FIG. 1. No escapement member cap is shown in this figure.

[0013] FIGS. 4 and 5 are a top plan view and an elevational view in partial section, respectively, of a novel escapement mechanism and supporting apparatus showing the escapement mechanism in a contact delivery configuration; i.e. in the configuration provided when the contact is being delivered from a first guide to the escapement.

[0014] FIG. 4A is a top plan view in partial section of an escapement element and a contact element as they appear when the contact is being transported for installation in a support element such as an electrical switch finger.

[0015] FIGS. 6 and 7 comprise a top plan view and an elevational view in partial section, respectively, of the novel escapement mechanism and supporting apparatus showing the escapement mechanism in a contact transport configuration; i.e. in the configuration provided when the contact is being held by the escapement element for movement and delivery to a second guide.

[0016] FIG. 8 is a top plan view of the escapement mechanism and the associated escapement rotating drive mechanism as they are configured when the contact is in position to be transported to the second guide or insertion track.

[0017] FIG. 8A is a top plan view similar to FIG. 8 but showing the contact and escapement mechanism as they are configured when the contact has been transported and is aligned for delivery to the second guide or insertion track.

[0018] FIG. 9 is an elevational view of the mechanism shown in FIG. 8.

[0019] FIG. 10 is an elevational view of the escapement mechanism and an associated ram cam mechanism when the escapement mechanism is located in its contact receiving position.

[0020] FIG. 11 is an elevational view similar to FIG. 10 but showing the escapement mechanism and associated ram cam mechanism when they are located in the contact delivery position.

[0021] FIG. 12 is a fragmentary top plan view showing the escapement mechanism when it is configured to receive a contact.

[0022] FIG. 13 is a fragmentary top plan view similar to FIG. 12 but showing the escapement mechanism when it is configured to deliver a contact to the second guide.

[0023] FIG. 14 is a top plan view showing the escapement mechanism when it is configured to receive a contact.

[0024] FIG. 15 is a top plan view similar to FIG. 14 but showing the escapement mechanism when it is configured to deliver a contact to the second guide.

DETAILED DESCRIPTION

[0025] While the invention will be described in connection with a preferred embodiment, it will be understood that it is not intended to limit the invention to this embodiment. On the contrary, it is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.
Turning more particularly to the drawings, and especially to FIGS. 1-3, an embodiment of a contact feed and installation station module 20 is illustrated as that station 20 may appear as part of a multi-station punch press and assembly machine 22 of known design. At other stations (not shown) preliminary forming and other operations can be performed upon, for example, a metal strip S. A feeding mechanism 24, which in this preferred embodiment is a vibratory bin or reservoir feeder, is mounted to a support plate 26 to direct a series of contacts from the reservoir along a first, relatively short ramped guide 28. In this particular embodiment, the insertion pieces are rivet-like contacts 30 each having a shank 31 and a relatively extended head 32. These contacts are relatively small, each having dimensions on the order of the dimensions described above. Preferably these small contacts 30 are carried along the first guide 28 in a head-down, shank-up configuration as suggested in FIG. 1A. To this end, the first guide has a cross-sectional shape which will accommodate the contacts 30 only in this configuration. The first guide 28 is inclined and/or can be provided with a known vibratory motion so that the contacts 30 flow in a continuous stream in single file from the reservoir 24 to a rotatable escapement mechanism 40 (FIG. 2) at an escapement receiving position 42.

In accordance with the invention and as illustrated in FIGS. 4-7, the escapement mechanism 40 includes a rotatable escapement element 44 which is adapted to receive a contact 30 from the first guide 28 at the escapement receiving position in a transporter recess 46, as shown in FIG. 4A. The escapement mechanism 40 then causes the escapement element 44 to rotate through approximately 90° from the contact receiving position shown in FIGS. 4 and 5 to an escapement contact delivery position shown in FIGS. 6 and 7.

This rotatable motion of the escapement element 44 is provided by an escapement drive system. An embodiment of this escapement drive system is shown in FIGS. 8-11, and parts of the drive system are suggested in FIGS. 12-15. The escapement element 44 rotates about its center 50 by the action of a connecting rod 52 which is journaled to the escapement element 44 at an eccentric point 53. The connecting rod 52 is also journaled to a drive slide 54 at a pin-like bearing 55. As suggested in FIGS. 8-13 and elsewhere, this drive slide 54 is mounted within the module 20 by conventional means for reciprocal motion. To accommodate this arrangement of the slide 54, the escapement element 44, and the associated parts, the drive slide 54 can be provided with a recess 56 as suggested in FIG. 8A.

Drive slide motion can be initiated by the action of a ram cam 60 moving in a downward direction so as to at least intermittently engage the drive slide 54, as suggested in FIGS. 10 and 11. The drive slide 54 and the ram cam 60 are provided with mating beveled surfaces 64, 65 so that, when the ram cam 60 descends as suggested in FIG. 11, the drive slide 54 is pushed to the left into the position shown in FIG. 11. This drive slide motion causes corresponding rotation of the escapement element 44, but the motion of the ram cam 66 past the drive slide 54 permits a momentary halt or dwell to the escapement element rotational motion so as to permit delivery of the contact from the escapement element to downstream portions of the equipment, as described below. As the ram cam 60 is withdrawn in an upward direction, the drive slide 54 is pushed to the right by the action of a return spring 70 which is the least partially mounted within the drive slide 54, as suggested in FIGS. 10-13 and elsewhere.

When the escapement 44 has been rotated from its contact receiving position shown in FIG. 12 to the escape delivery position shown in FIG. 13, the contact is delivered to a second guide 80 by an impeller system. In accordance with this aspect of the invention, the contact is impelled to travel along this second guide 80 by a fluid pressure differential created across the contact. Here in the illustrated embodiment of the invention, this contact motion is compelled by compressed air which is delivered from a known remote source (not shown) through a first series of fluid passages or conduits 82, 84. The escapement element 44 is provided with one or more second passages 86 which are arranged to be aligned in registry with a confronting end of a first passage 82 when the escapement 44 is rotated into its contact delivery position as shown in FIGS. 7 and 13. When the element 44 and air passages are so aligned, the contact is blown from the transport recess 46 (FIG. 4A) into and along the second guide 80 to a contact installation point 100 (FIG. 3). As suggested in FIG. 2 and elsewhere, these fluid passages are out of registry with one another so as to obstruct fluid communication between the fluid source and the escapement element transporter formation 46 when the escapement element 44 is not in its escapement delivery position.

It will be understood that the contact 30 so transported and delivered to the contact installation point 100 is in a head-down, shank-up configuration (FIG. 3). When it arrives at the installation point 100, the contact is engaged by an anvil of known design located at a relatively lower position below the contact, and a ram of known design is positioned above the contact. During its downward stroke, the ram engages the free end of the contact shank at its upper end and deforms that shank free into an enlarged head so as to secure the rivet-like contact in the support piece S, as shown in FIG. 1B.

1. A device for inserting and staking a rivet-like contact into a support piece, comprising, in combination, a first guide for carrying contacts in single file fashion to an escapement receiving position, a rotatable escapement mechanism adapted to receive a contact from the first guide at the escapement receiving position, to rotate between the receiving position and an escapement delivery position, and to deliver the contact at the delivery position to a second guide, and a second guide for carrying a contact from the escapement delivery position to a contact installation point.

2. A device according to claim 1 further including an impeller system for urging the contact along the second guide from the escapement delivery position to the contact installation point.

3. A device according to claim 2 further including a staking mechanism for securing the contact into a support piece.

4. A device according to claim 1 wherein said first guide comprises a track having a cross-sectional shape adapted to carry the contacts in a head-down, shank-up configuration.

5. A mechanism according to claim 3 wherein the staking mechanism includes an anvil member and a ram member each located at the installation point.
the anvil being positioned to engage and support a contact head at a relatively lower location, and
the ram being positioned to engage a free end of a contact shank at a relatively upper location and to deform that shank free end into an enlarged head so as to secure the rivet-like contact in the support piece.

6. A device according to claim 1 wherein said escapement mechanism has an escapement element mounted for reciprocal rotary motion between the escapement receiving position and the escapement delivery position.

7. A device according to claim 6 wherein said escapement element includes a transporter arranged to receive, engage and transport a contact from the escapement receiving position to the escapement delivery position.

8. A device according to claim 6 further including an escapement drive slide and a connecting rod pivotally mounted to the escapement element and the escapement drive slide.

9. A device according to claim 8 wherein said mechanism includes a ram cam mounted for reciprocal motion, and wherein said escapement drive slide has a beveled cam surface adapted and positioned for at least intermittent engagement by the ram cam.

10. A device according to claim 8 further including a biased element for urging the drive slide through at least part of its reciprocal motion.

11. A device according to claim 7 wherein said impeller system includes a number of fluid passages which are positioned so as to be in registry with one another to provide fluid communication between a fluid source and said escapement element transporter when the escapement element is in its escapement delivery position, the fluid passages being out of registry with one another so as to obstruct fluid communication between the fluid source and said escapement element transporter when the escapement element is not in its escapement delivery position.

12. A device for inserting and staking a rivet-like contact into a support piece at an insertion point, comprising, in combination,
a rotatable escapement element having a transporter adapted to receive a contact at an escapement receiving position, the escapement element being adapted to rotate between the receiving position and an escapement delivery position, and to deliver the contact at the escapement delivery position to a second guide, a guide for carrying a contact from the escapement delivery position to a contact installation point, and an impeller system for urging the contact along the guide from the escapement delivery position to the contact installation point, the impeller system including at least first and second fluid passages, the first and second fluid passages being in fluid communication with one another and with the escapement element transporter when the escapement element is in its escapement delivery position so as to deliver a contact from the escapement element transporter to the insertion position.

13. A device according to claim 12 further including a staking mechanism having an anvil member and a ram member each located at the contact installation point, the anvil member being positioned to engage and support a contact head at a relatively lower location, and the ram being positioned to engage a free end of a contact shank at a relatively upper location and to deform that shank free end into an enlarged head so as to secure the rivet-like contact in the support piece.

14. A device according to claim 13 further including an escapement drive slide and a connecting rod pivotally mounted to the escapement element and the escapement drive slide for driving the escapement element in an at least partially oscillatory motion.

15. A device according to claim 14 wherein said mechanism includes a ram cam mounted for reciprocal motion, and wherein said escapement drive slide has a beveled cam surface adapted and positioned for at least intermittent engagement by the drive slide.

16. A device according to claim 15 wherein said mechanism includes a ram cam mounted for reciprocal motion, and wherein said escapement drive slide has a beveled cam surface adapted and positioned for at least intermittent engagement by the ram cam.

17. A device according to claim 16 further including a biasing element for urging the drive slide through at least part of its reciprocal motion.

18. A method for inserting and staking a rivet-like contact into a support piece, comprising the steps of:
providing a single contact to an escapement mechanism at an escapement receiving position,
rotating the escapement element and the provided contact from the escapement receiving position to an escapement delivery position,
delivering the contact from the escapement mechanism to a guide,
impeiling the contact along the guide to a contact installation point, and staking the contact in a support piece.

19. The method according to claim 18 including the step of causing a fluid pressure differential across the contact when the contact is in the guide so as to impel the contact to move along the guide to the contact installation point.

20. The method according to claim 18 further including the step of causing a staking ram member to move in oscillatory manner in synchronization with oscillatory rotational movement of the escapement member.

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