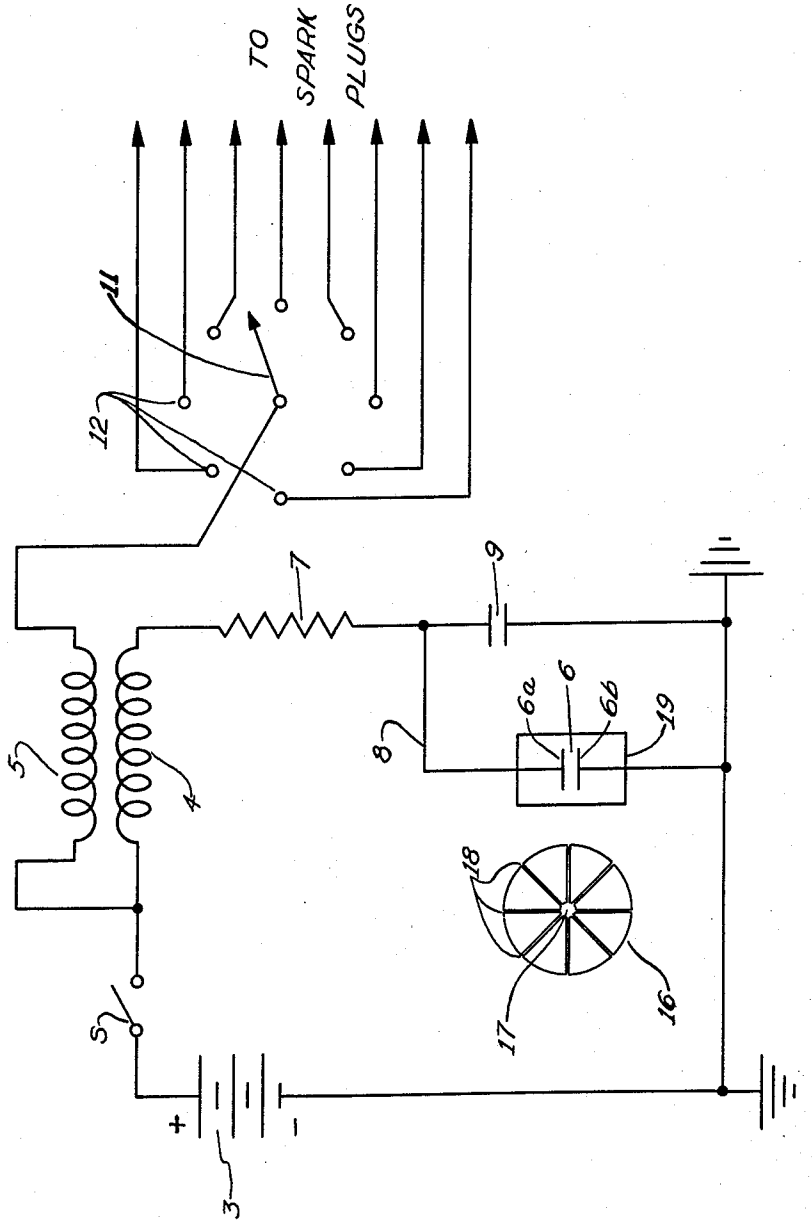
Jan. 5, 1960 W. B. LANE 2,920,238

RADIOACTIVE IGNITION SYSTEM

Filed Jan. 18, 1957



INVENTOR.

William B. Lane

BY George Sipkin

Paul A. Sutherland

United States Patent Office

2,920,238

Patented Jan. 5, 1960

2,920,238

RADIOACTIVE IGNITION SYSTEM

William B. Lane, Los Gatos, Calif.

Application January 18, 1957, Serial No. 635,562

2 Claims. (Cl. 315—154)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to internal combustion engine ignition systems and, more particularly, to a battery ignition system having an improved primary current breaking means.

Ignition systems of the type almost universally used with storage batteries employ an ignition coil formed of primary and secondary windings for transforming a low-tension battery current to one of high voltage. Customarily, a set of spring-pressed contacts is mounted in the circuit to the primary and a breaker or interruptor cam provided with a plurality of cam lobes is used for breaking the contacts and interrupting the primary current. As is well known, such interruptions cause a sudden decay of flux in the magnetic circuit of the ignition coil to produce a high-tension current in the secondary which then is carried through the distributor rotor to the proper spark plug.

Various breaker or interrupting mechanisms have been employed, such as the four-lobe cams with a single breaker arm used with the four-cylinder engines, or other interrupters having two sets of breaker arms and half as many lobes as there are arms. However, although operation of these mechanisms is satisfactory when the parts are new and properly adjusted, it frequently is found that the wear on the mechanical parts due to friction, arcing, electrolytic erosion and other phenomena, necessitate constant adjustment and replacement. Further, even under optimum conditions, precise control is not obtainable by adjustment of the contact points because a certain amount of arcing will be present between the points. Such arcing introduces unnecessary resistance into the circuit and ultimately limits the amount of spark with resultant deterioration of the combustion characteristics.

It is, therefore, an object of the invention to provide an ignition system for internal combustion engines which provides good timing control, freedom from arcing and which requires a minimum of adjustment and maintenance during use.

More specifically, an object is to provide such an ignition system with an interrupter mechanism that employs a minimum of mechanically-movable friction-producing parts.

A further object of the invention is the provision of an ignition system which reduces the arcing and thereby the introduction of unnecessary resistance into the ignition circuit.

Broadly considered, these and other objects are achieved by utilizing the ionizing effect of radioactive emissions in lieu of the conventional breaker arm for interrupting the primary current and initiating the necessary magnetic flux decay. More specifically, a shaft, which might be considered the motor-driven cam shaft,

mounts a radioactive source, such as strontium 90, that emits a plurality of collimated beams through a series of spaced holes which usually are arranged to provide one beam for each engine cylinder. Further, a pair of contact points are sealed in an inert atmosphere and are permanently disposed in the path of the collimated beams. As may be obvious, in the operation of such an arrangement the emitted radiation ionizes the inert gas and the circuit of a primary coil is thereby closed. When the shaft having the quantity of radionuclide therein, rotates enough so that the beam passes by the contact points, the gas no longer is ionized and therefore the circuit of the primary coil is broken. The result of the break in the primary coil circuit effects in the usual manner the necessary induction in the secondary coil for producing the spark across the gap in an engine plug. Conventional distribution means may be employed to direct the spark into the particular cylinder desired.

The preferred embodiment of the invention is illustrated in the figure of the accompanying drawing, this figure being a diagrammatic illustration of the radioactively ionized ignition system.

Referring to the figure, certain conventional elements of the conventional breaker cam ignition systems are easily recognizable. Thus, the system illustrated utilizes a storage battery 3 which, of course, may be of any suitable type such as the three-cell, six-volt battery customarily used in automotive ignition systems. The positive terminal of the battery is connected through a conventional key or switch S to a primary winding 4 of the ignition coil which, of course, is arranged in inductive relationship to secondary winding 5. Further, in a manner similar to earlier systems, a pair of contacts 6 is electrically connected into the primary circuit and, as can be seen, the circuit itself includes a protective resistor 7 electrically connected to a contact plate 6*a* by a conductor 8. Contact plate 6*b*, in turn, is directly connected to the negative side of the battery and, to reduce the possibility of arcing, a conventional capacitor or condenser 9 also is connected into the primary circuit in the manner shown.

Secondary winding 5 in which the high-tension, spark-producing current is initiated also is electrically coupled to the spark plugs of the cylinders in a somewhat conventional manner. Thus, the secondary winding is connected by suitable electric leads to a rotatable arm 11 which is rotatably driven synchronously with the primary current breaking means subsequently to be described. Here again the situation is analagous to prior ignition systems to the extent the rotatable distributor arms is driven indirectly by the engine. During its rotation, arm 11 contacts various points 12 which, in turn, are connected by electric leads to the various spark plugs (not shown) associated with each cylinder. Such a distributor mechanism, including arm 11 and contact points 12, is entirely conventional and may assume a variety of types.

One of the principal features of the invention resides in the primary circuit breaker or interrupting mechanism which, in the present instance, includes a source of radioactivity. As may be seen in the drawings, this interrupter mechanism is in the form of a shaft 16 which may be similar in mounting and drive to the conventional breaker cam shafts of prior ignition systems. However, in all other respects, both structurally and operatively, shaft 16 is a radical departure from these earlier shafts. In particular, the shaft, which preferably is formed of some radiation-shielding material, is provided with a central enclosed chamber in which is mounted a suitable radioactive material 17, such as the radionuclide strontium 90 which has been found particularly suitable because of its half-life characteristics, as well as the fact

that it is a beta emitter eventually decaying into yttrium 90 that has a half-life of a few hours. Other radionuclide materials may be used although it is desirable to employ a beta emitter for reducing health hazards and for other apparent reasons.

As has been indicated, the purpose of the radioactive material is to form collimated beams which, as shaft **16** rotates, are directed onto the primary current interrupter contacts **6** and, to permit the formation of such collimated beams, the shaft is provided with a plurality of radial holes or openings **18** spaced in a suitable manner circumferentially about it. In the preferred form, there are as many column-forming apertures **18** as there are cylinders and the spacing of these columns will be dependent upon rotational speeds as well as the diameter of the shaft.

Another very important feature related directly to the radioactive nature of the interrupter mechanism is the fact that contacts **6** are enclosed in an envelope **19** which is filled with an inert gas such as argon. As a result, as shaft **16** is rotated, each collimated beam in turn sweeps through the gap between the contacts to ionize the gas and temporarily produce a current flow which, in turn, passes through primary winding 4 of the ignition coil to initiate the self-induction utilized to convert the low-tension battery current into the high-voltage spark. However, when the beam is swung past the contacts so that ionization no longer is effected, the primary circuit instantly becomes broken and the phenomenon of a sudden decay of the flux in the magnetic circuit commences. Such a decay or sudden decline of the flux produces a high-tension current in secondary winding **5** which, in turn, is carried to the desired plug through rotatable arm **11** and one of contact points **12**.

From the above description, it will be seen that the radioactive ignitions are utilized for substantially the same purpose as the breaker cam to initiate the desired high-tension current. On the other hand, it can be recognized that the present arrangement utilizes no frictionally engaged and moving parts such as the lobes of the breaker cams which customarily are employed to physically press apart the contacts for the purpose of breaking the primary current. For this reason alone, the present arrangement is free of such frictional wear as frequently produces arcing or requires constant adjustment or replacement. Also, as can be appreciated, the gap between contacts *6a* and *6b* is capable of being precisely fixed as contrasted with the prior gaps which were dependent upon the physical thickness of the breaker cam lobes. Such an ability to fix this gap at a predetermined amount is most important to satisfactory operation and, when the gap is so fixed, it is obvious that it will not easily be disturbed. Of course, the synchronization of shaft rotation with the move of distribution arm **11** is a matter which will have to be empirically determined. Also, the size of the apertures, as well as the length of time involved in ionizing the gas in chamber **19** must be specifically determined for each application although such

determination should be relatively easily made. Other members, such as the type of ignition coil utilized, as well as the batteries, the resistances and the capacitors can be developed for individual applications according to well-known electrical principles. In general, for an automotive ignition system, an ignition coil which has the primary to secondary turns ratio of between 1:40 to 1:100 in which the secondary has from 9,000 to 25,000 turns is satisfactory for use with a six-volt system having conventional primary resistances and primary inductance.

The principal advantage of the present system lies in its elimination of mechanical wearing parts as well as the fact that parts used are absolutely susceptible to precise settings and time controls. Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A device of the type described comprising ignition means, a first winding, a second winding, means for connecting the second winding to said ignition means, a power source connected to said first winding, means for containing an ionizable gas, spaced contacts mounted in said gas containing means, the contacts one connected to said first winding and another to the power source, a rotatable shaft disposed relatively close to the contacts, the shaft having a chamber and a plurality of openings leading from said chamber to the exterior of the shaft, a radioactive source mounted within the chamber for emanating beams through the openings.

2. An ignition system comprising spark ignition means, a coil having a primary winding and a secondary winding, means for connecting the secondary winding to said ignition means, a power source connected to said primary winding, an envelope having gas therein, contacts spaced apart and mounted within said envelope and connected one to said primary winding and another to the power source, a rotatable shaft formed with a substantially closed chamber, and with a plurality of radially-spaced openings leading from said chamber to the shaft exterior, and a radioactive source mounted within the chamber for emanating radioactive beams through said openings, said shaft being so disposed relative to said contacts to cause a beam radiated through said openings to sweep said contacts and ionize said gas therebetween, whereby the circuit to said primary first is closed and then opened for inducing a spark-producing flux.

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