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Nawrocki

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[54] **SAFETY CONTROL DEVICE WITH OBSTRUCTION FEELER AND SWITCH ASSEMBLY**

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[52] **U.S. Cl.**..... **200/61.42,** 200/61.58 R, 100/53, 192/134, 307/92

[51] **Int. Cl.** **H01h 3/16**

[58] **Field of Search** ..... 200/52 R, 61.58 R, 153 T, 200/61.42, 61.58; 192/129 A, 134; 307/92-94; 317/9 R; 100/53

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[57] **ABSTRACT**

The device is fixedly applied in any convenient way to an impact type machine, such as a riveter. This is powered hydraulically or otherwise for its impact stroke through and under the sole and direct control of the electrical circuitry of the device, to the exclusion of any other direct application of power to the machine. The latter has a pivoted sensor control arm operated for a vertical protective swing by foot switchcontrolled electrical solenoid means of said circuitry, the physical mounting of said sensor being such that it cannot complete its protective operation, in a limited space alotted, in the event of a significant obstruction in said space, viz., a finger or hand of an operator present in this danger area. For this purpose, the sensor arm has means to trip a microswitch of the circuitry only upon completing a full, solenoid-operated protective swing, whereupon the microswitch completes an electrical circuit through its power relay, the latter operating, for example, a solenoid-type valve controlling application of hydraulic power to the impact machine. If such full swing is obsructed, the microswitch is not operated, the power relay sub-circuit remains open, and an impact machine operation cannot take place. A signal lamp is wired to a normally closed contact of the microswitch to be instantaneously and momentarily energized as the microswitch is solenoid-operated to make its normal power relay engaging contact; and as this occurs the lamp extinguishes and remains unlit until another foot switch cycle is inaugurated. Otherwise, as in the case of obstruction of the full sensor member stroke, the microswitch remains as normally closed in the absence of its mechanical opening by the safety sensor arm and the signal lamp remains lit to call attention to the condition. The usual foot control switch of the impact machine is wired into the circuitry of the device between a terminal of an electrical power supply and the several parallel microswitch and power relay, microswitch-operating solenoid and auxiliary or accessory sub-circuits of the present control circuitry, so that even with the foot switch closed an energizing voltage for the impact machine is applied to the latter only when the microswitch of the device completes the power relay sub-circuit.

10 Claims, 3 Drawing Figures

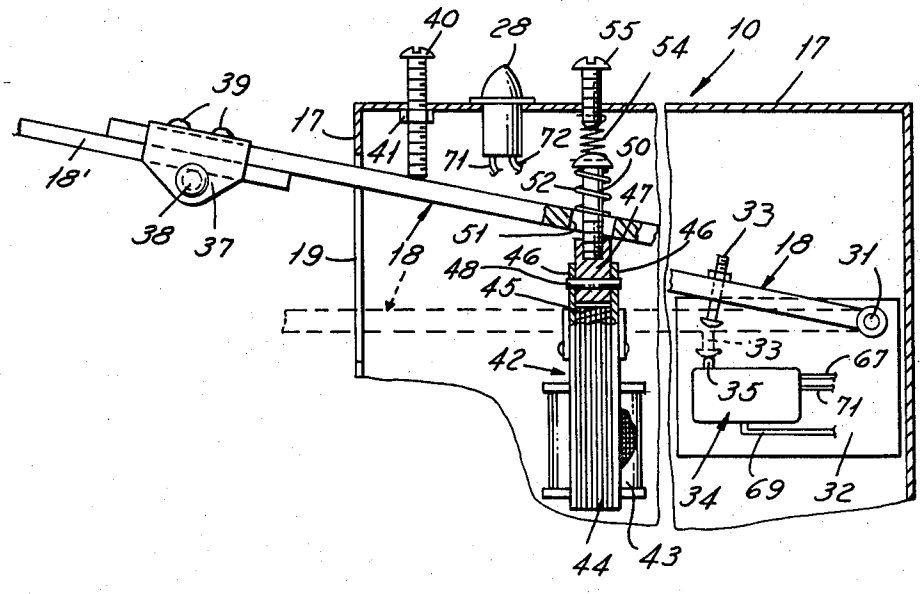


FIG. 1

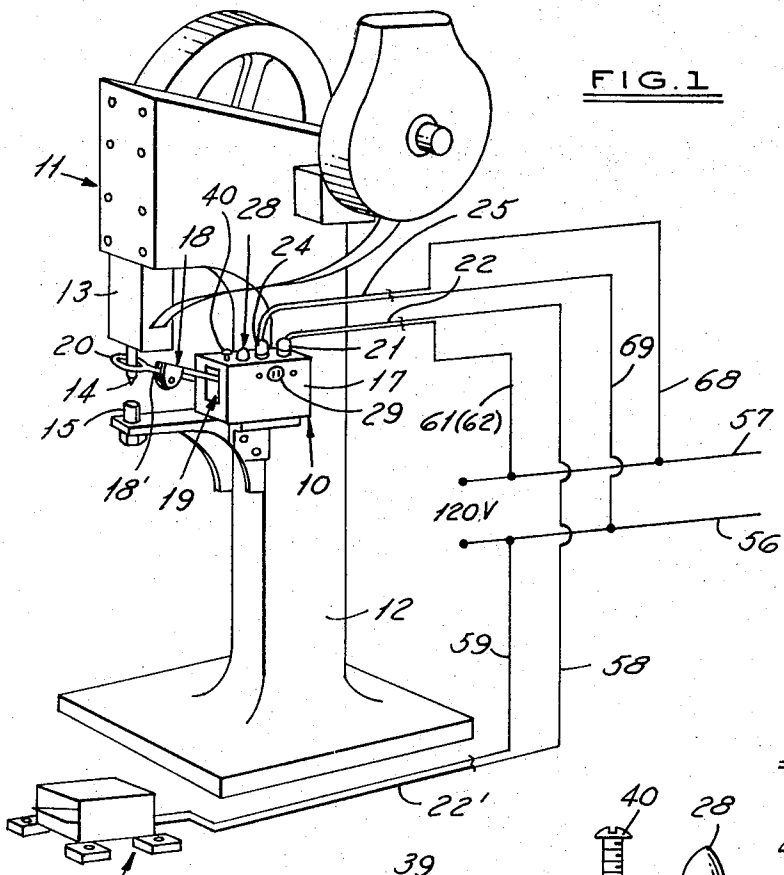


FIG. 2

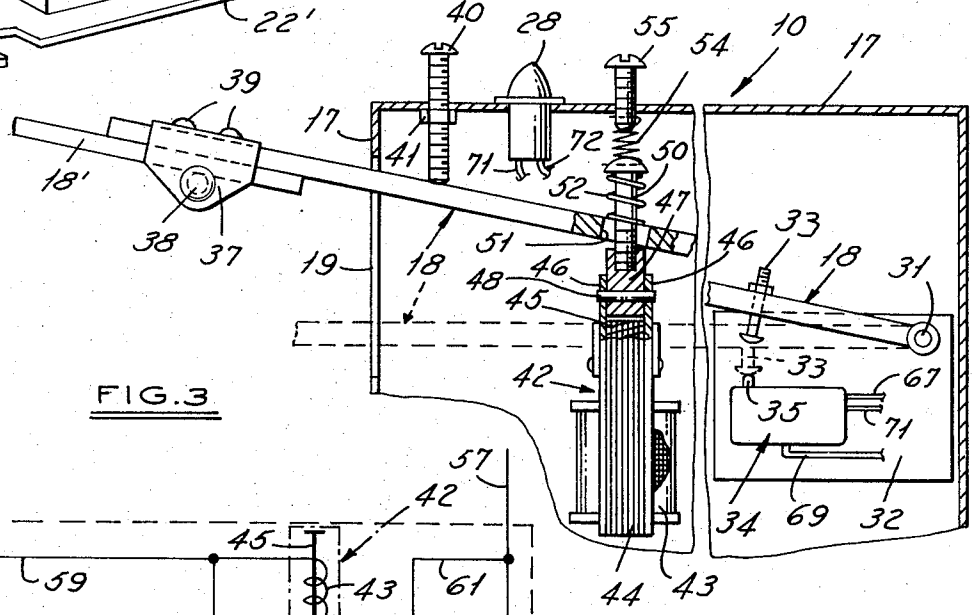
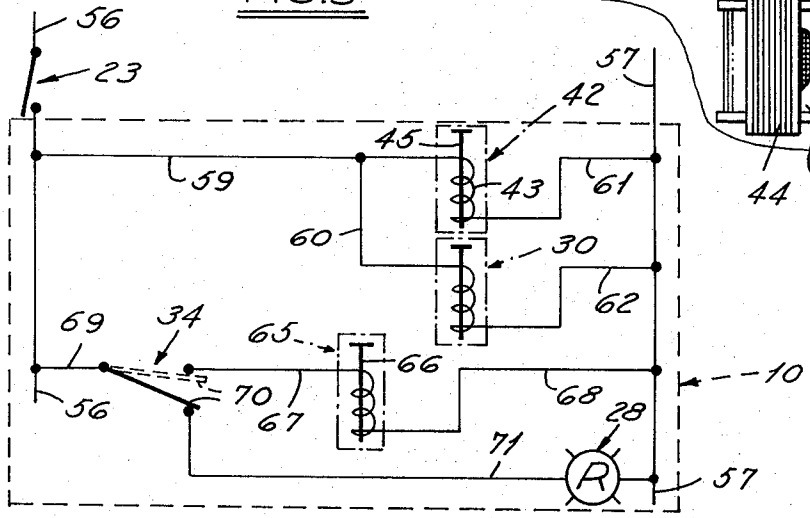


FIG. 3



SAFETY CONTROL DEVICE WITH OBSTRUCTION FEELER AND SWITCH ASSEMBLY

BACKGROUND OF THE INVENTION - FIELD

The improved safety control device finds application in the protection of personnel controlling the operation of many types of impact machine, of which riveting, staking or crimping types are examples, a riveter being instanced in the accompanying drawings and description. However, the end uses are many, indeed, outside of this special impact field, in instances in which worker protection is an essential objective, and in which, in addition to obtaining that end, it is desirable to alert a supervisor as to the existence of an unauthorized and dangerous practice.

SUMMARY OF THE INVENTION

The device is of extremely simple, light weight and compact construction and equally simple in its manner of operation, both in regard to mechanical structure and its standard electrical components and circuitry. As employed by way of modifying or supplementing existing equipment, or as a component of original such equipment, the device per se utilizes only two moving parts, namely the pivotally mounted sensor arm and the armature of the electrical solenoid operating said arm. All components are housed in a very compact sheet metal casing, which is simply and quickly opened for access to parts to be inspected or replaced, there being no possibility of electrical shock at any time. External connections are made through standard, non-interchangeable plug and socket means.

The conventional electrical wiring of the protected machine is modified in an extremely simple way to power its stroke as herein contemplated, similarly to power other ancillary or accessory equipment, such as a counter, time, etc., and to interrelate the device with the usual foot switch of the main apparatus. That is, the electrical wiring of the machine is simply revised to route its supply source through the control device, rather than directly to its own electrical system; and the arrangements are readily adaptable to many different types of equipment, impact-type or otherwise.

While enabling the sensor arm and an associated ring component to sweep a limited zone in which there is access of the operator's hands in loading and unloading, the arm nevertheless has a sufficiently rectractile or rest to permit loading and unloading of irregular shaped parts without interference. Mechanical parts of the device are easily and quickly replaced, including the sensor arm unit, which is relatively widely adjustable as to length and may have different shapes. All components of the control panel of the device are standard and can be replaced by maintenance personnel from stock items. The device is capable of manufacture and sale for little more than one-half the price of comparable safety equipment now on the market.

Most importantly, safety in operation underlies and is stressed throughout the invention. In addition to a minimum of moving parts, there is no electrical shock potential, whether or not the circuitry of the device is as normally housed or exposed; and the operator can in no way by-pass or nullify the intended operation of the device. Any tampering with the intended normal use will not only interrupt the instanced riveter's functioning, but will also receive the attention of a supervisor signalled at a distance.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the device as operatively attached to a typical riveting machine, also schematically showing simple electrical lines as basically wired to a power source, the foot switch of the machine and the microswitch and power relay or solenoid subcircuitry of the device;

FIG. **2** is a fragmentary view in vertical section through the housing or casing of the device, showing essential control sensor arm, solenoid and microswitch components, but omitting certain components not essential to operation as herein comtemplated; and

FIG. **3** is a schematic wiring diagram of the control.

DESCRIPTION OF A PREFERRED EMBODIMENT

The device of the invention, as generally designated by the reference numeral **10**, is shown in FIG. **1** as operatively applied fixedly in any convenient manner to a conventional impact riveting machine **11**, as at an upright standard **12** of the latter; and typically in such a machine there is a continuous blank-fed riveter head **13** guiding a rivet setting tool **14**, the operation of which is backed by a bracket-supported anvil **15** at a work station.

Device **10** includes an appropriate compact sheet metal housing **17**, one side of which is readily removable and in which an elongated sensor arm **18** is pivotally mounted for swing in a vertical plane, by means and in a manner further detailed in FIG. **2** and the description to follow. A rectangular opening **19** in casing **17** permits a limited action of the sensor arm **18** for the purpose of the invention, as a sensor ring **20** on an extension **18'** of said arm moves from an upper retracted position, shown in solid line in FIG. **1** (also FIG. **2**), to the dotted line position of FIG. **2**. By preference, ring **20** concentrically surrounds the reciprocatory axis of setting tool **14** in this operation, and its diameter and relative positioning, by means hereinafter described, are such as, while permitting proper loading and locating as well as unloading manipulations of a workpiece without danger, the ring and arm will, if the operator's hand or finger is in the danger zone at the time the foot pedal is tripped, be unfailingly stopped by such obstruction before a full downward motion of arm **18** is completed.

Referring to FIG. **1**, the device **10** has electrical means and connections, as exposed externally of its housing or casing **17**, including (a) an upper socket removably receiving a plug-in connector **21** whose wiring cable **22** connects, through a cable **22'** wired to the conventional foot switch **23** of machine **11**, to the terminals of a standard 120 volt power supply (in each case by electrical conductors or leads to be individually described in conjoint reference to the wiring diagram of FIG. **3**); (b) a conventional socket removably receiving a power connector plug **24** which, through a cable **25**, energizes an electrical control, such as a relay, for a mechanism (not otherwise shown) driving riveter **11**, the connector leads of cable **25** tapping co-terminally with those of foot switch cable **22** to the power supply **23**; (c) a warning safety signal lamp **28**; and (d) a laterally exposed socket **29** adapted to receive a plug-in connector (not shown) optionally to electrically energize a suitable counter schematically designated **30**

only in FIG. 3, or other corresponding accessory unit, concurrently with the closure of the foot switch 23. This occurs simultaneously with the foot switch-controlled energization of a microswitch-operating solenoid, as will be described, and other than in the optional accessory function the wiring of counter 30, or its equivalent, does not figure in the functioning of the device 10.

Now referring to FIG. 2, the sensor ring operating arm 18 is shown as being pivotally mounted on a horizontal axis at 31 by a relatively rugged block 32 which is fixedly secured to a side wall of the casing 17 of device 10; and in spaced relation to this pivot the arm 18 carries an adjustable threaded tappet stud 33 whose function is to actuate a conventional, normally closed microswitch 34 mounted to a side of block 32. Connections and operation of microswitch 34 will be later described; it is opened and closed conventionally under control of an operating button 35. The foot switch 23 forms a first switch and microswitch 34 forms a second switch of the electrical circuitry.

Sensor control arm 18 carries the longitudinally adjustable extension piece 18' adjacent its free end, this length substantially overlapping the arm proper 18, and at its own end has the safety sensor ring 20 fixedly secured thereon as an integral formation thereof. A releasably tightened clamp saddle 37 of inverted U-shaped cross-section secures extension 18' to the arm 18, a clamp screw 38 spanning the walls of saddle 37. By preference, a pair of screws 39 are passed through the top of clamp saddle 37 and threaded into the arm 18 proper; and the arrangement enables the effective overall length of the control arm to be adjusted a distance, for example, up to two inches, after which clamp screw 38 is taken up tightly to hold the setting. As indicated above, different configurations of the sensor ring extension 18' will adapt device 10 to accept different types of workpiece. The upward return of arm 18 following a partial or full length downward safety stroke is adjustably limited by a set screw 40 threaded in the top wall of casing 17 and held in adjusted position by a lock nut 41 beneath said wall.

The casing fixedly supports an arm-actuating solenoid unit, generally designated 42, including the usual coil 43, within whose pole structure 44 the solenoid armature 45 operates vertically downwardly upon energization of solenoid 42. The upper end of armature 45 is equipped with a pair of upright parallel side plates 46 (FIG. 2) between which a small armature adapter piece 47 is pivotally mounted by a transverse connector pin 48, whereby adapter 47 partakes of the same vertical shift as the armature 45.

A control arm operating screw or stud 50 is threadedly connected into the top of armature adapter 47, extending through an elongated clearance slot 51 in control arm 18 directly above the armature structure; and a cushioning coil compression spring 52 encircles stud 50, being normally under compression between the head of said stud and the top of safety control arm 18. It is the function of spring 52 to cushion the solenoid-powered downward blow of control arm 18 on the hand of the machine operator, should it improperly be present in the danger zone when foot switch 23 is tripped.

A fairly strong tension return spring 54 is hooked at its bottom coil into the head of arm actuator stud 50, anchoring similarly at its top to an adjustable set screw 55 which is threaded into the top wall of housing or casing 17. Spring 54 thus normally biases control arm 18 upward to its inoperative or rest position shown in solid line in FIG. 2; but its force is, of course, overcome upon energization of solenoid 42, through the agency of circuitry to be described, to drive arm 18 down in its safety-insuring stroke to the position of arm 18 appearing in dotted line in FIG. 2.

Inasmuch as certain internal electrical wiring and components mentioned above (typically relating to counter 30) are non-essential to the operation of the device 10 as mentioned above, they have been omitted for simplicity from FIG. 2. As for other electrical lead or conductor designations, they appear in FIG. 1 as specifically numbered in FIG. 3.

As shown in that figure, the circuitry of control device 10 is electrically supplied through 120 volt power lines 56, 57, to which parallel connectors of the foot switch and microswitch cable components 22 and 25 are respectively connected, coupling lead means common to those cables being designated 58.

A supply lead 59 of the foot switch cable 22, as tapped to power line conductor 56, is connected to energize in common the coil 43 of arm-operating solenoid 42 and, through a paralleling jumper line 60, the energizing coil of the solenoid or relay-type counter 30, the respective return leads 61 and 62 of said coils connecting to the second power line 57.

The reference number 65 in FIG. 3 generally designates a power relay or solenoid type operator unit wired in the circuitry of device 10, whose energization commences the operation of the riveting or comparable machine 11. This will typically be through the agency of a solenoid-operated valve (not shown) controlling the application of hydraulic machine power. Hence device 65 may be considered to comprise a relay contactor or solenoid armature 66 to operate such a valve under the direct and only control of the device 10. Power relay 65 is line-energized through leads 67, 68 connected to opposite terminals of the coil thereof, lead 67 being tapped to a normally open contact terminal of microswitch 34, whose fixed contact is connected by a lead 69 to main power supply line 56. Relay return lead 68 goes to the opposite power line 57.

The contactor 70 of microswitch 34 is normally spring held internally of the latter to engage against a terminal of an electrical lead 71 in parallel with power relay leads 67, 68 and connecting to the warning lamp 28. The latter's return lead 71 is to power line 57. However, as explained above, the normal closure of microswitch contactor 70, as shown in solid line in FIG. 2, is only momentary following closure of foot switch 23. Assuming that there is no obstruction to a full safety movement of control arm 18, switch contactor 70 practically instantaneously engages the terminal of power relay conductor 67. This is the result of the energization of control arm actuating solenoid 42 to draw the arm's tappet stud 33 (FIG. 2) down and operate the control button 35; and the action is instantaneously attended at its outset by a lighting of signal lamp as the foot switch 23 initially goes closed. Noting this momentary blinking from time to time, a supervisor is content that the riveter is being properly operated. Otherwise, an obstruction being present in the danger zone, the arm 18 has an incomplete safety stroke, an engagement of microswitch contactor 70 with lead 67 does not take place, and the sole electrical flow through that switch is to alarm lamp 28. Noting this continuing visible sig-

nal, the supervisor will make an appropriate investigation.

What is claimed is:

1. An impact or related type machine comprising a reciprocally movable tool part and an electrical operating circuit including a normally opened first switch and a power relay unit in series with said first switch, said power relay unit when energized effective to initiate movement of said tool part, a second switch interposed in said electrical operating circuit between said first switch and said power relay unit, said second switch having first and second positions, said second switch when in said first position opening said operating circuit between said first switch and said power relay unit, a safety control device governing operation of said electrical operating circuit comprising an elongated control arm pivotally mounted for a motion in which an end portion thereof may fully traverse a danger zone in proximity to the path of reciprocation of said tool part and prior to the reciprocation of said tool part, unless interrupted by a zone obstruction, said control device having an electrical safety circuit interposed in said operating circuit between said first and second switches parallel to said power relay unit, said electrical safety circuit being responsive to a signal initiated upon the closing of said first switch, said safety circuit including electrically responsive means connected to said control arm and when energized upon the closing of said first switch effective to swing said control arm through said danger zone unless the movement thereof is obstructed, said control arm after movement through said danger zone being effective to move said second switch to its second position thereby permitting current to flow through said power relay unit to initiate movement of said tool part.

2. The machine defined in claim 1 wherein an electrically energizable signaling unit is interposed in said electrical operating circuit parallel to said power relay unit, with said second switch when in said first position permitting said signaling unit to be energized upon closing of said first switch, said signaling unit remaining energized until said relay unit is energized or until said first switch is opened.

3. The machine defined in claim 2 wherein said electrically energizable signaling unit is in the form of a light.

4. The machine defined in claim 1 wherein said first switch is manually operable.

5. The machine defined in claim 1 wherein said first switch is in the form of a manually operable foot type switch.

6. The machine defined in claim 1 wherein said power relay unit is in the form of a solenoid.

7. The machine defined in claim 1 wherein said electrically responsive means is in the form of a solenoid.

8. The machine defined in claim 1 wherein a return spring is interposed in said control device engageable with said control arm for biasing said control arm towards an inoperative position when said electrically responsive means is de-energized.

9. The machine defined in claim 1 wherein said control arm consists of two elongated parts adjustably secured together to permit the length of the control arm to be varied.

10. The machine defined in claim 1 wherein said end portion of said control arm has a ring-like member formed thereon through which the tool part moves after said control arm has traversed the danger zone.

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