Aug. 4, 1942. J. J. ROSE 2,291,652

IGNITION DISTRIBUTOR

Filed Jan. 31, 1942 2 Sheets-Sheet 1

FIG. 1.

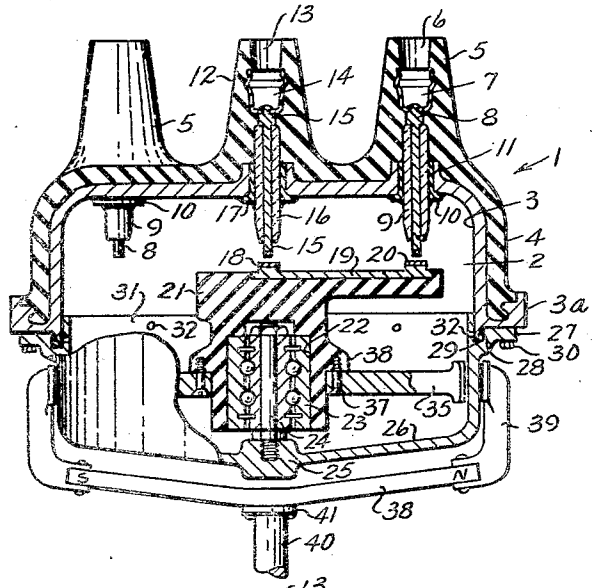


FIG. 3.

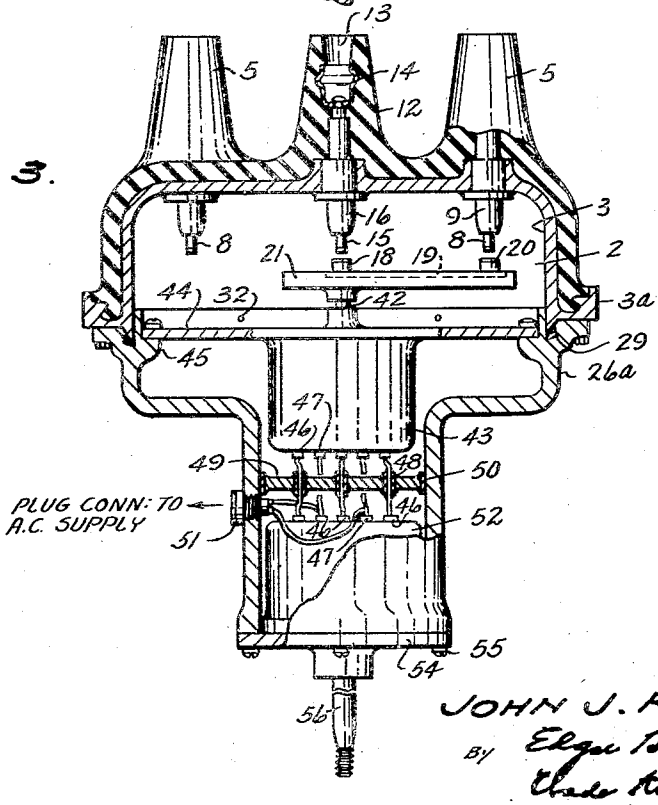


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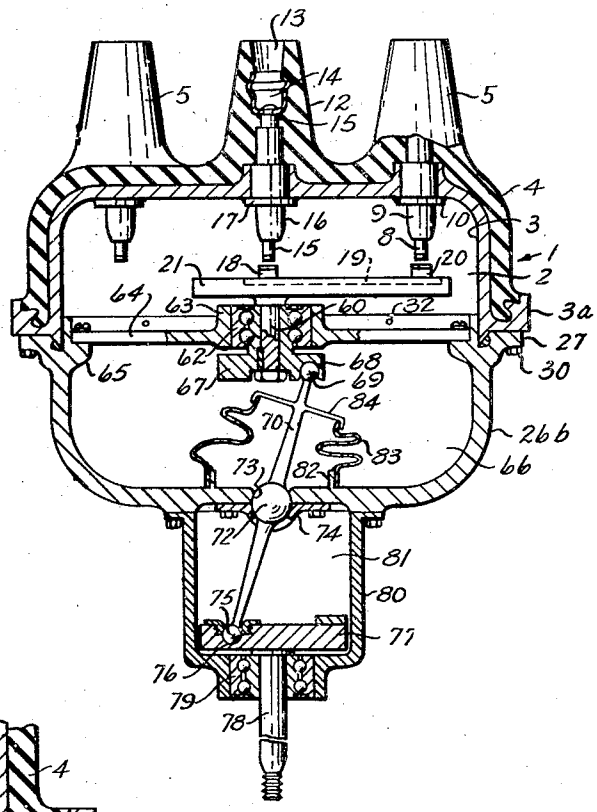
FIG. 4.



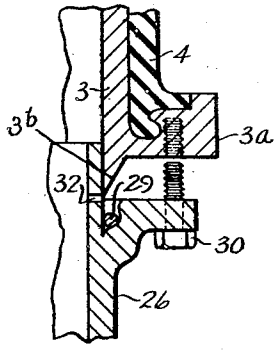




FIG. 2.

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Patented Aug. 4, 1942 2,291,652

# UNITED STATES PATENT OFFICE

2,291,652

## IGNITION DISTRIBUTOR

John J. Rosé, Dayton, Ohio

Application January 31, 1942, Serial No. 429,069

15 Claims. (Cl. 200—19)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to improvements in ignition distributors particularly adapted for use in airplane engine ignition systems to overcome difficulties heretofore encountered in high altitude flying.

Much trouble has been experienced with ignition systems on aircraft when flown at high altitudes due to the fact that in the rarefied atmosphere the flash over voltage to ground of the high tension portions of the ignition system is greatly reduced and giving rise to power plant failure. The source of most of the trouble is located in the distributor and various proposals have been made in the prior art for preventing flash over in the distributor such as maintaining the interior of the distributor at atmospheric pressure irrespective of the pressure of the outside atmosphere by connecting the distributor to a source of air under pressure such as an air tank, or to a pump driven by the distributor drive, and in the case of supercharged engines connecting the distributor housing to the pressure side of the supercharger blower. The above proposals while fairly satisfactory give rise to the difficulty that in order to maintain pressure within the distributor housing any discharge of air therefrom must be highly restricted which makes it difficult or practically impossible to properly ventilate the distributor housing to eliminate ozone and nitric acid fumes which quickly corrode and pit the contacts and bearings of the distributor.

It further has been proposed to fill the distributor housing with transformer or similar oil which, however, being churned up with air rapidly oxidizes and forms organic acids which attack metal. Further, such a solution of the problem is limited to a distributor in which the contact on the distributor rotor wipingly engages the stationary distributor contacts.

The ideal solution of the flash over problem would be to hermetically seal the distributor housing, which would ordinarily require the use of a rotary shaft seal on the driving shaft, which type of seal is unreliable over any extended period of time and would require frequent inspection and servicing. The present invention employs such a hermetically sealed distributor, but obviates the difficulty of sealing a rotary driving shaft by drivingly connecting the distributor rotor to the driving shaft by a power transmission which does not employ a shaft rotating about its own axis and hence requires no rotary shaft seal. One form of the invention employs a magnetic coupling for the power transmission, a second form of the invention employs an electrical power transmission in which the distributor rotor is driven by a self-synchronous receiver located within the sealed distributor rotor chamber and electrically connected to a corresponding self-synchronous transmitter unit located exterior of the sealed rotor chamber, and in a third form of the invention a mechanical transmission is employed of such a character that no shaft rotating about its own axis passes through the distributor casing walls, hence eliminating the use of rotary shaft sealing means.

It is thus seen that the invention is characterized by the fact that the distributor rotor is mounted in a hermetically sealed chamber and drivingly connected to a driving shaft or other driving means located exterior of the sealed chamber by a power transmission means which I prefer to define as a shaftless power transmission, i. e. a power transmission which does not require the use of a shaft rotatable about its own axis to pierce the walls of the sealed chamber and hence requires no rotary shaft sealing means to seal the chamber against leakage and it is understood that the term shaftless power transmission device or similar expression as hereinafter employed in the specification and claims also embraces magnetic, electrical and mechanical power transmitting means provided that they do not require the use of a rotary transmission shaft and shaft seal to transmit drive from a driving means to the distributor rotor.

A further feature of the invention is the fact that the hermetically sealed distributor rotor chamber may be filled with a gas, for example nitrogen, so as to produce a neutral atmosphere within the rotor chamber so as to eliminate the formation of corrosive gases due to electrical discharge.

It is therefore the principal object of the invention to provide a high tension ignition distributor for internal combustion engines in which the distributor rotor chamber is hermetically sealed from communication with the outside atmosphere, the distributor rotor being freely rotatably mounted within the chamber and being driven from a shaft external of the said chamber through a force transmission means which does not require a rotary shaft packing seal and the force transmitting means being of the magnetic, electric, or mechanical type.

It is a further object of the invention to pro-

vide a hermetically sealed distributor of the character described in which the distributor rotor chamber may be filled with a gas at or above atmospheric pressure to provide a neutral atmosphere within the chamber which will not decompose in the presence of an electrical discharge.

Other objects of the invention will become apparent by reference to the detailed description of the invention hereinafter given and to the appended drawings in which:

Figure 1 is a side elevation partly in section illustrating a form of the invention employing a magnetic drive for coupling the distributor rotor to a driving shaft.

Figure 2 is a view illustrating details of a pressure seal employed in the device of Figure 1.

Figure 3 is a view similar to Figure 1, illustrating a modified form of the invention employing a self-synchronous electrical transmission for transmitting rotation from the distributor driving shaft to the distributor rotor, and

Figure 4 is a view similar to Figure 1, illustrating a further modified form of the invention employing a mechanical transmission for driving the distributor rotor.

Referring now to Fig. 1, the reference numeral 1 generally indicates a distributor for distributing high tension electric currents as employed in automotive or aircraft ignition systems. The distributor 1 is constructed with housing elements so arranged as to form a hermetically sealed distributor chamber, indicated by the reference numeral 2. The upper portion of the distributor casing 3 is preferably made in the form of a metal casting and is surrounded on its exterior surfaces by a suitable insulating material, such as Bakelite or other synthetic resins which may be moulded around the casing in the desired form. The insulating material 4 is mounted to provide a plurality of bosses 5, equal in number to the number of engine spark plugs to be supplied with ignition current and each boss having a tapered aperture 6 into which a spark plug cable terminal may be inserted and retained by the metal contact 7 which is electrically bonded to a central electrode 8 which extends into the sealed distributor chamber 2. The electrode 8 is preferably centrally positioned in a glass or ceramic core 9 which is fused or otherwise sealed onto the electrode 8 and in turn is sealed into a sleeve 10 made, for example, from Fernico or other iron cobalt nickel alloy, well known in the radio tube industry for use in making vacuum seals. The sleeve 10 is adapted to be soldered or brazed to the inner walls of the casing portion 3 and similarly sealed to a flanged extension 11 of the casing 3, this assembly permanently sealing the electrode 8 from any leakage therealong into or from the sealed chamber 2 to the outside atmosphere. A central boss 12 is provided of exactly similar construction to the spark plug terminal mounting bosses 5 and provided with a tapered opening 13 to receive the high tension current conductor which may be connected to the high tension output terminal or a magneto or other source of current, the cable terminal being retained by the fitting 14, which conducts the current through a central electrode 15 which is sealingly retained in a glass or equivalent insulator 16 which, in turn, is sealed to a Fernico sleeve 17 in exactly the same manner as described above with reference to the electrode 8. The central electrode 15 is adapted to conduct high tension current across a short spark gap to an electrode 18 secured on the inner end of a conductor 19, which has a distributor electrode 20 arranged at its outer end and adapted to transmit high tension current across a spark gap to the respective electrodes 8. Electrodes 18 and 20 and conductor 19 form the well known distributor rotor and are mounted on a suitable distributor rotor head 21 made of insulating material and provided with a counterbored portion 22 which is adapted to be placed over the outer race of a double row sealed ball bearing 23, the latter having its inner race mounted on a spindle 24 which is suitably secured in a boss 25, forming part of the bottom distributor housing portion 26. It is thus seen that the distributor rotor is freely rotatably mounted within the sealed distributor chamber 2.

The distributor housing portions 3 and 26 are separable one from the other and adapted to be joined by a pressure tight seal between the corresponding mating flanges 3a and 27 respectively thereof, the flanges being secured by suitable removable screws 30. The sealing means shown also in detail in Fig. 2, comprises a flanged extension 3b on the casing 3 which is adapted to compress a soft metal sealing ring 29 into sealing engagement with a groove 28 cut in the flange 27 of the bottom housing portion 26 of the distributor, this type of pressure seal being also per se well known in the high vacuum art.

The housing portion 26 is also provided with an extension flanged portion 31 which is adapted to telescope into the housing portion 3 to relieve the pressure seal from any transverse shearing forces and the flanged extension 31 is provided with small ports 32 which are so arranged that the casing elements may be partly assembled, (as illustrated in Fig. 2) and placed in a compartment through which the hands of an operator may be inserted and shielded by rubber gloves or the like to prevent leakage from the compartment, the assembly chamber then being filled with nitrogen or other suitable gas which will give a neutral atmosphere within the distributor rotor chamber 2 and the assembly completed by tightening screws 30, which will then seal the gas within the chamber 2.

The distributor rotor hub 21 is provided with a shoulder 33 which serves as a support for a soft iron armature 35 having two poles 36 as shown and secured to the hub flange 33 by screws 37. External of the distributor housing portion 26 there is arranged a two-pole high coercive strength bar magnet 38 suitably mounted on the end of a driving shaft 40 which may be connected to the engine or other suitable distributor driving means and the magnet 38 being provided with suitable soft iron pole shoes 39 which overlie the casing element 26, directly above the pole shoes 36 of the armature 35.

*Operation*

In operation the distributor drive shaft 40 in rotating causes rotation of the armature 35 within the distributor rotor chamber 2 by the well known magnetic coupling action which, in turn, causes rotation of the distributor rotor body 21 which causes the electrode 20 to be angularly rotated in phase with the rotation of the shaft 40 and as the electrode 20 is rotated it will distribute high tension current from the electrode 15 to the respective electrodes 8 and thus transmit the high tension current to the respective engine spark plugs in timing relation in the same manner as is customary in the conventional distributor. Since the distributor casing elements are so arranged that the distributor rotor housing 2 may be filled

with nitrogen, or other suitable gas under slight pressure, no oxygen will be present in the distributor rotor chamber and all pitting and corrosion of the distributor parts will thereby be prevented and further, since by the above distributor construction the distributor rotor chamber 2 is hermetically sealed with respect to the outside atmosphere, changes in the external atmospheric pressure can in no way change the flash over voltage to ground within the distributor rotor chamber, thus rendering the distributor entirely free from the effects of altitude on its operation.

With respect to the distributor illustrated in Fig. 1, it is to be understood that the construction there illustrated could be readily achieved by using pressed glass for the casing portions and mounting the input and output electrodes directly into the housing portion 3 and providing a permanent seal between the housing portions as is now readily accomplished in the glass art, for example, in the manufacture of the well known sealed beam headlights, widely used for automobiles, and further it is to be understood that other forms of magnetic couplings than that illustrated in the figure may be employed.

Referring now to Fig. 3, there is disclosed therein a distributor constructed in its essential details so far as the housing portions, input and output electrodes and distributor rotor, in the same manner as the distributor above described with reference to Fig. 1 and differs therefrom in that the distributor rotor body portion 21 is secured on the outer end of a shaft 42, which shaft is connected to the rotor of a well known type of self-synchronous electrical motion transmitting means 43, well known in the art by the trade names of Selsyn and Autosyn. The casing of the self-synchronous receiver 43 is mounted by means of a flanged extension 44 thereof onto an inwardly projecting flange 45 of the casing 26a. The receiver 43 is provided with electrical terminals connected to its field windings indicated respectively by the reference numeral 46 and is also provided with a pair of similar terminals 47 connected to its rotor through slip rings or the like. The electrical terminals 46 and 47 being connected to suitable conductors sealed into glass beads 48 which are fused to a glass separating wall 49, which in turn is fused at its outer periphery to an annular metal ring 50 made of Fernico or similar alloy, which in turn may be soldered to the casing 26a to hermetically seal the electrical connections against leakage from within the distributor rotor chamber 2 to the outside atmosphere. The electrical terminals 46 and 47 of the receiver are electrically connected to the corresponding terminals of a self-synchronous transmitter unit 52 mounted in casing 26a below the partition wall 49 and the rotor terminals 47 being connected in parallel through a suitable plug 51 to a convenient source of alternating current so that the rotor of the receiver 43 may be rotated in unison with the rotor of the transmitter unit 52 in a manner well known in the art. The transmitter 52 is mounted on a plate 54 by which the transmitter is removably secured in the casing 26a by means of screws 55 and the rotor of the transmitter 52 being adapted to be driven by means of an extension shaft 56 which may be connected to a suitable drive from the engine.

The distributor of Fig. 3 may be filled with nitrogen or other suitable gas to form a neutral atmosphere within the distributor rotor chamber 2 in the same manner as previously described with respect to the device of Fig. 1 and in operation the rotation of shaft 56 causes rotation of the rotor of the self-synchronous transmitter unit 52, which in turn will cause rotation of the rotor of the receiver unit 43 in phase therewith so that the distributor rotor elements 18 to 21 inclusive will be rotated in phase with the driving shaft 56 and cause a proper distribution of the high tension current from the input electrode 15 to the respective output electrodes 8 in the same manner as in the device of Fig. 1. The device of Fig. 3 has the same advantages with respect to freedom from corrosive fumes and from the effects of change in atmospheric pressure external of the distributor as the device of Fig. 1.

In Fig. 4 there is disclosed a third form of the invention which with respect to the housing portions, input and output electrodes and distributor rotor is similar in construction to that above described with respect to Fig. 1 and this modification differs from the device illustrated in Fig. 1 in that the distributor rotor body 21 is mounted on the outer end of a spindle 60 which is freely rotatably mounted in a double row ball bearing 62 which is sealed against lubricant leakage at its upper end. The bearing 62 is mounted in an annular flange 63 centrally located and integrally formed with a mounting disc 64 which is secured by means of screws or the like to a flange 65 formed integral with the lower casing portion 26b. The mounting disc 64 defines a partial wall inclosing a chamber 66 in the lower portion of the casing 26b which may serve as a reservoir for lubricant to supply the bearing 62 and other rotating parts. The spindle 60 is provided on its outer end with a crank disc 67 which may be splined or otherwise rigidly secured to the spindle and provided with a hemispherical bearing seat 68 which serves as a seat for the ball end 69 of an inclined crank or motion transmitting rod 70, the latter being provided with an enlarged spherical portion 72 intermediate its ends which is supported in a hemispherical bearing seat 73 formed in the casing 26b and retained by a clamping ring 74, the bearing elements 73 and 74 allowing a free oscillatory movement of the crank 70. The crank or power transmitting rod 70 is provided at its lower end with a ball 75 which is adapted to seat in a hemispherical bearing 76 provided in a crank disc 77, which is mounted on the upper end of a driving shaft 78, the latter being journalled in a sealed double row ball bearing 79 pressed into the lower portion of a housing 80, which is secured by screws or the like to the casing 26b. The interior of the housing 80 forms a chamber 81 adapted to serve as a reservoir for a lubricant which will be distributed by splashing due to the rotating parts. The casing 26b is provided with an inwardly directed annular flange 82 to which is soldered or brazed a flexible, seamless, metal bellows 83 which, in turn, is soldered or brazed to an annular washer 84 formed integral with the upper end of the power transmitting crank or rod 70. The bellows 83 serves to seal the distributor chamber 2 and hub chamber 66 against any leakage to the outside atmosphere.

In the device of Fig. 4 the rotation of the driving shaft 78 causes rotation of the crank disc 77 which will cause an oscillatory movement of the outer end of the crank or power transmission rod 70 and which, in turn, will cause a similar movement of the upper end of the power transmitting rod which will cause rotation of the

crank disc 67 and correspondingly rotating the distributor rotor body 21. The motion of the transmitting rod 78 is such that while each of its ends rotate there is no rotation of the transmitting rod 78 about its own axis so that the flexible bellows 83 are subjected to a nutating movement which is free from rotation and consequently rotation is transmitted from the shaft 78 through the wall of the casing element 26b to the crank disc 67, which drives the distributor rotor, without the use of a rotary shaft seal. This type of mechanical transmission is per se not new in the art but serves in an admirable fashion to solve the problem faced by the applicant of providing a hermetically sealed distributor. With respect to its operation, the distributor of Fig. 4, with the exception of the difference in the manner of transmitting rotation to the distributor rotor is otherwise identical with the devices of Figs. 1 and 3 above described.

With respect to the device of Fig. 4 it is to be understood that other types of mechanical transmissions may be employed in which the motion is transmitted from a driving shaft to the distributor rotor through a flexible wall or the like forming the sealing means to hermetically seal the distributor rotor chamber from leakage so long as it is not necessary to employ a rotary shaft seal.

While several preferred forms of the invention have been disclosed and described, other variations and modifications thereof will become apparent to those skilled in the art as falling within the scope of the invention as defined in the appended claims.

I claim:

1. A distributor for use in an internal combustion engine ignition system, including a housing forming a hermetically sealed distributor chamber, an input and output electrodes extending into said chamber, a distributor rotor rotatably mounted within said chamber for conducting high tension current from the input electrode successively to the output electrodes, a driving means external of said housing, and a shaftless power transmission means rotatably connecting the driving means to said rotor.

2. The structure as claimed in claim 1, in which the said distributor chamber is filled with a gas which forms a neutral atmosphere within the chamber under operating conditions.

3. The structure as claimed in claim 1, in which the housing forming the distributor rotor chamber is constructed in separable portions adapted to be assembled in gas tight sealed relation to form the hermetically sealed rotor chamber.

4. A distributor for use in an internal combustion engine ignition system, including a housing forming a hermetically sealed chamber, an input electrode and a plurality of output electrodes extending from said chamber, a rotor freely rotatably mounted within said sealed chamber and adapted to conduct high tension current from the input electrode successively to the output electrodes, a driving shaft external of said sealed chamber and a magnetic coupling drivingly connecting said driving shaft and said rotor, said coupling including a driving element connected to said driving shaft and a driven element mounted within said sealed chamber and connected to said rotor, whereby said rotor is driven in unison with said driving shaft.

5. The structure as claimed in claim 4, in which the hermetically sealed chamber is filled with a gas forming a neutral atmosphere within the chamber.

6. The structure as claimed in claim 4, in which at least one of the magnetic coupling elements is a permanent magnet.

7. A distributor for use in an internal combustion engine ignition system, including a casing forming a hermetically sealed chamber, an input electrode and a plurality of output electrodes extending from said chamber, a distributor rotor within said chamber and adapted to conduct high tension current from the input electrode successively to each of the output electrodes, an electrical self-synchronous receiver mounted within said sealed chamber and drivingly connected to the distributor rotor, a driving means external of said sealed chamber and including a self-synchronous transmitter electrically connected to said receiver by conductors passing into said sealed chamber but sealed with respect thereto, whereby said distributor rotor is driven in synchronism with the driving means.

8. The structure as claimed in claim 7, in which the said sealed chamber is filled with a gas providing a neutral atmosphere therein under operating conditions.

9. A distributor for use in an internal combustion engine ignition system, including a housing forming a hermetically sealed distributor rotor chamber, an input electrode and a plurality of output electrodes extending from said chamber, a distributing rotor in said chamber adapted to conduct high tension current from the input electrode successively to each of the output electrodes, a driven shaft rotatably mounted within said chamber and connected to said rotor to drive the same, a crank on said driven shaft, a driving shaft external of said housing, a crank on said driving shaft, an inclined rod passing through the wall of said housing into said chamber and universally pivotally connected at each end thereof respectively to said cranks, a bearing for supporting said inclined rod intermediate its ends for a limited universal oscillation and flexible sealing means connected to said rod and to the wall of said housing to permit oscillation of said rod to thereby transmit drive from said driving shaft to said driven shaft but to prevent leakage from within the said chamber externally to the outside atmosphere.

10. The structure as claimed in claim 9, in which the hermetically sealed distributor chamber is filled with a gas forming a neutral atmosphere under all conditions of operation.

11. In a distributor of the character described having a casing forming a hermetically sealed distributor chamber, a distributor rotor mounted within said chamber, a driving means external of said chamber, a power transmitting element passing through the wall of said housing into said chamber, said element being free to oscillate but restrained against rotation about its own axis, a flexible sealing element connected to said power transmitting element and to said housing to prevent leakage from said chamber to the outside atmosphere, and said power transmitting element being connected to said driving means and to said distributor rotor to transmit rotation of said driving means to said rotor.

12. A distributor for use in an internal combustion engine ignition system, comprising a housing having an input and a plurality of output electrodes sealed therein and extending into a hermetically sealed distributor chamber formed

by said housing, a high tension current distributing rotor within said chamber, a magnetic coupling element within said sealed chamber drivingly connected to said distributor rotor and another magnetic coupling element rotatably positioned exterior of said chamber and adapted to transmit a driving torque through the chamber walls to said first named coupling element to thereby rotatably drive the distributor rotor, said chamber being filled with a gas which maintains a neutral atmosphere therein under all operating conditions of the distributor.

13. A distributor for use in an internal combustion engine ignition system, comprising a housing having an input and a plurality of output electrodes sealed therein and extending into a hermetically sealed distributor chamber formed by said housing, a high tension current distributing rotor in said chamber, an electrical self-synchronous rotary motion transmitting device including a receiver drivingly connected to said distributor rotor and mounted wholly within said sealed chamber and a transmitter unit located external of said chamber and electrically connected to said receiver by conductors passing in sealed relation through the portion of said housing forming the walls of said sealed chamber, and said sealed chamber containing a neutral gaseous atmosphere.

14. A distributor for use in an internal combustion ignition system, comprising a housing having an input and a plurality of output electrodes sealed therein and extending into a hermetically sealed distributor chamber formed by said housing, a distributor rotor mounted within said chamber and co-operating with said electrodes, a portion of the wall of said chamber being in the form of an impervious flexible material capable of deflection in more than one plane but restrained against rotation, a driving means external of said chamber and means for mechanically transmitting rotation from said driving means to said distributor rotor at least in part through the medium of said flexible material, and said sealed chamber being filled with a gas providing a neutral atmosphere therein.

15. In a high tension ignition distributor of the character described, a housing forming a hermetically sealed distributor chamber, a distributor rotor freely rotatably mounted within said chamber, driving means external of said chamber, and power transmitting coupling means rotatably connecting said driving means with said distributor rotor, said power transmitting coupling means being constructed such that torque may be transmitted through the walls of said chamber without the use of a connecting shaft rotatable about its own axis and the use of a rotary shaft seal therefor.

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