March 22, 1960 A. RONNING 2,929,896

CIRCUIT CONTROLLER

Filed Sept. 23, 1958 2 Sheets-Sheet 1

FIG. 1

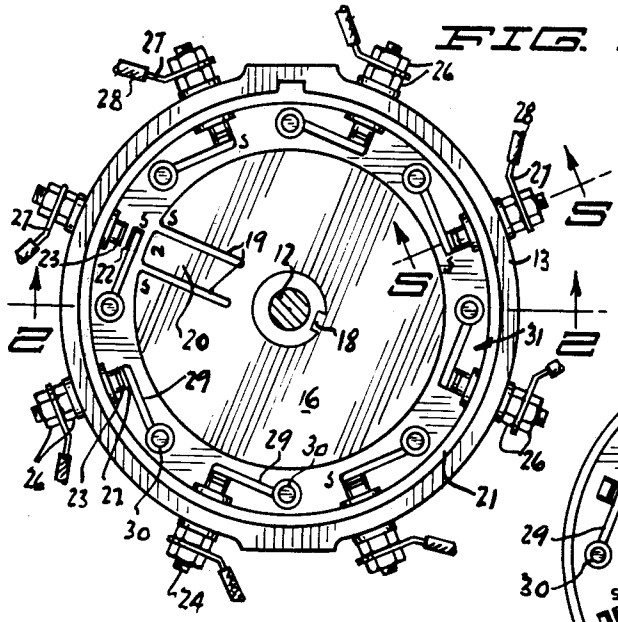
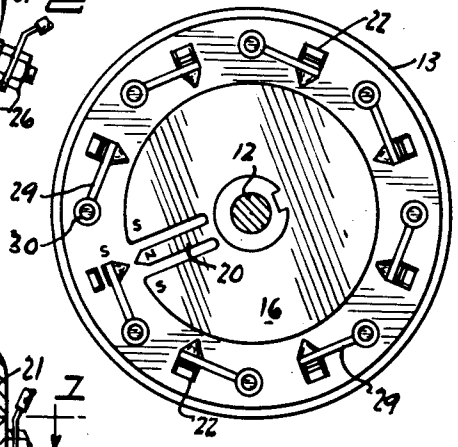


FIG. 3



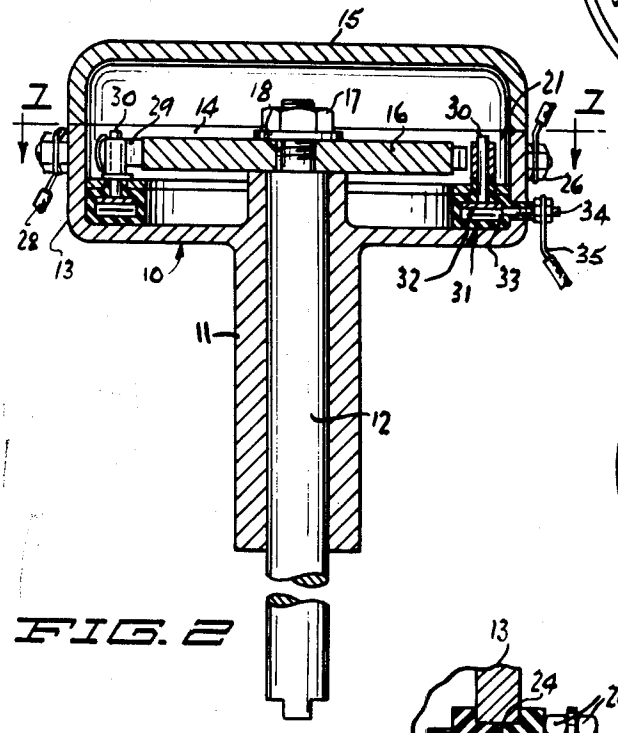
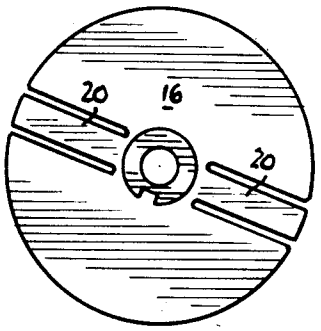


FIG. 2

FIG. 4



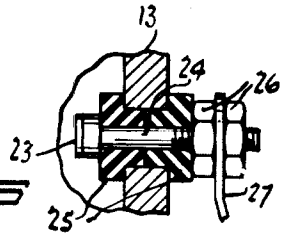


FIG. 5

INVENTOR.
ADOLPH RONNING

BY Carlson & Hayes
ATTORNEYS

March 22, 1960 A. RONNING 2,929,896

CIRCUIT CONTROLLER

Filed Sept. 23, 1958 2 Sheets-Sheet 2

FIG. 6

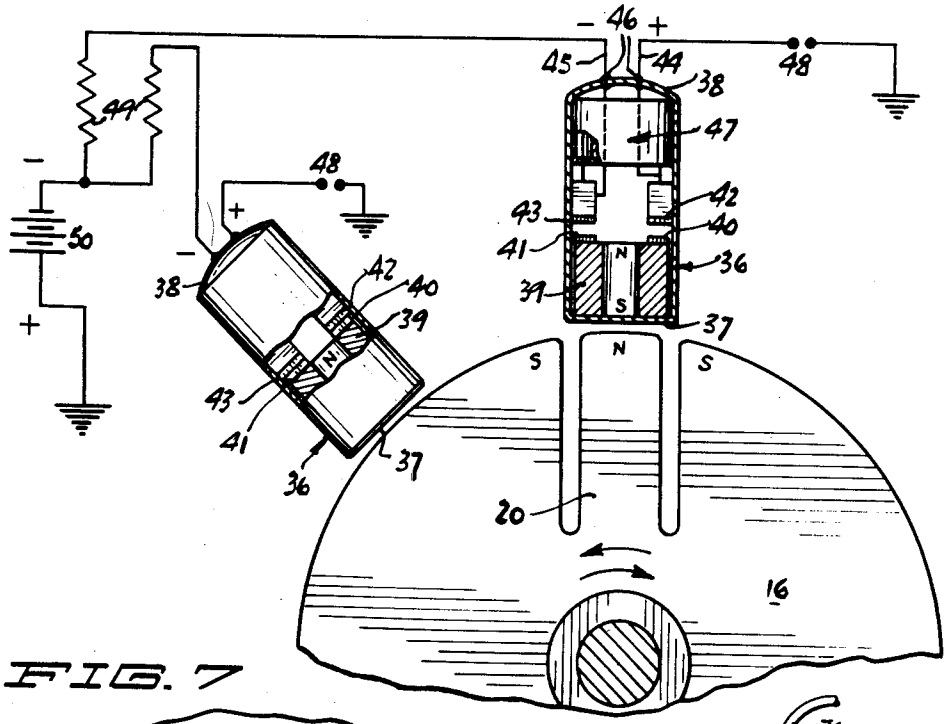


FIG. 7

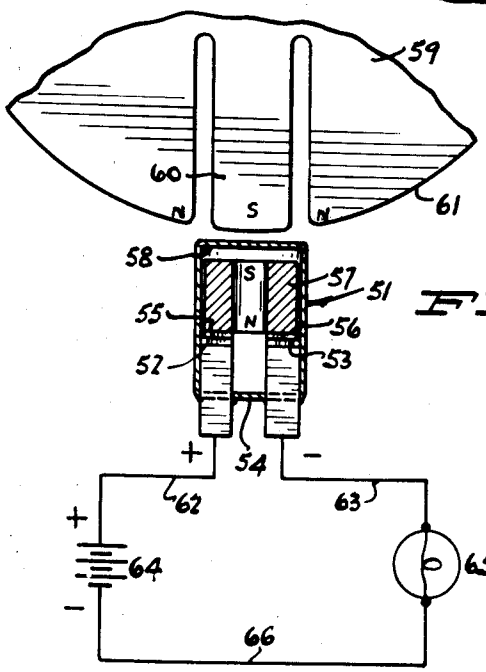
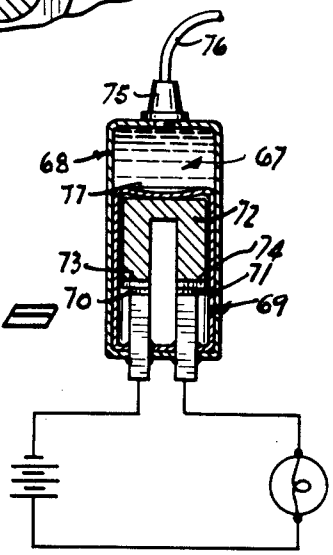


FIG. 8



INVENTOR.
ADOLPH RONNING
BY
Carlson & Hoyle
ATTORNEYS

United States Patent Office 2,929,896 Patented Mar. 22, 1960

2,929,896

CIRCUIT CONTROLLER

Adolph Ronning, Phoenix, Ariz.

Application September 23, 1958, Serial No. 762,745

11 Claims. (Cl. 200—87)

My invention relates generally to devices for controlling electrical circuits, such as high tension ignition circuits supplying spark voltage to the spark plugs of combustion engines, controlling light or motor circuits or other electrical power distribution systems.

Considering first the application of my invention to ignition circuits for combustion engines it is the primary object to provide a magnetically operated series of contacts, by contrast with the long used cam actuated contacts of the usual distributor. The magnetic distributor of my invention will permit more precisely timed and controlled instantaneous high tension impulses to be supplied for ignition purposes, and this is extremely desirable in the case of modern high speed engines which use generally eight cylinders or even more, which operate with fuel of high octane rating and with high compression ratios, all as will be readily understood by those skilled in the art and in the light of the following description. In common with the ordinary distributor my improved and magnetically operating distributor includes a rotor which turns in synchronism with the rotation of the engine crankshaft, and which operates within a circular casing, but in lieu of the cam actuated points or contacts now used I employ a series of points, one or more for each cylinder, and with no mechanical engagement whatever between the rotor and points. Instead the rotor is a permanent magnet having one or more suitably magnetically polarized operating or pole portions and the movable contacts are of opposite (or like, depending on whether a closed circuit or open circuit system is used) magnetic polarity so that each time the pole portion or portions of the rotor pass the contacts will be momentarily opened. The width of the operating portion of the rotor, measured peripherally thereof, will determine the time the contacts are opened for a given rotor speed, and this portion of the rotor may, in fact and as per one modification of my invention, be pointed to reduce the contact open time, if so desired. Another object is to provide a distributor of the foregoing characteristics in which the condenser forming part of all such ignition circuits may be built in as an annular part of the distributor and as a support for the movable contacts.

Since the magnetic lines of force which operate the moving contact elements or breaker points require no mechanical interaction between these elements and the rotor it becomes possible, in accord with a further object of my invention, to completely enclose these elements in sealed capsules located about the rotor. This sealed capsule modification of my invention makes possible the elimination of sparking at the contact elements as they make and break, and the consequent fouling and burning which currently require frequent replacement of the points in ordinary ignition systems, and this may be accomplished by sealing in a quantity of an inert gas such as helium or sulphur hexafluoride or the like, which has the property of quenching electric sparks. It is this sparking or arcing which corrodes and burns the points, as well as causes afterglow. Furthermore this sealed

capsule version of the invention makes possible the sealing of an individual condenser in each capsule and the use of individual high tension coils or transistors of small size for each cylinder of the associated engine with a resulting simplification of the circuit and the possibility of servicing the circuit individually for each cylinder, replacing only those components which may be reducing power of the individual cylinder, and servicing to provide smoothest overall operation of all cylinders.

Withal the distributors of my invention make possible a longer dwell period for each cylinder, better ignition with an instant hot spark and with no after-glow action, and fuel saving even at high speeds in the modern high compression, high power engines now so prevalent in modern automotive vehicles of all kinds for air, sea and land travel.

The sealed capsule type of contact operation, wherein no mechanical or sliding connections are required for operation of the contact opening and closing elements, also lends itself to a further modification of my invention, and as a further object I provide for the operation of the contacts by pressure, fluid or otherwise, corresponding in its functioning to the magnetic lines of force which are used in the system described hereinabove. Thus the capsule may be located in a suitable pressure chamber and have one end function as a diaphragm according to the pressure, negative or positive, of fluid in the chamber to properly position the contacts. This kind of operation, in addition to operation magnetically, may be utilized to provide a switch or relay controlling a circuit to a light, motor or other system of power distribution and in any case the sealed capsules may contain a spark quenching gas as aforesaid with a resulting saving in contact burning, and furthermore making possible the use of a switch or relay of the sealed type in the presence of explosive or combustible materials without danger of fire or explosion. In the latter instance since position or orientation of the switch or relay is immaterial it may even be desirable in some low power use in preference to the so-called mercury switches now widely used.

These and other more detailed and specific objects will be disclosed in the course of the following specification, reference being had to the accompanying drawings, in which—

Fig. 1 is a plan view of a magnetic distributor of my invention for use in ignition systems and showing the shaft rotating the rotor in cross section.

Fig. 2 is a diametrical sectional view taken substantially along the line 2—2 in Fig. 1.

Fig. 3 is a view similar to Fig. 1 but on a smaller scale, omitting the mounting for the stationary contacts, and showing a modification of my invention wherein the rotor pole or actuating portion is tapered and the movable contacts are provided with tapered magnetic elements which cooperate with the tapered pole to reduce the contact opened or closed time increment for a given speed of rotation of the rotor.

Fig. 4 is a plan view of a rotor wherein two diametrically opposed actuating portions or poles are employed.

Fig. 5 is a detail section view through the insulated mounting for one of the stationary contacts as taken substantially along the line 5—5 in Fig. 1.

Fig. 6 is a fragmentary plan view showing a rotor much like that of Fig. 1 but cooperating with contact points which are arranged in capsules or capsular containers positioned around the peripheral surface of the rotor, this being another modification of my invention, and portions of the ignition circuit used therein being schematically illustrated.

Fig. 7 is a view of still another version of the magnetically actuated and capsule-contained contacts particu-

larly useful for controlling lighting circuits or other electrical systems, in which case the contacts may serve as circuit controlling switches or relays.

Fig. 8 is a schematic and sectional view of another modification of my invention wherein the contacts are contained within a capsule and lines of force are provided for positioning the contacts by positive or negative fluid pressures applied within an outer casing enclosing the capsule so that these pressures will squeeze the capsule and actuate the shuttle element therewithin.

Referring now more particularly to that modification of my invention shown in Figs. 1–5 and wherein the invention is particularly designed for use as a distributor providing high tension electrical impulses to the spark plugs used for igniting the combustible mixtures in engines, it will be noted that there is provided a circular casing 10 arranged in a horizontal position, as conveniently illustrated in Fig. 2, and provided with a depending bearing 11 wherein is journaled the shaft 12 by which connection is made to the timing gears or chain of the engine (not shown) so that this shaft will rotate at a speed proportional to the crankshaft speed of the engine. The casing 10 includes an annular wall 13 forming a circular and upwardly opening recess 14 which is normally closed by a cover 15 in the usual manner. Secured upon the shaft 12 within the casing 10 is a circular rotor 16 held in place by means of a nut 17 and suitable key 18, also in accordance with conventional construction of these mechanisms. Arranged about the peripheral surface of the rotor 16 and within the wall 13 is a series of pairs of cooperating contacts by which impulses are transmitted to the spark plugs and in the ordinary distributor these contacts are actuated by means of cam acting elements with an actual mechanical contact between the rotor and the movable portions of the contacts. In accordance with my invention, however, the rotor 16 is a magnet and is provided with spaced apart, generally radially extending slits 19 on at least one side of the axis of rotation to provide an intervening, radially extending actuating portion or pole 20. The magnetic polarization of this rotor is then such that the outer end of the pole 20 will be polarized differently from the remaining peripheral surface of the rotor, as is designated by the letters N and S throughout the various drawings, these letters of course indicating north and south poles. The external diameter of the rotor 16 is such that there intervenes between this rotor and the wall 13 an annular channel or chamber 21 in which are located the contacts, and in this modification of my invention each pair of contacts includes a movable contact point 22 and a stationary contact point 23. The latter points are, as best seen in Fig. 5, formed on or provided at the inner ends of outwardly and radially extending screws 24 projecting through the wall 13 and insulated therefrom in the usual manner by bushings 25. At their outer extremities the screws 24 are fitted with nuts 26 for clamping engagement with lugs 27 formed at the ends of cables 28 which lead to the spark plugs (not here shown) of the various cylinders and in Figs. 1 and 3 there are eight such pairs of contacts, thus suited for the ignition system of an eight cylinder engine. The movable contacts 22 are secured upon the free extremities of levers 29, extending in a generally tangential direction with respect to the periphery of the rotor 16 and pivoted at their opposite ends upon pins 30 so that the points 22—23 of each pair may move into and out of electrical engagement by inward and outward swinging movements of the free ends of the levers 29 as will be readily understood. The levers 29 are also of magnetic material, magnetized and so polarized that the free ends of the levers, whereon the movable contacts 22 are provided, are oppositely polarized with respect to the outer extremity of the pole 20 of the rotor 16.

As thus far described it will be understood that the contact pairs 22—23 will be closed at all times (except as the outer end of the extremity of the pole 20 passes the free ends of the levers 29) for the reason that the peripheral portion of the rotor 16, being polarized the same as the free ends of the lever, will repel the levers, keeping the contacts in the closed position, but as the pole 20 passes the free ends of the levers the magnetic polarity of the extremity of this pole and the free ends of the levers will be opposite so that there will result a momentary attraction to pull the levers 29 inwardly and open the contacts 22—23 as is clearly seen in Fig. 1. In accordance with the objects of my invention as heretofore set forth there thus results the beneficial operation of the contacts without any mechanical or cam engagement whatsoever bteween these contacts and the rotor, the actuation of the contacts being wholly by the effects of magnetic lines of force or of magnetic flux as will also be apparent.

In Fig. 3 I show the cooperating ends of the pole 20 and levers 29 as pointed, beveled or tapered to reduce the contact open (or closed) time for a given rotor speed.

The annular channel 21 provides a convenient location within the casing 10 for a similarly shaped condenser, designated generally at 31, having an upper capacitor plate 32 in which are anchored the aforesaid pins 30 by which the contact levers 29 are pivotally mounted. The opposed capacitor plate or foil 33 of the condenser 31 is connected to an outwardly extending screw 34 mounted through the wall 13 of the casing 10 exactly as are the screws 24 so that connection may be made at 35 to the primary portions of the ignition system (not shown). Inasmuch as the ignition system, per se, is identical to that currently used it is not detailed herein insofar as the modification of my invention illustrated in Figs. 1–5 is concerned. As seen in Fig. 4 the rotor 16 may have two opposed poles 20 permitting paralleling of the contacts if so desired or actuation of two sets of contacts simultaneously.

Bearing in mind that the relative movements of the contacts occur only by means of magnetic lines of force I may as a further modification of my invention provide a distributor which is schematically illustrated in Fig. 6. In this modification the rotor 16 and its pole piece or portion 20, along with its drive shaft 12, are all identical to the corresponding portions of the distributor heretofore described, but in lieu of the pivotally mounted contact pairs I place in angularly spaced relation about the peripheral surface of the rotor 16 a number of sealed capsules or capsular containers, designated generally at 36, equaling in number the number of the spark plugs to which impulses are to be transmitted. The material from which these capsules 36 are made is such that it is preferably an electrical insulator, and in any case readily permeable by magnetic lines of force, and the capsules are of generally cylindrical configuration closed at their inner and outer ends 37 and 38 as clearly shown. Loosely slidably mounted within the inner portions of each capsule 36 is what I identify herein for convenience sake as a shuttle element 39 of a ferrous metal, magnetized and so polarized with respect to the polarity of the rotor 16 that the inner end portion of this shuttle element will be of a polarity opposite that of the outer extremity of the pole 20 as clearly designated by the use of the letters N and S. Thus as long as the peripheral portion of the rotor 16 is adjacent the inner extremities of the capsules the shuttle elements 39 will be repelled and moved in an outward direction within the capsules, as is indicated in the left hand capsule in Fig. 6, but as the pole 20 moves into registry with each capsule in succession the magnetic polarity is such as to attract the shuttle elements 39 and move them inwardly as far as possible in the capsules until they contact the inner closed ends 37 thereof. Each shuttle element carries a pair of contact points 40—41 which cooperate with fixed contacts 42—43 cemented or otherwise suitably secured to the walls of the capsules and so disposed

with respect to the travel movement of the shuttle elements that as the latter are repelled these contact points will be brought into electrical engagement, and as the pole **20** passes the capsules in succession the resulting attraction of the shuttle elements **39** will open the contact points as seen at the upper portion of Fig. 6. Terminal wires **44—45** are brought out through the outer ends **38** of the capsules **36** through suitable fluid-tight relatively insulated seals **46** for making connection to the ignition system as will be shortly described.

In accordance with my invention these sealed capsules **36** are evacuated of air and instead are filled with an inert gas having the property of quenching sparks which would otherwise occur as the contacts **40—43** open and close. Any such gas having this desirable characteristic may be employed such as helium or sulphur hexafluoride for example. Inasmuch as it is the arcing and sparking at these contact points which causes the corrosion and pitting thereof so that they require frequent replacement, it will be readily observed that the use of a spark quenching element, particularly if it completely removes the effects of arcing and sparking, will make the contacts good for the life of the ordinary engine or at least will require such infrequent replacement of the contacts that this statement could be made with considerable justification. Thus the added expense of the use of the sealed capsules will be more than justified and I prefer, in view of the long life of the system as provided by these capsular spark quenching enclosures of the contacts, to provide in each capsule a condenser, designated generally at **47**, so that there will be one condenser for each spark plug **48** of the ignition system. Furthermore I may employ small high-tension induction coils **49** in the circuit leading to each conductor **45** of each capsule from the ungrounded side of the battery **50** and in addition to the fact that smaller coils are thus usable it is further, as a servicing feature, made possible to individually check each cylinder of an engine to ensure that each cylinder performs its proper function and if any replacement is necessary then the replacement of the components leading only to the one under par cylinder is necessary. In the proper tuning of modern high speed and high powered engines using fuel of high octane ratings and operating at high compression ratios, this individual cylinder tuning will be a distinct advantage not only for a smooth, uniform maximum power output but also from the standpoint of conserving fuel as will be readily understood by those skilled in the art.

The contact control, according to my invention, by lines of force, magnetic or the like, is also useful in other than ignition circuits, as for example as a switch or relay for controlling various electrical circuits and electrical power distribution. In fact, the sealed capsule modification is particularly useful where high power or high voltages must be controlled and which conditions frequently offer a particular problem from arising at the contacts as the circuit is opened or closed. Referring to Fig. 7 I show a sealed capsule **51** having fixed contacts **52—53** with terminals leading out through an end **54** of the capsule, with fluid-tight seals where they emerge. Contacts **55—56** are then secured or formed on and electrically connected by a shuttle element **57** slidable in the capsule toward and away from the end **58** thereof so that the contacts **52—53** may be bridged and opened according to the position of the shuttle element. Here again a magnetized actuator element **59** is provided, having a pole **60** which will repel the shuttle element when the pole is positioned as shown in order to close the circuit between the contacts **52** and **53**. The element **59** may be a rotor like that heretofore designated at **16** but manually operated and however made it will have surfaces **61** so polarized as to attract the shuttle element **57** and thus open the circuit whenever desired.

For convenience sake the contacts **52—53** are shown as connected by conductors **62—63** to one terminal of a battery **64** and to a lamp **65**, the circuit being completed by a conductor **66** as clearly shown. The electrical polarity indications in the circuit are, of course, for illustration only and in no way imply a limitation.

Instead of the actuation of the contacts by magnetic flux or lines of force I may, as seen in Fig. 8, use force created by negative or positive fluid pressures in the end **67** of an outer fluid-tight casing **68**, in the opposite end portion of which a capsule **69** very much like that of Fig. 7 is mounted. Said capsule **69** has fixed contacts **70—71** extending outward for connection into the circuit to be controlled and suitably sealed. A shuttle element **72** slidable in the capsule **69** has contacts **73—74** for bridging the contacts **70—71** or clearing them and for so moving the shuttle element **72** fluid under pressure, or vacuum, is supplied to the outer casing through a fitting **75** and line **76** leading to a suitable pump and related components (not here shown). By properly shaping the end **77** of the capsule **69** or reducing its thickness this end will serve as a diaphragm and, responsive to the fluid pressure lines of force, will position the shuttle element as may be desired.

In either Figs. 7 or 8 the capsules, being fluid tight, may contain a spark quenching gas as aforesaid eliminating the problems usually encountered by arcing at the contacts, with the resulting wear and pitting thereof.

It is understood that suitable modifications may be made in the structure as disclosed, provided such modifications come within the spirit and scope of the appended claims. Having now therefore fully illustrated and described my invention, what I claim to be new and desire to protect by Letters Patent is:

1. In a distributor for ignition systems, a casing having a circular recess and a circular rotor centered therein and rotatable with respect thereto, the respective diameters of the recess and rotor being such that there is an annular channel around the exterior of the rotor, a circular series of contact pairs arranged in said channel and each pair having a fixed contact and a movable contact movable into and out of engagement with the fixed contact of the pair, the said movable contacts being of magnetic material of like polarities, and the rotor being of magnetic material having a pole portion of a polarity so related to the polarity of the movable contacts as to move these contacts into and out of engagement with the fixed contacts as the rotor rotates, the said movable contacts having pivoted levers swingable radially with respect to the radius of the rotor, and an electrical condenser of circular configuration located in said annular channel in supporting and electrical contact with said levers.

2. A distributor for an ignition system, comprising a rotatable rotor of magnetic material having an outwardly extending pole portion of predetermined magnetic polarity differing from the polarity of the remaining peripheral portion of the rotor, a series of capsules of electrical insulating material permeable by magnetic lines of force, said capsules being arranged about the periphery of the rotor and each containing a movable shuttle element of a predetermined magnetic polarity and movable by said pole portion each time it passes the associated capsule, and ignition circuit controlling contacts movable into and out of electrical engagement by said movements of the shuttle element.

3. A distributor for an ignition system, comprising a rotatable rotor of magnetic material having an outwardly extending pole portion of predetermined magnetic polarity differing from the polarity of the remaining peripheral portion of the rotor, a series of capsules of electrical insulating material permeable by magnetic lines of force, said capsules being arranged about the periphery of the rotor and each containing a movable shuttle element of a predetermined magnetic polarity and movable by said pole portion each time it passes the associated capsule, ignition circuit controlling contacts movable into and out of electrical engagement by said movements of the shuttle

element, and an electrical condenser in each capsule operatively connected to said contacts.

4. A distributor for an ignition system, comprising a rotatable rotor of magnetic material having an outwardly extending pole portion of predetermined magnetic polarity differing from the polarity of the remaining peripheral portion of the rotor, a series of capsules of electrical insulating material permeable by magnetic lines of force, said capsules being arranged about the periphery of the rotor and each containing a movable shuttle element of a predetermined magnetic polarity and movable by said pole portion each time it passes the associated capsule, ignition circuit controlling contacts movable into and out of electrical engagement by said movements of the shuttle element and having terminals leading out of the capsule and sealed where they emerge therefrom.

5. A distributor for an ignition system, comprising a rotatable rotor of magnetic material having an outwardly extending pole portion of predetermined magnetic polarity differing from the polarity of the remaining peripheral portion of the rotor, a series of capsules of electrical insulating material permeable by magnetic lines of force, said capsules being arranged about the periphery of the rotor and each containing a movable shuttle element of a predetermined magnetic polarity and movable by the said pole portion each time it passes the associated capsule, ignition circuit controlling contacts movable into and out of electrical engagement by said movements of the shuttle element and having terminals leading out of the capsule and sealed where they emerge therefrom, the said capsules being completely sealed and containing a spark quenching gas to eliminate sparking at the contacts and resulting pitting thereof.

6. A circuit controller of the character described, comprising a capsular container, a shuttle element slidable in said container by lines of force permeating the walls of the container, contacts in said container movable into and out of electrical engagement by movement of said shuttle element and said contacts being operatively connected in a circuit to be controlled, and means wholly outside said container and controllable to develop lines of force to selectively move said shuttle element into contact closing and contact opening positions.

7. A circuit controller of the character described, comprising a capsular container, a shuttle element sildable in said container by lines of force permeating the container, contacts in said container movable into and out of electrical engagement by movement of said shuttle element and said contacts being operatively connected in a circuit to be controlled, and means wholly outside said container and controllable to develop lines of force to selectively move said shuttle element into contact closing and contact opening positions, said shuttle element being magnetically polarized and the last mentioned means consisting of an element having portions of opposite magnetic polarity for oppositely influencing the shuttle element by magnetic lines of force permeating said container.

8. A circuit controller of the character described, comprising in combination, a movable magnet pole, a sealed capsular container having walls permeable by magnetic lines of force emanating from said pole, circuit controlling contacts operatively associated with said container, and a shuttle slidable inside said container to positions for selectively opening and closing a circuit through said contacts, said shuttle having a magnet pole and movable by said lines of force from said movable magnet.

9. In an electrical circuit controller, a stationary member, a rotatable member and means rotatably mounting the same with respect to said stationary member, at least one pair of contacts arranged adjacent the margin of said rotatable member and including a fixed contact and a movable contact, means supporting the movable contact with equal freedom to move both into and out of engagement with the said fixed contact for opening and closing said contacts and an electrical circuit therethrough, the said movable contact being magnetic and of predetermined magnetic polarity, and the rotatable member being also magnetic and having one marginally located pole portion of a polarity so related as to repel said movable contact and another pole portion to attract said movable contact whereby to alternatively and magnetically open and close said contacts upon rotation of said rotor.

10. In an electrical circuit controller of the character described, the combination comprising a casing, a circular rotor, means rotatably mounting the rotor with respect to said casing, at least one pair of contacts arranged adjacent the periphery of said rotor and including a fixed contact and a movable contact, means supporting a movable contact for movement with equal freedom both into and out of engagement with the said fixed contact for opening and closing said contacts, the said movable contact being magnetic in nature of predetermined magnetic polarity, and the rotor being also magnetic in nature and having one relatively narrow peripherally located pole portion and another longer and peripherally extending pole portion to respectively magnetically influence said movable contact whereby to successively and magnetically move the same in opposite directions with respect to said fixed contact.

11. An electrical circuit controller, comprising a rotatable rotor of magnetic material having a pole portion of predetermined magnetic polarity differing from the polarity of the remaining peripheral portion of the rotor, at least one capsule of electrical insulating material permeable by magnetic lines of force, said capsule being arranged adjacent the periphery of the rotor and containing a movable shuttle element of a predetermined magnetic polarity and movable by said pole portion each time it passes the associated capsule, cooperating circuit controlling contacts on the capsule and shuttle element and movable into and out of electrical engagement by movement of the shuttle element, said shuttle element being free for rotating and oscillating movements in the capsule and presenting a varying contact surface to the contacts on the capsule.

References Cited in the file of this patent

UNITED STATES PATENTS

1,530,936	Greenwood	Mar. 24, 1925
1,769,910	Ponsonby et al.	July 1, 1930
2,584,907	Nelson	Feb. 5, 1952
2,803,720	Mason	Aug. 20, 1957
2,814,689	Roche	Nov. 26, 1957

FOREIGN PATENTS

520,540	Germany	Mar. 12, 1931