

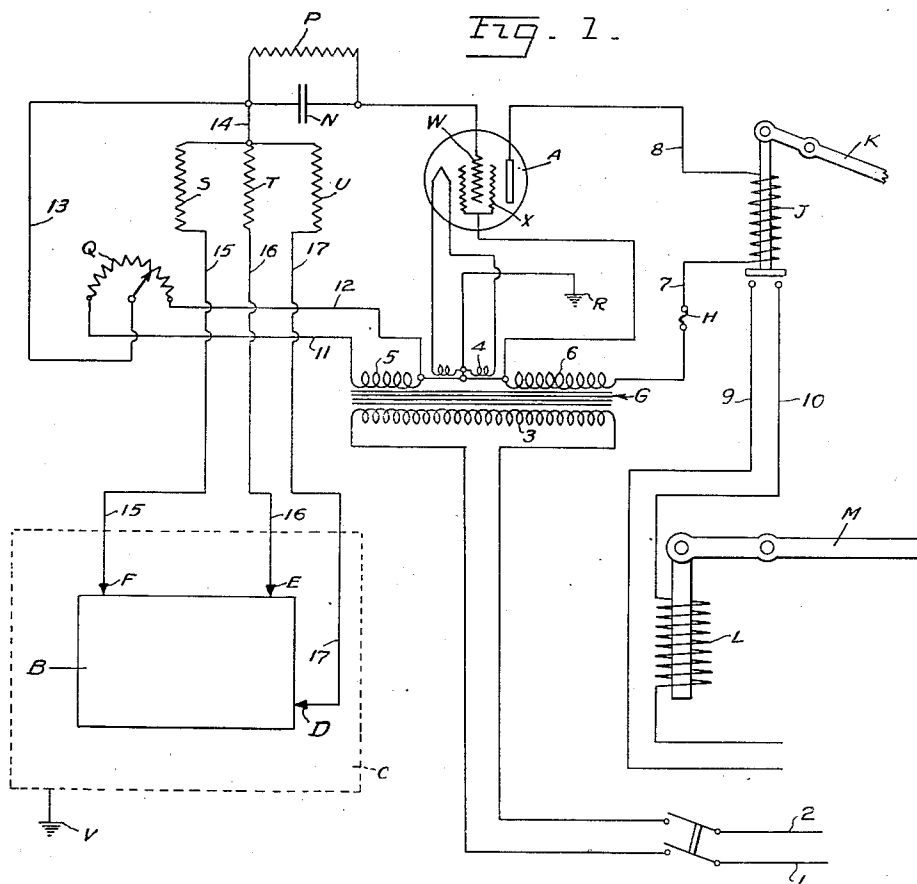
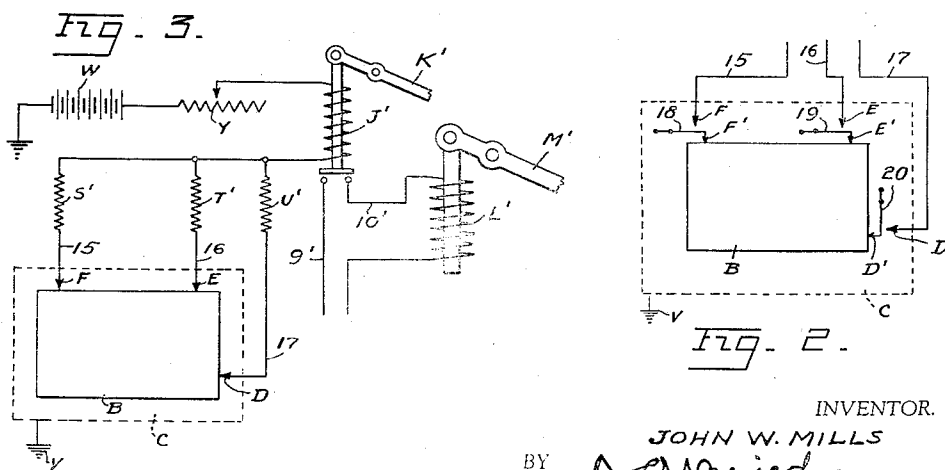
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RELAY CIRCUIT FOR MACHINE CONTROL

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RELAY CIRCUIT FOR MACHINE CONTROL

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This invention relates to relay electric circuits for general machine control and particularly for controlling various machine movements by the work passing through or positioned in the machine in the course of manufacture.

The principal object of the invention is to provide a relay circuit of the kind mentioned which may be easily adjusted to any desired sensitivity, will operate without requiring the moving of electric contacts, and provides for operation of the relay element only upon the closing of any predetermined number of contacts. Other features and advantages of the circuit will appear in the following description and accompanying drawing.

In the drawing:

Figure 1 is a diagrammatic representation of an electric circuit for machine control incorporating the features of my invention.

Figure 2 is a diagram showing how movable electric contacts for actuation by the work may be used in the circuit in place of fixed contacts. Figure 3 shows a modified form of the invention.

Before describing my improved machine controlling relay circuit, it may be said that in the operation of various industrial machines such as punch presses and metal slitting and cutting machines, it is common practice to have some automatic device which must be contacted by the metal or other material worked upon when in a certain position before the press or machine can be tripped to punch or cut the metal. Such devices are generally mechanical latches, trips, or triggers, which in turn release other parts and permit the machine to function only after the piece of metal has been properly inserted in position against these devices.

In automatic machinery such as can making machinery where sheets of tin are fed into machines at great speed there are commonly provided special electric contacts which are closed by the striking of the edge or side of the tin sheets and which control the further operations of the machines, so that if a sheet of tin does not arrive at the right place at the right time, or the sheet of tin is deformed such as by having its edge bent over so that it does not strike the proper control contact, the machine will stop working or the machine may throw off the deformed piece of tin, all depending on what the nature of the mechanism is that is started or stopped by the inability of the sheet of tin to close the particular contacts or to touch the particular levers or triggers which control the action.

Generally such devices as above outlined re-

quire the actual bumping and moving of some small trigger, or flexible electric contact, such as pushing one spring electric terminal against another to make a contact, and where electric contacts are used they generally close a circuit which carries sufficient current to directly operate some vital feature of the mechanism. Sometimes such electric contacts are run on a lower voltage and they operate an electric relay which in turn switches in a heavier current to operate a more ponderous part of the mechanism which the lower voltage current could not operate. Such relays, however, bring in a slower response to the final mechanism, on account of the fact that they involve the magnetization of armatures and the moving of mechanical parts. Electronic relays have been used for controlling various mechanical functions and it is with improvements in the latter type that applicant's invention is directly concerned, though a modified form of the circuit without the tube also has value.

Applicant's arrangement as shown on the drawing uses a thermionic, or electron tube A as a sensitive relay. This is accomplished by applying a negative bias to the controlling grid so that normally no plate current will flow, then upon the metal object or sheet B being placed in the machine C to be operated upon closing a plurality of electric contacts D, E, F forming several resistance controlled legs from the tube grid circuit and grounding them simultaneously through the machine frame it "bleeds" off the negative bias from the grid so that the tube will "fire" and the operating current will at once pass through the plate circuit and operate the machine.

In the diagram the source of current or house wires are indicated at 1, 2, of say 220 v. A. C., connected to the primary 3 of step-down transformer G with a suitable tap 4 on the secondary for the filament of the tube, say 2½ v., about a 12 v. tap 5 for the grid control circuit, 11, 12, and about a 120 v. tap 6 for the plate or operating circuit 7, 8.

The operating circuit is preferably fused at H and operates a solenoid or other suitable magnet J which may directly operate, release or lock the part of the machine K as may be desired, or it may close another or heavier independent circuit 9, 10 carrying electric energy of any type received from any desired source, for operating a heavier magnet or relay L in turn connected to a machine element M.

The grid circuit includes a condenser N, grid

leak resistor P, a potentiometer Q, a lead 13 from the potentiometer for adjusting the grid bias, and a ground R from an intermediate point in the secondary of the transformer, while extending from lead 13 is a branch 14 separated into three legs 15, 16, 17 which respectively connect to the contact points F, E, D on the machine C, and interposed in each leg is a resistor S, T, U. The frame of the machine C is grounded at V so that the metal sheet B in position on the machine is likewise grounded, and will ground any or all of the contacts F, E, D upon being placed in position to touch them.

In the diagram a four element electron tube is shown, (G. E. Co. "Thyratron" FG 98 was actually used), with the controlling grid at W, and an extra grid at X which causes a greater flow in the plate current. But an ordinary three element tube will operate satisfactorily, either vacuum or gas filled type.

As the operation of the circuits depends on the relative electrical value of the various elements, suitable values for resistor P would be 25 m. ohms, resistors S, T and U each 10 m. ohms, and the potentiometer Q, 25 m. ohms and condenser N .1 microfarad.

In the illustration it is assumed that the device B is a metal sheet, plate, or other article constituting the "work" to be operated on in machine C, and that before the particular operation the work B must be in precise position to touch all three of the stationary contacts F, E, D (which are in insulated relation to the machine), before the machine, say a punch press, is operated. Under such conditions the potentiometer is adjusted to give a negative bias to the grid W of such a value that it will take the combined current capacity of all three resistors S, T and U, to reduce it to a point where the tube will operate when they are concurrently grounded by properly positioning the work B against the three contacts F, E, D, and which will at once cause the tube to "fire" and the plate current to operate the solenoid J (or L if used) and the desired machine part K or M, as the case may be.

The moment the work B is removed or moved away from the exact position, the grid bias is at once reestablished for repetition with succeeding pieces of work.

It is of course evident that connection 14 may be split into any number of legs each with its work contact on the machine instead of three as shown, each leg in series with a suitable resistor so that the combined drain or leakage of all of them will be required to overcome the grid bias to fire the tube, or one contact only may be used if the potentiometer is adjusted accordingly so that the grounding of but one contact by the work will fire the tube.

With regard to Figure 1, the work contacts F, E, D are presumed to be stationary after once being set, though they may of course be adjustable for initial setting, but when the circuit is used for gaging "work" in the machine which is not a conductor of electricity, then instead of stationary contacts, movable contacts set to close limits may be used as indicated in Figure 2 of the drawing and wherein the contact points F', E', D' are each carried on spring arms 18, 19, 20 secured to the grounded bed or frame C of the machine, and which close against the stationary contacts F, E, D, of circuit legs 15, 16, 17. It is evident that such movable contacts will not gauge the position of the work as accurately as

the stationary contacts, also that any number may be used by suitably adjusting the potentiometer and providing resistors on the circuit legs to correspond so that it will require the concurrent grounding of all of them to enable the plate current to flow.

Figure 3 shows a modified form of machine control circuit without electron tube, but using my feature of a plurality of contact circuit legs each with a resistor S', T', U', in series with it so that the sum total of the current flowing through all of them is required to overcome the resistance of and operate the solenoid or magnet, though preferably an adjustable resistance Y is interposed in the circuit to permit of proper adjustment for any number of contacts desired to be used.

In the figure the parts of the circuit corresponding to those already described for Figure 1 are similarly numbered and lettered so that repetition of the description is not necessary. In this showing a battery W is shown as the source of current and which may be strong enough to directly operate a magnet or solenoid J' of a size capable of moving the machine element K' desired, or J' may be a relay to close a still higher volt circuit 9', 10' to operate solenoid L' and machine element M' as shown in Figure 1 at corresponding designations.

A study of Figure 3 will show that any number of contact legs may be used, and while I show a grounded circuit, this may be a wired return. Also the form of contacts shown in Figure 2 may be employed.

While I have shown grounded machine or work contacts, it is evident that two point control or return wire may be used where grounding is not desired.

If desired to maintain continuous firing of the tube after making a contact on the machine, but one contact only should be used and the potentiometer carefully adjusted to establish a very low negative bias so that once the tube is fired the electronic stream to the plate will continue until the grid bias is raised definitely beyond the critical point to stop it, or the plate circuit is broken.

One of the particular features of my improved control circuit is that the control may be dependent on the work being in precise position at several points at the same time before the next machine operation can take place. Another feature is its adjustment for extreme sensitivity, also the fact that a very low voltage is used on the machine and almost negligible current flow. Still another advantage is that the rectifying action of the tube will yield a pulsating direct current in the plate or operating circuit for better operating the magnets or solenoids.

From the preceding description and diagrams it will be apparent to those skilled in the art that variations in the hook up may be made while retaining the important features of the invention, and any such modifications are intended to be included in my appended claims.

I claim:

1. An electric control system comprising a thermionic tube having a filament, plate and grid, circuit means for supplying current for operating said tube, means operated by the plate circuit for controlling a desired mechanism, means normally biasing the grid of said tube to a point to prevent flow of an operative plate current, and a circuit for overcoming the grid bias provided with a plurality of paths each with contacts

arranged to require their concurrent operation to overcome said bias and permit instant operation of said plate circuit.

2. An electric control system comprising a thermionic tube having a filament, plate and grid, circuit means for supplying current for operating said tube, means operated by the plate circuit for controlling a desired mechanism, a potentiometer for biasing the grid of said tube to a point to prevent an operative plate current, and a circuit for overcoming the grid bias provided with a plurality of normally open paths each path respectively incorporating a resistance element of such value as to require the concurrent flow of current through all of the paths to overcome said bias, and individual contact circuit closing means for each of said paths adapted to be simultaneously operated by an extraneous article for concurrently closing the circuit through said paths.
3. A machine control system comprising an electric circuit split into a plurality of paths each extending to the machine to be controlled, resistors, one respectively in series with each of said paths, a controlling element for said machine, means including a single work article being worked on in the machine arranged when in a certain position only to close the circuit through all of said paths concurrently, and means operable by the combined current flowing concurrently through all of said paths only arranged for operating said controlling element.

4. A machine control system comprising an electric circuit split into a plurality of paths each extending to the machine to be controlled, resistors, one respectively in series with each of said paths, a variable resistance in said circuit, a controlling element for said machine, means including a single work article being worked on in the machine arranged when in a certain position only to close the circuit through all of said paths concurrently, and means operable by the combined current flowing concurrently through all of said paths only arranged for operating said controlling element.

5. An electric control system comprising an electron tube having a plate circuit arranged to operate a desired device and a controlling grid, a potentiometer in circuit with said grid adapted for adjustably biasing the grid to normally prevent flow of an operative plate current, a grounded circuit for overcoming the grid bias to permit instant flow of plate current provided with at least three paths each having a contact gap spacedly positioned at a remote point and arranged for concurrently grounding by an extraneous member when in a predetermined definite position, said grounded circuit requiring the combined flow of current through all of said paths to overcome said bias.

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