March 6, 1945. C. G. ROPER 2,370,686

CYCLE CONTROLLED SWITCHING DEVICE

Filed Aug. 3, 1940 3 Sheets-Sheet 1

Fig. 1

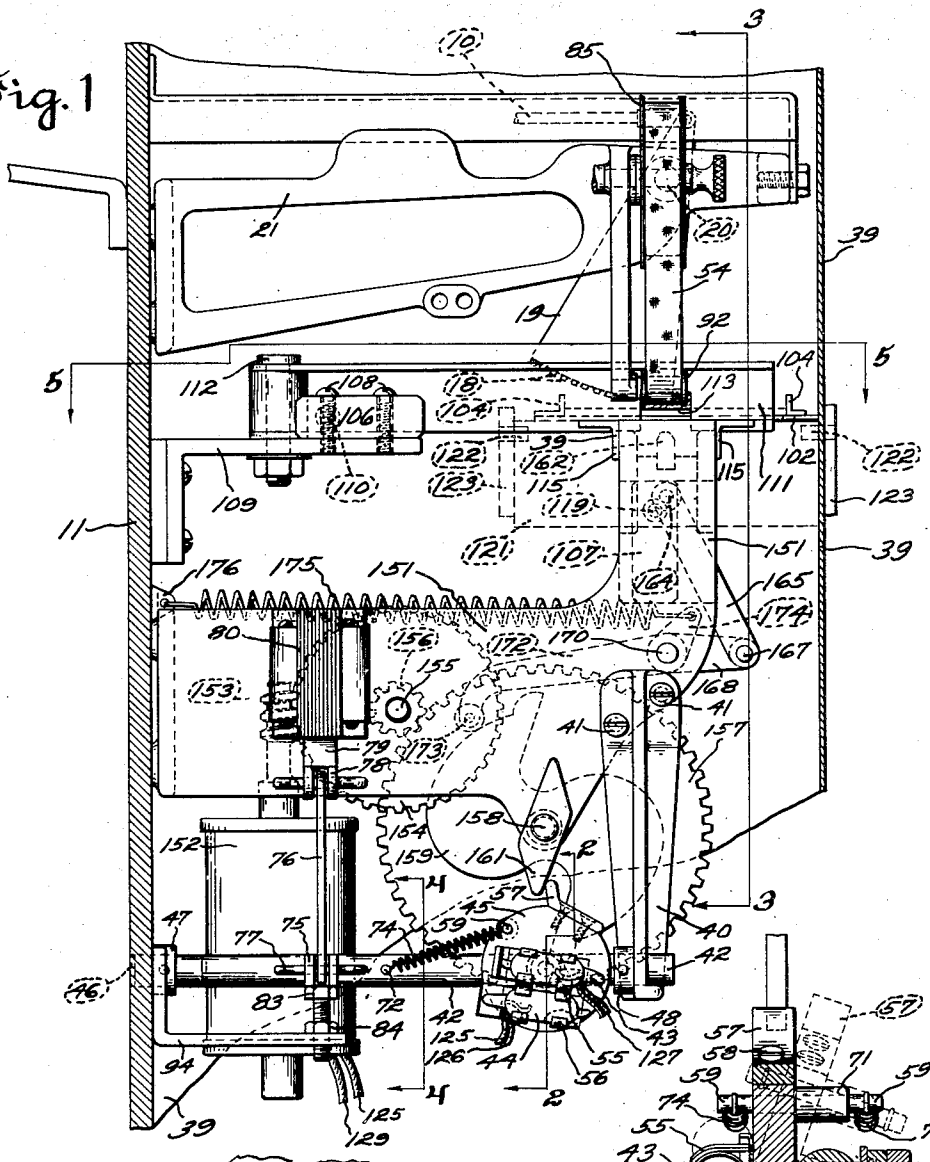


Fig. 9

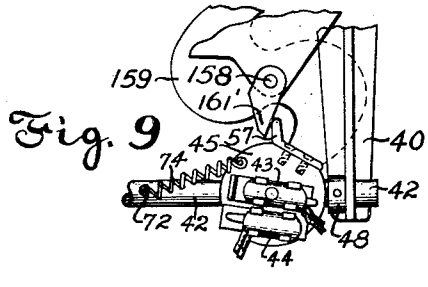


Fig. 2

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CYCLE CONTROLLED SWITCHING DEVICE

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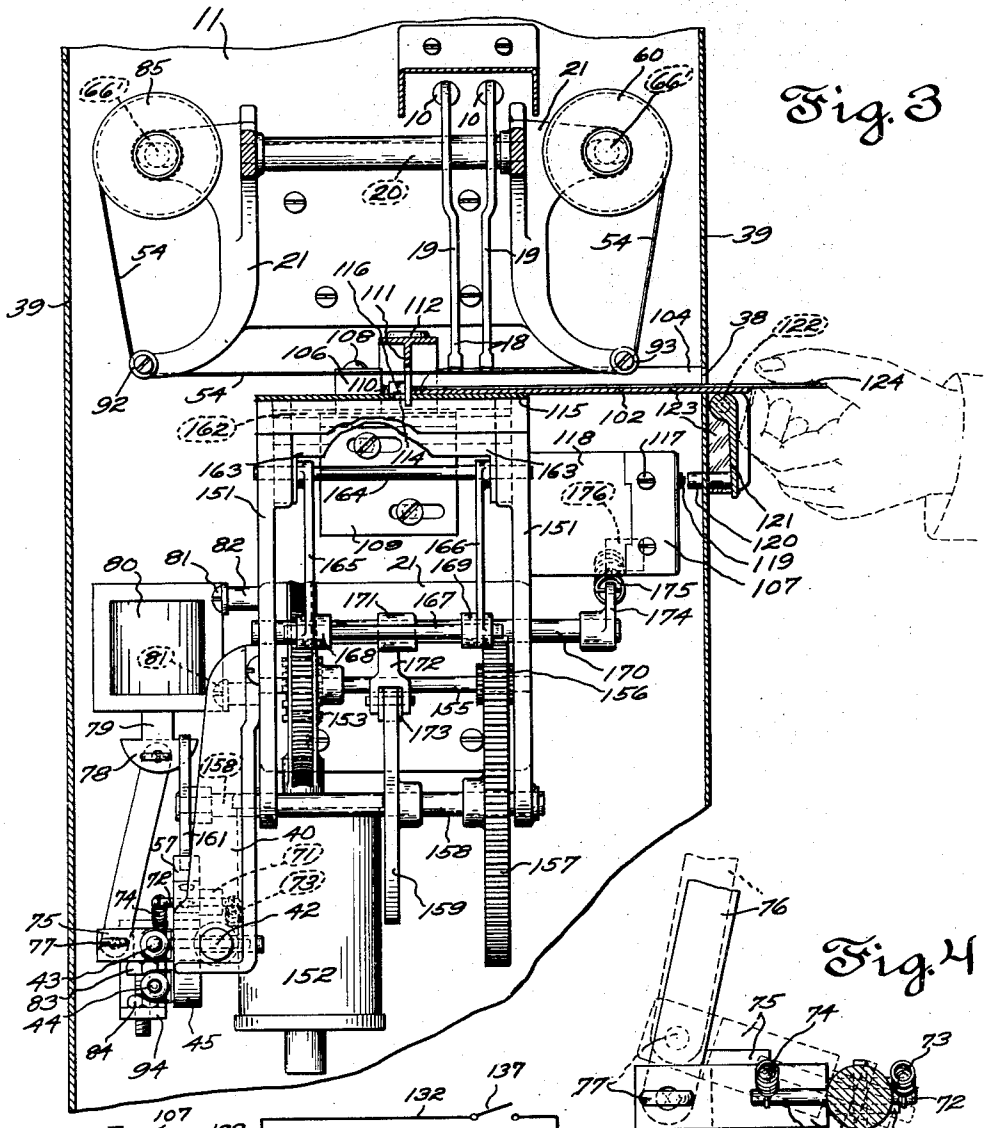


Fig. 3

Fig. 4

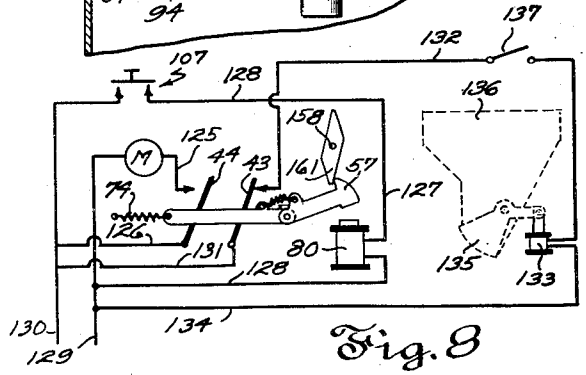


Fig. 8

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CYCLE CONTROLLED SWITCHING DEVICE

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Fig. 5

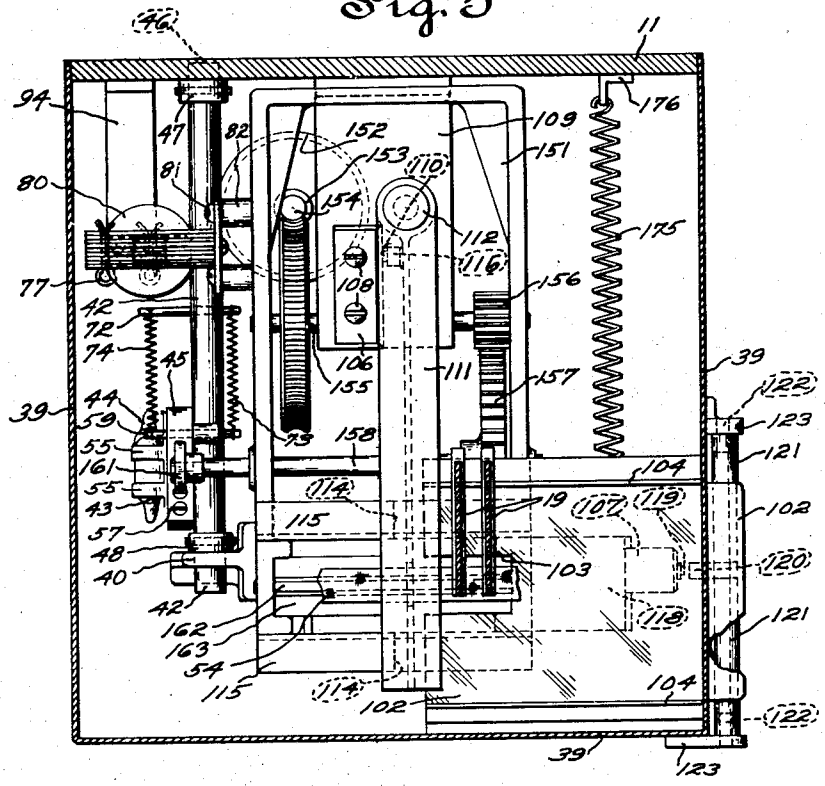


Fig. 6

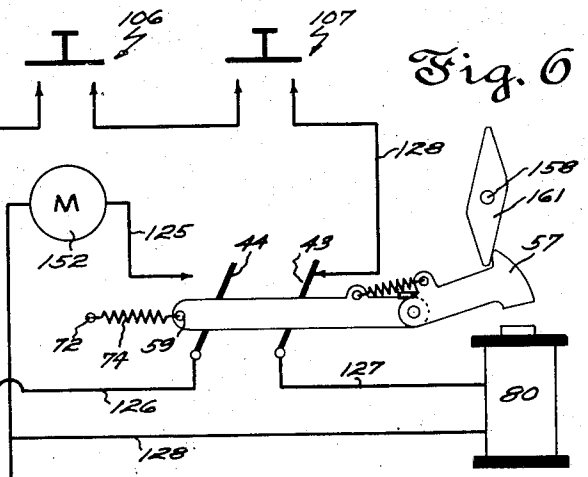
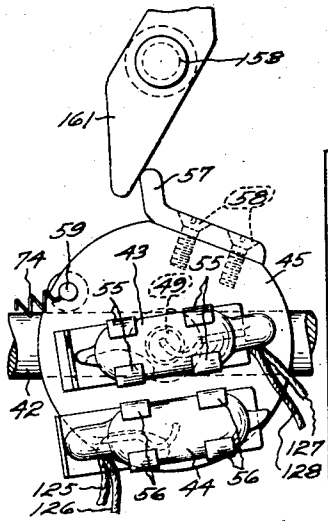


Fig. 7



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Patented Mar. 6, 1945 2,370,686

UNITED STATES PATENT OFFICE

2,370,686

CYCLE CONTROLLED SWITCHING DEVICE

Charles G. Roper, Bridgeport, Conn., assignor, by mesne assignments, to The Yale & Towne Manufacturing Company, Stamford, Conn., a corporation of Connecticut

Application August 3, 1940, Serial No. 350,185

27 Claims. (Cl. 234—5.4)

This invention relates to cycle performing apparatus and cyclic power stop mechanism incorporating electric switch operating devices for starting and/or stopping a cycle of electrically powered operation of mechanism for performing any useful work such as the printing or recording of weight values, and particularly concerns current switching devices which become actuated as a consequence of manipulating a record card or blank in a natural manner in the act of presenting or inserting the same into position to receive its printed impression.

An example of weight printing apparatus to which the electrical switching devices of this invention may have useful application is more fully disclosed in U. S. Patent No. 2,198,139, granted April 23, 1940. In the apparatus shown in that patent the power drive mechanism which acts to position the type and then strike a record therefrom is set in operation by separate manipulation of a switch handle located remotely from the point of insertion of the record card. The mechanism of said patent automatically terminates its own cycle of recording action by mechanically reversing the movement of the switch operating handle.

One object of these improvements is to provide a safety form of sparkless or explosion proof circuit controller for supplying and cutting off the relatively heavy current by which the driving motor of the power mechanism is energized.

A further object is to enable this safety form of circuit controller to be initially actuated through remote control by the use of a pilot switch or switches for starting the power cycle, and to then be reversely actuated—that is restored to its initial condition—by the running of the power mechanism at the end of the recording cycle.

A further object is to dispose one or both of the pilot switches at a location in juxtaposition to the point of presentation of the record card to the printing station so that the action of the operator's hand which presents or inserts the card may directly or indirectly also actuate one or both of the pilot switches. This leaves the other hand of the operator free for simultaneous use in other connections when required.

A further object is to guard against premature closing of circuit through one or both pilot switches before the record card is properly presented and received fully into its record receiving station.

A further object is to employ pilot switches of the momentary contact type together with a "hold-over" relay so arranged in circuit as not to require prolonged maintenance of manually exerted pressure against the pilot switch throughout the period of manually initiated automatically completed recording action.

A still further object is to make use of practically the same mechanical form of cycle terminating cam as is disclosed in the above said U. S. patent.

The foregoing and other objects of the invention are further referred to in the following description of an illustrative embodiment thereof in which description reference is made to the accompanying drawings wherein:

Fig. 1 is a view in elevation showing parts of an incomplete weight recording apparatus incorporating the present improvements in electric switching devices, a more complete form of which apparatus without the present improvements is disclosed in the above said patent.

Fig. 2 is an enlarged view taken in section on the planes 2—2 in Fig. 1 looking in the direction of the arrows.

Fig. 3 is a view drawn on the same scale as Fig. 1 taken in section on plane 3—3 in Fig. 1 looking in the direction of the arrows.

Fig. 4 is a fragmentary view taken in section on the plane 4—4 in Fig. 1 looking in the direction of the arrows.

Fig. 5 is a plan view taken in section on the plane 5—5 in Fig. 1.

Fig. 6 is a diagram of the electric circuit with the current switching controls of the present improvements incorporated therein.

Fig. 7 shows on an enlarged scale a fragmentary portion of Fig. 1 with the mercury switches tilted in opposite directions.

Fig. 8 is a diagram of modified electric circuit arrangements wherein one of the electric tubes is utilized to prevent discharge of a weighable load until its weight has been recorded.

Fig. 9 is a fragmentary view like a portion of Fig. 1 showing a modified construction.

For convenience of reference, some of those parts of the improved recording apparatus herein shown which are common or analogous to the apparatus disclosed in the aforesaid Patent No. 2,198,139 are designated herein by the same reference characters as in the said patent. It will be understood that only as much of the said apparatus of the patent is herein disclosed as serves to illustrate the relationship and the cooperative functioning of the present improvements therewith.

Referring first to certain type registering mech-

anism, one or more horizontal feeler rods 10 are slidable longitudinally to positions corresponding respectively to different magnitudes of weight measured by a weighing scale (not herein shown but more fully explained in the aforesaid patent) and in doing so cause type segments 19 to swing on a common pivot 20 to different positions in which respectively different type characters 18 projecting from the peripheral edge of each type segment occupy such positions that that type character which indicates the proper magnitude of weight is in lowermost position vertically under pivot 20. Pivot 20 may constitute a shaft supported by and spanning the space between the left and right sides of an upper frame casting 21 mounted at its rear end on the main vertical frame plate 11 which later may be bolted to the dial head casing of the weighing scale. The weighing scale thus can determine the extent of movement of rods 10 and thereby the recording positions of segments 19 when a record of weight is to be printed from type 18.

A power and printing hammer mechanism is located completely below a bed plate 102 which latter is supported mainly upon upstanding portions of the lower frame casting 151 by the assistance of angle irons 115. Most of the power and printing hammer mechanism is supported and operates between the spaced opposite sides of this frame casting 151 which itself is bolted to vertical frame plate 11 and hence supported in fixed relation to upper frame casting 21.

A suitable electric power motor 152 may be separately mounted on the said frame plate 11 and have its shaft equipped with a drive worm 153. A worm wheel 154 meshes with worm 153 and rotates shaft 155 to which the worm wheel is fixed. This shaft has a bearing at each end in frame casting 151 and carries fixed thereon the pinion 156. This pinion is in mesh with a large gear 157 which is fixedly carried by a cycle performing cam shaft 158. This cam shaft spans the space between the opposite sides of frame casting 151 and has bearings therein. Between these frame sides, shaft 158 fixedly carries a work performing cam 159 for operating a printing hammer comprising a strip of suitable platen material 162 forming the top surface of a slidable block 163 whose ends are guided for vertical movement in the frame casting 151. Operative connections between cam shaft 158 and the platen block 163 include the block carried wrist pin 164 pivotally engaged by two depending links 165 and 166 whose lower ends likewise pivotally engage a rod 167 which connects and is rigid with the free ends of spaced arms 168, 169 fixedly mounted on shaft 170. This shaft has bearings in frame casting 151 and midway its length fixedly carries the hub 171 of a cam follower 172 whose free end is equipped with a roller 173 that rides against the periphery of cam 159. Outside of the frame casting, one end of shaft 170 fixedly carries a stub arm 174 which is connected by the hammer actuating spring 175 to a bracket 176 secured to the main frame plate 11.

At its left extremity in Fig. 3, shaft 158 carries fixedly thereon, and rotates, as part of a cycle controlling rotor electric circuit cut-out cam or timing cam wheel 161 which automatically causes the current supply to the power motor 152 to be interrupted when a cycle of recording action has been completed. The present improvements are more particularly concerned with the construction and operation of current switching devices which cooperate with cam 161 for electrically initiating the cycle of recording action, as well as for enabling the travel of said cam to terminate such cycle automatically.

The present improvements include what may be termed pilot switches located in the neighborhood of bed plate 102 which latter serves as a rest for the ticket, card or blank 124 which is to receive the printed record of weight. An inked ribbon 54 passes in usual manner between the type characters 18 and the bed plate 102. This ribbon has one of its ends wound upon a spool 60 which is rotatable on a spindle 66' and has its other end wound upon a spool 65 which is rotatable on a similar spindle. The spindles 66' are supported on the upper frame casting 21, and between the spools ribbon 54 passes around and under and is stretched between guide pulleys 92 and 93, also supported from frame casting 21. The manner in which the ribbon is fed and reversed does not concern the present invention. It will be observed however that the horizontal stretch of the ribbon is spaced slightly above bed plate 102 so that a record receiving card 124 may be inserted therebetween from the right in Fig. 3 through an aperture 38 in the side wall of the recording apparatus casing 39.

The outer left face of the frame casting 151 is equipped with a bearing bracket 40 secured rigidly thereto by bolts 41 and whose lower end contains a hole which provides support for one end of a rotatable shaft 42 carrying a current switching unit including mercury tubes 43, 44 which are supported from shaft 42 through the medium of a carriage tube mounting disc 45. While carried bodily by shaft 42, disc 45 is also provided with limited rotative movement relative thereto on an axis crosswise the axis of the shaft. The construction showing the manner in which the disc 45 is movably mounted on shaft 42 is best set forth in Fig. 2 and is hereinafter referred to in greater detail. The left end of shaft 42 in Fig. 1 is rotatably supported in a bearing hole 46 in the main vertical frame plate 11 so that shaft 42 extends horizontally past and alongside motor 152. Thrust collars 47 and 48 are pinned to shaft 42 to prevent lengthwise sliding thereof.

Disc 45 is rigid with its central projecting trunnion stud 49 which extends through a bearing hole bored crosswise through shaft 42, and has a threaded reduced portion 50 receiving the thrust washer 51 retained by lock nuts 52. Disc 45 carries upper spring clips 55 to receive and releasably hold the lower mercury tube 44 which may be like tube 43 but reversed end for end as to position. Disc 45 further carries on a flatted portion of its peripheral edge the upwardly projecting finger 57 removably secured by screws 58. Disc 45 is still further equipped with a spring stud 59 which projects laterally on both sides of the disc and is stiffened by the assistance of a collar 71 which overlies shaft 42. By contacting with shaft 42, collar 71 serves as a stop to limit the counterclockwise rotation of disc 45 in its normal position shown in Fig. 7. Rigidly inserted in shaft 42 and projecting on both sides thereof is a corresponding spring stud 72. Stretched between spring studs 59 and 72 are two extension spring coils 73, 74 each on a different side of shaft 42. Obviously the pull of springs 73 and 74 constantly urges plate 45 counterclockwise away from the position shown in Fig. 1 to its aforesaid normal position.

Shaft 42 has fastened to it a horizontally projecting arm 75 whose mounted end comprises a round tang fixedly lodged in a hole bored cross-

wise through shaft 72 and held tightly therein by a tapered pin 75 or otherwise. A link 76 is pivotally connected to the free end of arm 75 by a cotter pin 77 and extends upwardly having its opposite top end pivotally connected by another cotter pin 86 to the head 78 of a magnetic plunger 79 which slides vertically within the magnetic field of an electrical solenoid 80 whose body is mounted on the lower frame casting 151 by means of screws 81 and spacer stud 82. Plunger 79 thus serves as actuator for arm 75. The downward swing of arm 75 and thereby the counterclockwise turning of shaft 42, is limited by an adjustable stop stud 83 having threaded engagement with a bracket 94 secured to the main frame plate 11 and fastened in adjusted position by lock nut 84.

For initiating the electrical energization of solenoid 80 at appropriate times for starting a cycle of recording action, one or more momentary or pilot switches are located in the neighborhood of bed plate 102 at points which may be remote from the mercury tubes 43, 44 and from the solenoid 80. But very special instrumentalities are provided for operating these pilot switches which will now be described.

Pilot switches 106 and 107 are herein illustrated to be so connected in circuit (Fig. 6) that both must be temporarily closed at the same time in order to energize solenoid 80 electrically. These switches may be constructed alike and be of the general type illustrated and described in U. S. Patent No. 1,960,020 characterized by the need of only an extremely small amount of mechanical movement (a few thousandths of an inch is sufficient) to shift their contacts from "on" to "off" position with a snap action.

The body of pilot switch 106 is shown as mounted by screws 108 on an angle bracket 109 bolted to the main frame plate and in such position that the operating plunger 110 of this switch projects toward the right in Figs. 3 and 5 just above the bed plate 102 thereby to be contacted by a swingable card barrier or gate 111 hinged on the shouldered vertical pivot stud 112 which is made fast to bracket 109 by nut 113 on its lower threaded end. The free end of gate 111 flanks the left terminal edge of bed plate 102 in Figs. 1 and 3 and contains a cut-out 113 in its bottom edge in order to clear ribbon 54, while room is provided for the small degree of swinging movement of gate 111 by narrow shallow notches 114 cut in the top of angle iron braces 115 which connect and strengthen the topmost ends of the spaced sides of the lower frame casting 151. A projecting boss 116 carried by gate or barrier 111 makes the actual contact with switch plunger 110.

Through this operative arrangement and positioning of switch 106 and its operating gate 111, the insertion of a sufficiently stiff record receiving card 124 through casing aperture 38 and toward the left in Figs. 3 and 5 along the space between ribbon 54 and bed plate 102 will eventually result in the leading edge of such card bringing up against gate 111 and swinging the latter clockwise in Fig. 5 sufficiently to exert a circuit-making thrust against the plunger 110 of pilot switch 107. Aperture 38 constitutes an elongated slot in the closure wall of the recording station.

The body of pilot switch 107 is shown as mounted by screws 117 upon a bracket 118 secured to the lower frame casting 151 and in such position that the operating plunger 119 of this switch projects toward the right in Figs. 3 and 5 in the neighborhood of the side wall of the apparatus casing 39. Plunger 119 is thus disposed to be pressed upon by a stud 120 which projects through an aperture in the said side wall of the casing and is fixed to a swingable plate-like handle member or finger plate 121 which is elongated in a horizontal direction and depends from the coaxial pivotal support pins 122 which are held in hinge brackets 123 fixed on the outside of the casing wall. Fig 3 shows that this depending finger plate 121 is thus swingably hinged directly beneath the outwardly projecting marginal edge of the bed plate 102 so that knuckles of the third, fourth or little finger of an operator's hand can, in the act of inserting the record receiving card 124 through the casing aperture 38 and without appreciable extra motion of such hand or fingers, press on this plate toward the left in Fig. 3 when the card has been inserted and thereby operate the normally open pilot switch 107 in a manner to close the circuit which it governs.

With reference to Fig. 6 which shows one possible circuit arrangement in which the current switching devices which have been described may be electrically associated, the following is a typical example of operation of the recording apparatus under partly manual and partly automatic control of the improved switching device. In the tilted position of the two mercury tubes shown in Fig. 1 the lower tube 44 is so inclined as to break circuit through the flexible conductive leads 125 and 126 running thereto, and the upper mercury tube 43 is so inclined as to make circuit between the two flexible leads 127 and 128 running thereto. Lead 125 connects to motor 152 which is connected to one side 129 of the supply line 129, while lead 126 connects to the opposite side 130 of the supply line. Lead 127 connects to the solenoid 80 which through mercury tube 43 and pilot switches 107 and 106 places solenoid 80 in connection with the side 130 of the supply line, while lead 128 completes the solenoid circuit to the opposite side 129 of the supply line. Therefore in the starting position of parts referred to, the circuit through motor 152 stands broken by mercury tube 44 while the circuit through solenoid 80 stands broken through both of pilot switches 106 and 107, these being normally open momentary contact switches as hereinbefore explained.

When the weighing scale is ready for starting the recording apparatus in action to make a recording of weight, such action will comprise a cycle of mechanical movement during which cam shaft 158 performs a half revolution counterclockwise in Fig. 1.

While the complete mechanism is not herein shown whereby one or more additional cams which may be fixed on shaft 158 position the type segments 19 preparatory to striking an impression from type characters 18 on the record receiving card 124, it may be assumed that according to the disclosure in aforesaid U. S. Patent 2,198,-139 the cycle of recording action powered by motor 152 first automatically establishes the proper type characters in position to record the weight indicated by the scale and then strikes an impression from such characters by means of an upward blow of platen 162 against the record receiving card. Within the scope of the present invention the cycle of recording action might be comprised of different or additional operations of record printing mechanism, it sufficing for an understanding of these improvements that the record printing cycle is accompanied by a half revolution of cam 161.

Cam 161 normally is stationary and in planar

alignment with finger 57 which it engages thus holding mercury tubes 43 and 44 tilted as shown in Fig. 1 against the tendency of springs 73 and 74 to tilt these tubes in the opposite direction of inclination relative to the horizontal. The cycle of recording action can be initiated by closing both of the pilot switches 106 and 107 in the manner heretofore explained. The fingers of the operator's hand which inserts the record receiving card 124 between the upstanding guide lips 104 of the bed plate 102 and between the inked ribbon 54 and said bed plate may conveniently be pressed against the finger plate 121 when card 124 is nearly or fully inserted through casing aperture 38 into position to receive its printed impression. This will close pilot switch 107 alone. However in the double pilot switch form of the invention herein illustrated this is not sufficient to complete a circuit through the de-energized solenoid 80. This is because pilot switch 106 still remains open unless or until the record card 124 has been thrust into the recorder to the fullest extent permitted by the movable barrier or gate 111 which becomes contacted by the advancing edge of the record card. This final thrusting home of the record card swings gate 111 sufficiently to close pilot switch 106 so that now, with both pilot switches at their different locations held closed by the pressures respectively of the record card and of the operator's fingers, circuit is established through solenoid 80. Thereupon this solenoid becomes electrically energized so that it draws upwardly the plunger head 78 and thereby link 76 which latter by means of arm 75 turns shaft 42 clockwise from its position in Fig. 3 to its position in Fig. 4. Finger 57 thus becomes displaced or tipped away from coplanar alignment with cam 161 and escapes the intercepting end of the latter whereupon springs 73 and 74 tilt the mercury tubes 43 and 44 abruptly to their opposite direction of inclination shown in Fig. 7 causing circuit to be made through the upper tube 43 and broken through the lower tube 44. The breaking of circuit through lower tube 44 instantly deenergizes solenoid 80 so that arm 75 drops back against its stop stud 83 and restores finger 57 to coplanar relationship with cam 161. Finger 57 as part of the holder for the mercury tube may thus be said to serve as a "follower" for cam 161 and can swing about the primary axis of shaft 50 to "follow" the cam and can swing about the secondary axis of shaft 42 to escape the cam, these axes bearing a crosswise relationship.

Motor 152 is now energized and begins to run and through the gearing 153, 154, 155, 156, 157 slowly rotates cam shaft 158 counterclockwise in Fig. 1. As this cam shaft continues to rotate, various cams (not shown) which may be fixed thereon and provided with followers, may thereby operate through suitable connections to produce various mechanical effects on various parts of recording apparatus, typical of which effects is the causing of a blow to be struck upwardly by platen 162 against record card 124 for pressing the latter against the ribbon 54 and the latter against the type characters 18 by moving through an aperture 103 in the bed plate 102. This printing blow is struck under the impulse of spring 175 when the cam follower 172 is permitted to drop suddenly into a cut-away portion of cam 159.

It is desired to insure that the above described mechanical performances shall be completed before rotation of cam shaft 158 ceases. To this end, the mercury switches remain positioned as in Fig. 7 until cam 161 approaches the completion of its half revolution. At this time its end which is uppermost in Fig. 1 has swung around into contact with finger 57 as indicated by broken lines in Fig. 7 and picks up and impels said finger toward the right. Thus the final stage of movement of cam 161 is accompanied by slow restoration of the mercury tubes to their original tilted position as shown in Fig. 1, whereupon circuit again becomes broken through the lower mercury tube 44 and simultaneously made through the upper tube 43. This, however, does not result in re-energization of solenoid 80 because prior to this time, pressure of the operator's fingers on finger plate 121 has been removed permitting pilot switch 107 to reopen. The current supply to motor 152 is however now cut off causing cam 161 to come to rest as in Fig. 1, whereby all parts are restored to their normal positions ready to repeat a like subsequent cycle of weight recording action.

In Fig. 8 a modification of circuit arrangements is illustrated in which mercury tube 43 is eliminated from all electrical interconnection with the electrical control units of Fig. 6 controlling the recording cycle and is thus made available to make and break some separate electric circuit in definite sequential relation to the performance of the recording cycle. Thus this mercury tube 43, or others like it which may be mounted likewise upon the disc 45, may serve to make and break the separate circuit in Fig. 8 containing conductor 131 leading from main 130 to one of the tube terminals and containing conductor 132 leading from the other of the tube terminals to the solenoid 133 from which solenoid conductor 134 leads to the supply main 129. This solenoid, when energized, may cause the gate 135 of a weigh hopper 136 to open and discharge from the latter a load such as sand or cement whose weight has been measured by the weighing scale and printed by the recording mechanism as herein described with reference to Patent No. 2,198,139. A recording weighing scale is further disclosed in operative association with a solenoid for opening the discharge gate of a weigh hopper in a copending application Serial No. 315,903, filed January 27, 1940, now Patent No. 2,343,000, granted February 29, 1944. See for instance the parts designated by reference characters 125, 126 and 127 therein. In relation to the apparatus disclosed in said copending application, the present arrangement disclosed in Fig. 8 possesses certain advantages. For instance, by utilizing the time giving performance of the power mechanism which effects the recording of weight, it does away with the need of a separate time giving relay outside the weight recording unit such as the thermal relay designated "D" in the said copending application and it more positively insures that the load whose weight is being measured by the scale shall not be discharged from its container or weigh hopper until the action of recording its weight has been surely completed. To further make this clear the operation of the illustrative system of apparatus shown in Fig. 8 is as follows:

As in Fig. 6, the cycle of recording action can be initiated by closing both pilot switches 106 and 107, or only one of such pilot switches if the other is omitted from the system. Prior to this, mercury switch 44 stood open and mercury switch 43 stood closed so that the discharge gate 135 could either be opened or closed at will by some control switch such as 137 outside of the record-

ing unit. Now, however, and simultaneously with the closing of mercury switch **44** by electromagnet **80**, mercury switch **43** becomes open and cuts out the entire circuit **132—133—134—135—136—137** for the duration of the recording cycle, so that the operation of load discharge gate **135** is assuredly "locked out" for this entire period, meaning for instance, that gate **135** could not be opened by any untimely manual or automatic closing of switch **137**.

A recording mechanism including the present improvements, when furnished to the trade for use in connection with weighing mechanisms and with associated remotely controlled apparatus, provides within itself, and as a unit, sufficient control means for electrically "locking out" or guarding against erroneous and untimely operation of the associated apparatus with respect to the performance of the recording cycle. It will be appreciated that any desired number of mercury tubes may be mounted on disc **45** for analogous purposes.

The circuit interrupting cam **161'** may be single ended instead of double ended as shown in Fig. 9 thus permitting a full revolution instead of merely a half revolution of the cam shaft **158** and permitting a corresponding use of the full periphery of the other mechanical actuating cams carried by this shaft for effecting a cycle of movement of more involved or complicated mechanisms for performing the recording operations. These and many other departures will be suggested by this disclosure to those skilled in the art and the following claims are intended to cover and apply to all substitutes and equivalents for the exact construction herein shown which fairly fall within their terms.

As an example, the term "barrier" in the claims is not limited specifically to the gate **111**, nor is the term "shiftable current controlling means" limited to mercury tubes **43**, **44**, nor is the term "electrically energizable device" limited to the electromagnet which includes solenoid **80**, etc.

Certain features which are herein disclosed but not herein claimed are claimed in my copending application, Serial No. 426,596, filed January 13, 1942.

I claim:

1. In cycle-performing apparatus, the combination of, an electric motor, mechanism powered by said motor for carrying through a cycle of operations, current controlling means constructed and arranged automatically to assume a normal position operative to energize said motor and mechanically associated at times with said mechanism in a manner to be impelled away from said normal position by said mechanism during the performance of said cycle said means being electrically connected automatically to deenergize said motor when said cycle, has been at least nearly completed, an electrically powered actuating device operatively related to said current controlling means in a manner to disassociate the latter from said mechanism temporarily thereby to permit said means automatically to assume said normal position for starting said motor, and a normally open switch manually closable for momentarily energizing said device thereby to initiate repeated performance of said cycle of operations.

2. In cycle-performing apparatus, the combination defined in claim 1, in which the said current controlling means includes two contact making and breaking controllers, one electrically connected to feed current at times to the said motor, and the other electrically connected to feed current at other times to the said electrically energizable shifting device.

3. In cycle-performing apparatus, the combination defined in claim 1, in which the said current controlling means includes two tiltable mercury tubes mechanically connected to tilt in unison, one of said tubes being electrically connected to feed current at times to the said electrically energizable shifting device, and the other one of said tubes being electrically connected to feed current at other times to the said motor.

4. In cycle-performing apparatus, the combination defined in claim 1, in which the said electrically energizable device includes an electromagnet having a solenoid winding electrically connected to receive current fed thereto in series through both the said current controlling means and the said momentary contact switch.

5. In cycle performing electrically powered apparatus, the combination of, a cam rotatable in said apparatus during a cycle of the latter's operation, a mercury switch tube connected to make and break an apparatus controlling electric circuit by tilting in one plane of movement, a movable holder for said tube, and means constructed and arranged to support said holder in such manner that the latter is rockable about a primary axis for tilting said mercury tube in its said plane and is also rockable about a secondary axis extending crosswise said primary axis to and from a position occupying the path of travel of said cam.

6. In cycle performing electrically powered apparatus, the combination of, a cam rotatable in said apparatus during a cycle of the latter's operation, a shaft mounted to oscillate about a longitudinal axis disposed approximately in the plane of rotation of said cam, a mercury switch tube connected to make and break an apparatus controlling electric circuit by tilting in planes parallel with said plane of rotation, and a holder for said mercury tube pivotally carried by said shaft in a manner to rock into and out of the path of rotation of said cam in unison with the oscillation of said shaft as well as to be turnable relative to said shaft for tilting said tube in its said planes, means normally biasing said tube to move in one tilting direction, and means normally biasing said holder into the path of rotation of said cam.

7. In electrically controlled cycle performing apparatus, an electro mechanical system of circuits and electrically energized instrumentalities for controlling the apparatus, including in combination with current supply mains, a motor for driving the apparatus, a solenoid having an actuating armature, a motor governing circuit controller, a solenoid energizing circuit controller, an electric circuit bridging said mains and containing said solenoid and said solenoid energizing controller in series relationship, another electric circuit bridging said mains and containing said motor and said motor governing controller in series relationship, mechanical connections between said armature and both of said controllers enabling the latter to be actuated by the former in a manner to occasion a cycle of apparatus performance, and additional mechanical connections between said motor and both of said controllers enabling the latter to be actuated by the former to terminate said cycle of apparatus performance.

8. In electrically controlled cycle performing apparatus, a system of circuits and electrical con-

trolling instrumentalities as defined in claim 7, in which the said two circuit controllers are mechanically associated in a manner always to be moved in unison.

9. In electrically controlled cycle performing apparatus, a system of circuits and electrical controlling instrumentalities as defined in claim 7 in which the said two circuit controllers constitute respectively two mercury tubes movably mounted in fixed relation to each other.

10. Knuckle operated electric circuit switching devices for manually initiating a cyclic operation of electrically powered recording apparatus by use of the same hand of the operator that is engaged in presenting a record blank to a recording station, including in combination, a closure wall flanking said recording station containing a vertically narrow slot dimensioned to guide the insertion edgewise therethrough of the record blank in a horizontal direction into said recording station, and a plate-like member supportingly hinged at its top edge and hanging swingably downward outside of said wall below said slot in the path of movement of the knuckles of the operator's hand that is engaged in grasping and inserting the record blank through said slot, and a power controlling electric switch arranged to be operably actuated by said plate-like member for initiating operation of the recording apparatus.

11. Electric circuit switching devices as defined in claim 10, together with a bed having portions of its horizontal length extending respectively inward and outward from the said slot to serve as a rest for supporting the said record blank, the said plate-like member being hinged to the said wall structure on an axis immediately underlying the outward extending portion of said bed.

12. Electric circuit switching devices for manually initiating a cycle of electrically powered action of a recording apparatus through the instrumentality of a stiff record blank when the latter is manually placed in recording position at said station, including in combination, a horizontal bed for supporting the record blank having an aperture overlapped by said blank when in recording position through which aperture said blank may be struck for making a record, and a barrier movably mounted and positioned to extend across said aperture in the path of approach of said blank to its said position thereby to be engaged and moved by an advancing edge of the latter while said edge overlaps said aperture, and a power controlling electric switch arranged to be operably actuated by said barrier for initiating a cycle of action of the recording apparatus.

13. Electric circuit switching devices as defined in claim 12, in which the said barrier is mounted to swing parallelly to the plane of the said bed on a vertical pivot offset from the said aperture and occupies at least in part a plane coincident with the top surface of said bed.

14. In an electrically powered recording apparatus, instrumentalities for manually actuating at least two power controlling switches jointly by the single act of advancing a record receiving blank edge-foremost to a recording position in said apparatus, embodying in combination with a bed for supporting said blank in recording position, a plate-like member movably mounted close to the entrance edge of said bed constructed and arranged to be engaged and thrust ahead by the concluding movement of the operator's hand which presents said blank to the apparatus, a power controlling switch arranged to be operably actuated by the thrusting ahead of said plate-like member, a barrier mounted to have limited movement in the path and direction of approach of the foremost edge of said blank to be engaged and thrust ahead thereby as the latter reaches its recording position on said bed, and a structurally separate power controlling switch arranged to be operably actuated by blank-caused movement of said barrier, together with an electric power circuit for controlling the energization of the recording apparatus containing both of said power controlling switches.

15. In cycle performing apparatus, the combination of, an electric motor, a cycle performing mechanism mechanically powered by said motor for carrying through a cycle of operations, current controlling means including two tiltable mercury tubes mechanically mounted and biased to tilt automatically in unison to a normal position and so electrically connected that in said normal position the first one of said tubes passes current to said motor, said tubes further being mechanically associated at times with said mechanism in a manner to be displaced by the latter from said normal position for automatically deenergizing said motor when said cycle has been at least nearly completed, an electromagnet, instrumentalities motivated by said electromagnet mechanically related to said tubes in a manner to cause the latter to become disassociated temporarily from said mechanism thereby to permit automatic tilting of said tubes to said normal position, electric circuit connections enabling said electromagnet to be energized and deenergized by tilting of the second one of said tubes, and an automatically opening electric switch manually closable for momentarily feeding current through said electromagnet and through the second of said tubes thereby to initiate said cycle performance of said mechanism.

16. In cycle performing electrically powered apparatus, the combination of, a current controlling mercury tube connected electrically to govern the apparatus, a holder for said tube, biasing means normally urging said holder to tilt said tube at one inclination, a projection on said holder to assist in retaining said tube tilted at an opposite inclination, a timing cam rotatable by the cycle performing action of said apparatus and engageable with said projection for automatically displacing said holder to its said opposite inclination while biased by said means, and manually operable means to shift said projection out of engagement with said cam for delivering said holder to the urge of said biasing means.

17. In cycle performing apparatus for recording on a card or the like, the combination of, an electric motor, mechanism including a recorder at a recording station adapted to receive said card powered by said motor for carrying through a cycle of operations including the making of a record, means for controlling current supply to said motor constructed and arranged automatically to assume a normal position in which said motor is electrically energized, said means being mechanically associated with said mechanism in a manner to be displaced from said normal position by said mechanism when a cycle of operation is performed and at least nearly completed by said mechanism, an electrically energizable device operatively related to said cur-

rent controlling means in a manner on occasion to disassociate said means and said mechanism mechanically thereby to free said means for automatic return to its said normal position to start said motor, an automatically opening momentary contact switch electrically connected to control the energization of said device momentarily when closed, and means for closing said switch constructed and arranged at said recording station to be engaged and actuated by said card when the latter is moved manually into said recording station.

18. In cycle performing apparatus, the combination defined in claim 17, together with another automatically opening switch having electric contacts connected in electrical series with the said momentary contact switch, and having an operating handle for closing the last said contacts located within the path traversed by the hand of the operator in moving the said record card into the said recording station.

19. In cyclic power stop mechanism, the combination of, an electric motor, a cycle performing shaft rotatable by said motor to perform useful work, a cycle controlling rotor connected to revolve in synchronous relation to the rotation of said shaft, and a circuit controlling device shiftable by said rotor and electrically connected to start and stop the running of said motor, in which combination the said rotor includes a cam wheel, and the said device includes a single follower pivotally supported in neighboring relation to said cam wheel in a manner to be engaged and swung by said wheel about one axis for electrically deenergizing the said motor and to be swung about a different axis to a position enabling said follower to escape from said cam wheel.

20. In cyclic power stop mechanism, the combination of, an electric motor, a cycle performing shaft rotatable by said motor to perform useful work, a cycle controlling rotor connected to revolve in synchronous relation to the rotation of said shaft, and a circuit controlling device shiftable by said rotor and electrically connected to start and stop the running of said motor, in which combination the said rotor includes a cam wheel, and the said device includes a single follower pivotally supported in neighboring relation to said cam wheel in a manner to be engaged by and swung in a path alongside of said wheel for electrically deenergizing said motor and further pivotally supported in a manner to be movable crosswise said path away from engagement with said cam wheel for escaping the latter.

21. In electrically powered apparatus adapted to perform a cycle of action, the combination of, a cam rotatable by said apparatus during a cycle, a mercury tube adapted to make and break electric contact by tilting in one plane of movement, a movable holder for said tube, and means constructed and arranged to support said holder in such manner that the latter is rockable about one axis for tilting said mercury tube in its said plane and is also rockable about a different axis to and from a position occupying the path of travel of said cam.

22. In electrically powered apparatus adapted to perform a cycle of action, the combination of, a cam connected to be rotated by said apparatus during the latter's said cycle, a carriage mounted to oscillate about an axis disposed approximately in the plane of rotation of said cam, a mercury tube adapted to make and break electric contact by tilting in a plane parallel with said plane of cam rotation, and a holder for said mercury tube pivotally carried by said carriage in a manner to rock into and out of the path of rotation of said cam in unison with the oscillation of said carriage, said holder further being turnable relative to said carriage for tilting said tube to make or break electric contact, means normally biasing said tube to tilt in one direction, and means normally biasing said holder into the path of rotation of said cam.

23. In cycle stop power mechanism, in combination, an electric motor, a shaft turnable by said motor, rotary cams connected to complete a cycle of rotation in synchronism with the turning of said shaft, mechanism motivated by one of said cams for performing useful work, a circuit controlling device connected electrically to energize and deenergize said motor including a member operably related to a second one of said cams constructed and arranged when mechanically moved from one position by said second cam to deenergize said motor before the cams repeat their said cycle of rotation, and an electrically energizable actuator structurally disassociated from said motor constructed and arranged mechanically to initiate reverse movement of said member to said position independently of the said second cam thereby to reenergize said motor and initiate a repetition of said cycle of cam rotation.

24. In cycle stop power mechanism, in combination, an electric motor, a shaft turnable by said motor, rotary cams connected to complete a cycle of rotation in synchronism with the turning of said shaft, mechanism motivated by one of said cams for performing useful work, a circuit controlling device connected electrically to energize and deenergize said motor including a cam follower member operably related to a second one of said cams constructed and arranged when moved by said second cam to deenergize said motor before said cams repeat their said cycle of rotation, and means for operatively disassociating said cam follower member from said second cam thereby to permit the latter to pass the former after said cams have completed each of their said cycles of operation.

25. In electrically controlled cycle performing apparatus, the combination of, an electric motor, mechanism operated by said motor to perform a cycle of operation, an electromagnetic actuator operatively incorporated in said apparatus adapted to be electrically energized in conjunction with the performance of said cycle of operation, a circuit controlling device electrically connected to start and stop said motor, an additional circuit controlling device connected electrically to control energization of said electromagnetic actuator, and devices mechanically operable by said mechanism constructed and arranged mechanically to actuate both of said circuit controlling devices in predetermined synchronous relation.

26. In cycle stop power mechanism, in combination, an electric motor, a shaft turnable by said motor, rotary cams connected to complete a cycle of rotation in synchronism with the turning of said shaft, mechanism motivated by one of said cams for performing useful work, a circuit controlling device connected electrically to energize and deenergize said motor including a cam follower member operably related to a second one of said cams constructed and arranged when moved by said second cam to deenergize said motor before said cams repeat their said

cycle of rotation, means biasing said member toward motor energizing position, and means for operatively disassociating said cam follower member from said second cam thereby to permit the latter to pass by the former for reenergizing said motor after said cams have completed each of their said cycles of operation.

27. In cyclic power stop mechanism, the combination of, an electric motor, a cycle performing shaft rotatable by said motor to perform useful work, a cycle controlling rotor connected to revolve in synchronous relation to the rotation of said shaft, and a circuit controlling device shiftable by said rotor and electrically connected to start and stop the running of said motor, in which combination the said rotor includes a cam wheel, and the said device includes a single follower supported in neighboring relation to said cam wheel in a manner to be engaged and shifted by said wheel in one plane of movement for electrically deenergizing the said motor and to be shiftable in a differently directed plane of movement to enable said follower to escape from said cam wheel.

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