

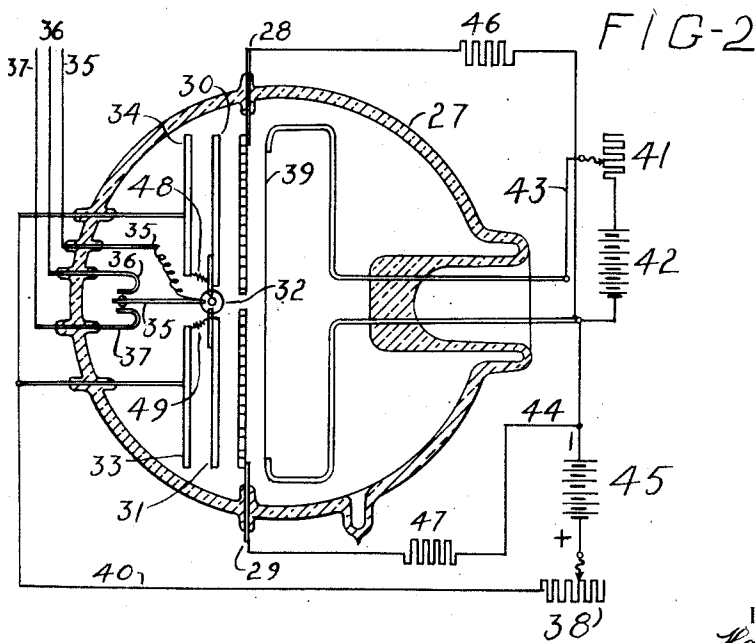
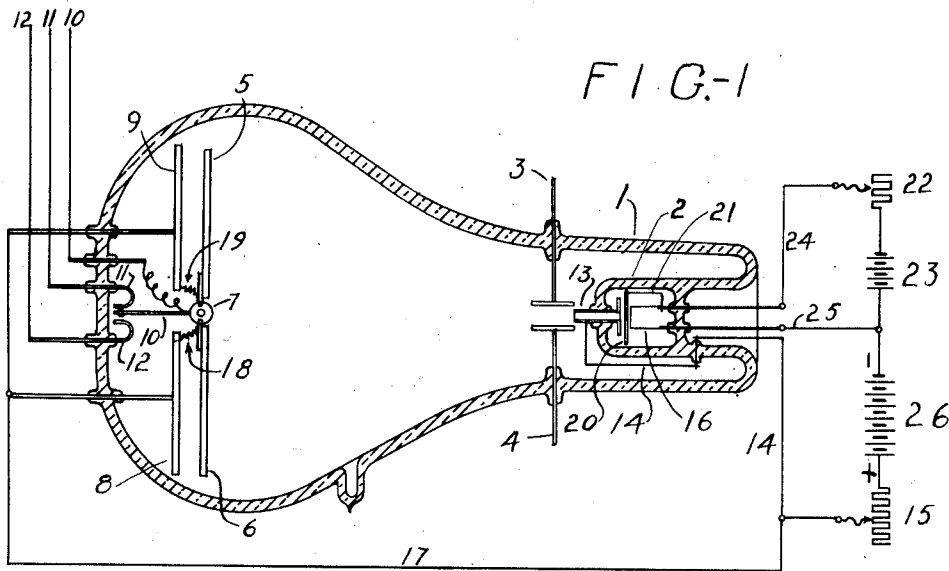
Dec. 29, 1936.

H. J. McCREARY
ELECTRON CONTACT RELAY

2,066,211

Filed Feb. 6, 1931

2 Sheets-Sheet 1



INVENTOR
Harold J. McCreary

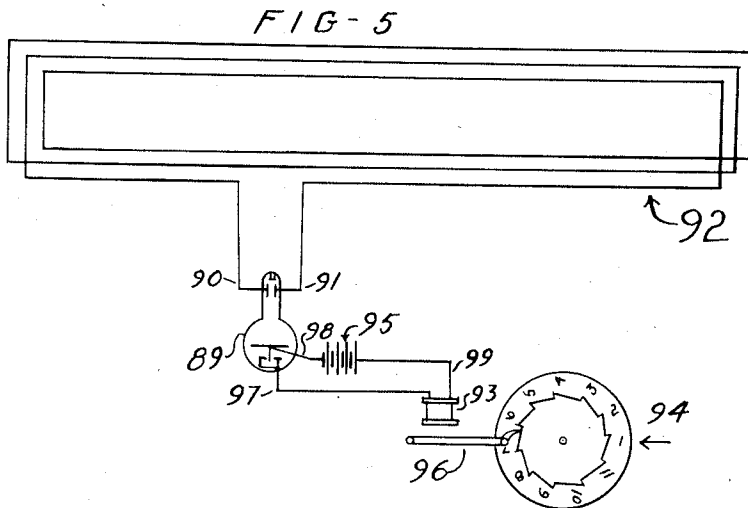
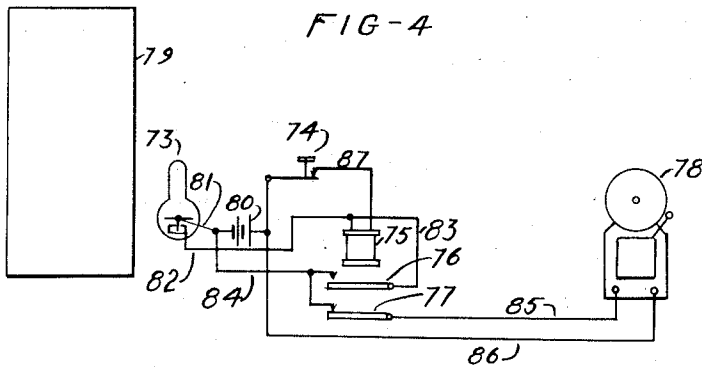
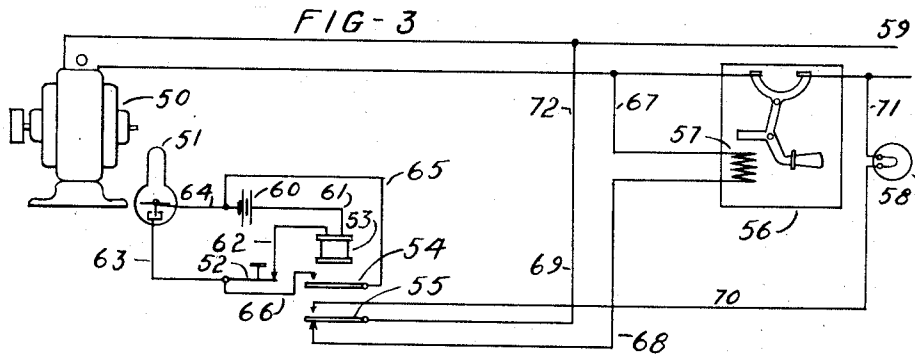
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INVENTOR

Harold J. McCreary

UNITED STATES PATENT OFFICE

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ELECTRON CONTACT RELAY

Harold J. McCreary, Chicago, Ill., assignor of
one-third to Rodney G. Richardson, Chicago,
Ill.

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My invention relates in general to electron contact relays, and the object of the invention is the production of a highly sensitive relay operating on new principles which so far as I am aware have not hitherto been known or used. While my improved relay can be used to replace certain of the present type relays, it extends the application of relays in general, since it is sufficiently sensitive to be operated by electrostatic or magnetic fields or by the distortion of such fields.

My improved relay, for example, may be operated by a distortion of the earth's field by a large locomotive, or for that matter by an automobile, and such an operation may control signal circuits. It may be used as a synchroscope to show when two high voltage lines, to be synchronized, are in step, the latter case requiring no metallic connection. It may be used to detect weapons in the possession of criminals, when they pass within a few feet of the instrument, by the distortion of the earth's magnetic field by such a weapon. It may be set near some large electrical power machinery and when any extraordinary disturbances occur it will be automatically operated by the leakage flux or field of such machinery to shut such machinery off and protect it from damage. In short this is a new device which replaces ordinary relays and extends the field of their application.

Referring to the drawings accompanying this specification, Fig. 1 shows an electron contact relay with lateral control of electron movements, while Fig. 2 shows an electron contact relay with longitudinal control of electron movements. Fig. 3, Fig. 4, and Fig. 5 show some of the possible applications of the relays shown in Fig. 1 and Fig. 2. More specifically Fig. 3 shows a motor and a circuit breaker controlled by leakage flux or extraneous fields. Fig. 4 shows a circuit which rings a bell when a distortion of the earth's magnetic field or an artificial magnetic field occurs, as would be the case when a piece of ferro-magnetic material such as a gun is carried through the door. Fig. 5 shows a device suitable for traffic signalling, and in this specific case is shown as a traffic counter.

Referring now to Fig. 1, 1 is a glass envelope containing a cathode ray gun 2, deflecting plates 3 and 4, vanes 5 and 6, which are pivoted at 7, electrodes 8 and 9, contact arm 10 and contact points 11 and 12. Associated with the tube there is a proper source of power for its operation and control. Thus in the cathode ray gun 2, is the anode 13, connected by lead 14, through resistor 15, to the positive side of the battery 26 (approx-

imately 300 volts D. C.) the negative side of which is connected to the oxide coated tantalum filament 16. The anode 13 is connected by means of wires 14 and 17 to electrodes 8 and 9, which are in turn connected through flexible grid leaks (about 10 megohms each) 18 and 19, to vanes 5 and 6. If the vanes are made of mica the grid leaks need not be used.

The filament has a small disc 20 perforated in the center to shield it from the anode 13. This disc is connected to one side of the filament by wire 21. The filament 16 is heated through lead 24, rheostat 22, battery 23 and lead 25.

Referring now to Fig. 2, 27 is a glass envelope containing a thermionic filament 39, control grids 28 and 29, vanes 30 and 31 which are pivoted at 32, electrodes 33 and 34, contact arm 35 and contact points 36 and 37. Associated with the tube there is a proper source of power for its operation and control. Thus the thermionic filament 39 is heated by battery 42 through rheostat 41, lead 43, filament 39, lead 44, and an accelerating potential or "B battery" is applied between the thermionic filament 39 and plates 33 and 34 by battery 45 through leads 40 and 44 and rheostat 38. The plates 33 and 34 are in turn connected through flexible grid leaks (about 10 megohms each) 48 and 49, to vanes 30 and 31. If the vanes are made of mica the grid leaks need not be used. The grids 28 and 29 should be provided with grid leaks 46 and 47 (about 10 megohms each) which drain off charges collected to lead 44.

The flexible grid leaks referred to above may be made of a fine quartz fiber sputtered with nickel. These quartz fibers may be used as spring supplying mechanical tension to maintain the contact arm normally halfway between contacts or against one contact or the other. The pivot 32 is a pyrex bead through which runs a tungsten wire the ends of which lie in pockets in the glass envelope very much like in the "Crooks" radiometer.

Referring now to Fig. 3, 50 is a motor, 51 is the electron contact relay, 52 is a push button switch, and 53 is an electromagnetic relay of the conventional type with contact arms 54 and 55. 56 is a circuit breaker with a no load trip coil 57 connected as shown, 58 is a pilot lamp which lights when the stick relay 53 is up. 59 is the power source. 60 is a battery for energizing relay 53 through leads 61 and 62, push button 52, lead 63, electron contact relay 51 and lead 64.

Referring now to Fig. 4, 73 is the electron contact relay, 74 is a push button switch, 75, is a

stick relay, 76 and 77 are contact arms, 78 is an electric bell, and 79 is a door.

Referring now to Fig. 5, 89 is the electron contact relay, 90 and 91 are the deflector plates connected to the coil 92, which is laid under or over a street so that iron vehicles cause the earth's magnetic field to cut this coil by its distortion. 93 is a relay or magnetic counter.

Having described the several figures of drawings I will now describe the operation of my invention. Referring first to Fig. 1, the oxide coated filament 16 is heated by battery 23 and the usual thermionic emission takes place and is accelerated by the positive potential on the anode 13.

A portion of this emission travels through the perforated disc 20 and through the center of the anode 13, forming a cathode ray. The cathode ray impinges upon either vane 5 or 6 and the following are the results: First, the kinetic energy of the ray is partly absorbed in exerting a pressure upon the vane 5 or 6; second, a heating effect is produced and another pressure exists on the vane 5 or 6 which is very similar in nature to the pressure produced in the "Crooks" radiometer; third, and perhaps most important, the vane 5 or 6 becomes charged negatively from the charge carried by the ray, as the grid leaks 18 or 19 do not allow this to leak off as fast as supplied. The vane is therefore attracted to the positively charged plate 8 or 9 immediately behind it. All of the described phenomena cooperate in causing the vanes 5 and 6 to turn on their pivot, which of course closes the contact arm 10 to either 11 or 12 depending upon which vane is impacted by the ray.

Plates 3 and 4 are for the purpose of deflecting the ray electrostatically. If 3 and 4 are connected to any source of potential an electrostatic field is produced between these plates and the ray is repelled from the plate that is negatively charged and attracted to the plate that is positively charged. These plates may be used to adjust the ray to any position desired, to compensate for undesired constant fields, to control the relay by induced voltages, or they may not be required at all and in such cases they may be left out of the tube entirely or they should be connected to the anode 13.

The ray in the tube of Fig. 1 may normally fall on the pyrex bead or upon one of the vanes if the application demands it, but the earth's magnetic field or electrostatic field will affect this ray unless shielded from them or unless some other electromagnetic or electrostatic field is supplied to compensate for the above deflections. If the tube is shielded from any field it is no longer controlled by that field, but if it is merely compensated by a second constant field it is still subject to the controlling influence of the first field but the normal position of the ray is shifted.

Altho plates 3 and 4 are shown in Fig. 1 many applications may not require their use as for instance where the earth's magnetic field, stray fields from electrical machinery or the electrostatic field of the paper in a large printing press is used to actuate this relay.

The tube shown in Fig. 2 does the same thing as that shown in Fig. 1 but the control of the electron emission is longitudinal instead of lateral. The oxide coated filament 39 is heated by the battery 42 and the usual thermionic emission takes place, being accelerated by the potential on the plates 33 and 34. The emission is allowed to fall on vane 30 or 31 depending upon

the relative potentials of the grids 28 and 29. The action in closing the contact 35 to 36 or 37 then becomes identical to that of Fig. 1.

The specific applications of my invention shown in Fig. 3, Fig. 4 and Fig. 5 do not show all the possible uses of my invention but only a few very simple embodiments thereof, and indicate the very broad and basic scope of this invention. In order to simplify matters and prevent duplication of descriptions the electron contact relay is shown in outline only with its contacts, because the electronic portion of the tube with its local circuit and elements would merely complicate the drawings and reference may be had to Fig. 1 or Fig. 2 for that information.

In Fig. 3, Fig. 4, and Fig. 5 it is assumed that the ray stands exactly in the center on the pyrex bead and that the contact arm stands halfway between the contacts so that the contacts are normally open. If the ray does not fall in the center, the tube may be tilted until it does, or the ray may be brought to the center by a suitable compensating potential.

In Fig. 3 assume that a great electrostatic or electromagnetic disturbance occurs in the field of the motor, such as might be caused by a lightning stroke outside, then the ray in 51 is deflected closing the contacts 64 to 63 and the relay 53 picks up and stays up by means of battery 60, wires 64, 61, 62, 63 and the normally closed push button 52. This opens the trip magnet 57 on the circuit breaker 56, operating the circuit breaker and shutting off the motor 50. The pilot lamp 58 is also lighted telling the reason the motor was shut off. To reset the system the motor must be inspected and the button 52 near it pushed.

It is of course understood that the electron contact relay may be located at other or any strategic points in any electrical power system. Such another point might be in a paper mill drive, locating the electronic relay so that it can be effected by the charges on the paper, so that when the charges on the paper become dangerously large the relay will shut off the motor. It could be used in a modified form to regulate the moisture in the paper.

It is a well known fact that iron or ferromagnetic objects offer a path of less resistance to magnetic flux than does air. The earth's field is therefore distorted or contracted around the ferro-magnetic object so as to pass through the object. It is also a well known fact that iron or ferro-magnetic objects when jarred in the earth's field become slightly magnetized and they may therefore produce a deflection of a cathode ray due to their own magnetic field.

In Fig. 4, assume that the earth's magnetic field is distorted by an iron object in the vicinity of a cathode ray such as a weapon concealed in a man's pocket as he walks through the door 79. Then the ray in 73 is deflected closing the contacts 81 to 82 and the relay 75 picks up and sticks up ringing the bell 78 until the button 74 is pressed releasing the relay 75.

Referring now to Fig. 5, assume that a large iron mass such as an automobile passes over the coil 92. Such a mass of iron distorts the earth's magnetic field in its immediate vicinity as before explained. Therefore as the car passes over the coil it will cause the earth's magnetic field to cut the coil, or there will be a variation in the density of the magnetic flux inclosed by the coil and a potential will be induced into the coil 92. When a potential is induced into the coil 92 this will

produce an electrostatic field between the deflector plates 90 and 91 deflecting the cathode ray. The ray therefore falls on one of the vanes, causing the contacts 97 and 98 to close, which closes the circuit of battery 95 through coil 93 of electromagnetic counter 94 and a new number is registered by means of armature 96 and counter 94.

It is understood of course that where the street is not wide the coil may be dispensed with entirely and the deflection of the ray by the earth's field alone relied upon.

While I have described in the foregoing certain specific forms of my invention, it will be understood that numerous modifications may be made without departing from the principles of the invention. I do not, therefore, wish to be held to the precise forms shown and described, but decide to include and have protected by letters patent all embodiments of my invention which come within the scope of the appended claims.

What I claim is:

1. A cathode ray device comprising an evacuated chamber, a target in said chamber, means for producing a cathode ray for delivering heat to one side of said target, means supporting said target for movement responsive to radiation of heat from the target, and electrical contacts controlled by movement of said target.

2. A cathode ray device comprising an evacuated chamber, fixed and movable members spaced apart in said chamber, electrical contacts in said chamber controlled by said movable member, means for maintaining a positive charge on said fixed member, and means for producing a cathode ray for impressing a negative charge on said movable member, thereby causing said movable member to be attracted toward said fixed member to operate said contacts.

3. A cathode ray device comprising an evacuated chamber, means in said chamber for producing a cathode ray, contacts in said chamber leading to an external circuit, and means directly operated by the kinetic energy of the ray for engaging and disengaging said contacts.

4. In combination, an evacuated container, a movable member in said container, electrical contacts controlled by said member, and means including an emitting element for producing an electron stream to directly operate said member by the force of impact thereon.

5. In a circuit controlling device, means for generating an electron stream capable of deflection by a magnetic field, a target impacted by said stream only when the same is deflected, said target being moved when impacted by said stream and an electrical contact operated by movement of said target.

6. In a circuit controlling device, means for generating an electron stream, a target suspended for movement responsive to mechanical pressure exerted by said stream when it strikes the target, and an electrical contact controlled by movement of said target.

7. In a circuit controller, means for generating a stream which is susceptible to deflection by a magnetic field, a movable member impacted by said stream in deflected position thereof, and an electrical contact device operated by movement of said member responsive to impact.

8. In combination, an envelope enclosing means for producing a cathode ray capable of being deflected by an external field, a circuit controller having two positions, means supporting said controller in the path of the ray, the controller

being maintained in one position by the mechanical pressure of the ray thereon, and means for shifting the controller to its other position when the ray is deflected.

9. An electrical circuit controller comprising a switch, two plates parallel to each other and close together, one plate being fixed and the other movable, an operative connection between the switch and the movable plate, means for producing a charge on one plate, and means for producing a space discharge directed against the other plate to build up a charge thereon, whereby the electrostatic field between said plates causes the movable plate to operate said switch.

10. In a circuit controlling device, means for producing an electron stream, an anode on which a potential is impressed for accelerating the stream, a movable target supported in front of said anode to intercept the stream, a grid positioned between the source of said stream and said target on which a potential may be impressed in order to quantitatively modify the stream flow, and a contact maker connected to said target and operated thereby when the target moves under pressure of the stream.

11. In a circuit controlling device, two vanes, a contact member movable to one position by electrons impinging on one vane and to another position by electrons impinging on the other vane, means for producing electron emission and for directing the same toward said vanes, and two grids intervening between the source of emission and said vanes, respectively, on which potentials may be impressed to modify the amount of electrons arriving at either one or both of said vanes.

12. In a circuit controlling device, means for generating a cathode ray, said ray being capable of deflection so that the end thereof may change its position, a movable target located in the path of the ray when the same is in deflected position, and electrical contacts controlled by said target responsive to movement thereof under the impact of the ray.

13. In a circuit controlling device, means for generating a cathode ray, said means including a source of potential for accelerating the ray, a movable target located to one side of the normal path of the ray, said target being engaged by the ray when the latter is deflected from its normal path by an external field, and an electrical contact operated by movement of the target responsive to such engagement.

14. In a circuit controlling device, a contact member having two positions, two vanes mounted on said member, means supporting said member for movement from one position to the other and back again responsive to pressure against said vanes, respectively, means for emitting electrons, and means for forming said electron emission into a ray or beam directed toward said vanes and capable of being deflected to one or the other of them to operate said contact member as set forth.

15. In a circuit controlling device, means for generating a cathode ray, means for deflecting the ray to cause the remote end thereof to traverse back and forth, a target, means supporting said target in the path of the moving ray, said target being movable responsive to impact of the ray thereon, and contacts operated by movement of said target.

16. In a circuit controlling device, means for generating a cathode ray, said means including a cathode and an anode, a second anode toward

which said ray is directed, a movable target supported in front of said second anode for intercepting the ray and to be moved thereby, and electrical contacts controlled by movement of said target.

17. In a circuit controlling device, means for generating a cathode ray, said means including a cathode and an anode, a second anode toward which said ray is directed, a movable target supported in front of said second anode for intercepting the ray and to be moved thereby, electrical contacts controlled by movement of said target, and a high resistance leak connecting said target with said second anode.

18. In a circuit controlling device, means for generating an electron beam capable of changing its position under the influence of an external field, two movable members, means supporting said members so that one member intercepts said beam in one position while the other member intercepts said beam in another position, said members movable by said beam, an electrical contact controlled by movement of one member, and a second contact similarly controlled by the other member.

19. In an electrical responsive device, means for producing a stream composed of charged particles, said particles capable of being deflected by a field, whereby the stream is directed in either of two directions depending on whether it is acted on by the field or not, a movable member operable by said stream, and means supporting said member where it will intercept the stream when the same is flowing in one direction but not in the other.

20. In a circuit controlling device, means for generating a stream of charged particles capable of deflection by a field of force, said stream flowing in either of two paths depending on whether it is acted on by the field or not,

a target impacted by the stream in one of its paths but not in the other and movable by said stream, and an electrical contact operated by movement of said target.

21. The method of operating a movable member, which consists in supporting said member for movement relative to a fixed member and adjacent thereto, in maintaining a charge on said fixed member, in generating a stream consisting of particles bearing an opposite charge, in directing said stream against said movable member, whereby it receives a charge opposite to that maintained on the fixed member, and in utilizing the attraction between the oppositely charged members to move the movable member.

22. In a vacuum tube device, a thermal emitting element, an accelerating electrode for accelerating the emission from the thermal element, vanes pivoted within the tube in the path of the electronic emission and movable thereby, and contacts caused to engage by the movement of the vanes.

23. A cathode ray device comprising an evacuated chamber, means in said chamber for producing a cathode ray, contacts in said chamber for controlling an external circuit, and means directly operated at least in part by the kinetic energy of the ray impacting thereon for controlling the engagement of said contacts.

24. A cathode ray device comprising means for producing a cathode ray, a movable member impacted by said ray and moved thereby, a fixed member positioned adjacent said movable member, and means for maintaining a positive charge on said fixed member to assist in the movement of said movable member by the attraction between the positive charge on the fixed member and the negative charge delivered to the movable member by the ray.

HAROLD J. McCREARY.