Dec. 12, 1944. E. E. DREESE ET AL 2,365,064

SWITCH

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Fig. 1.

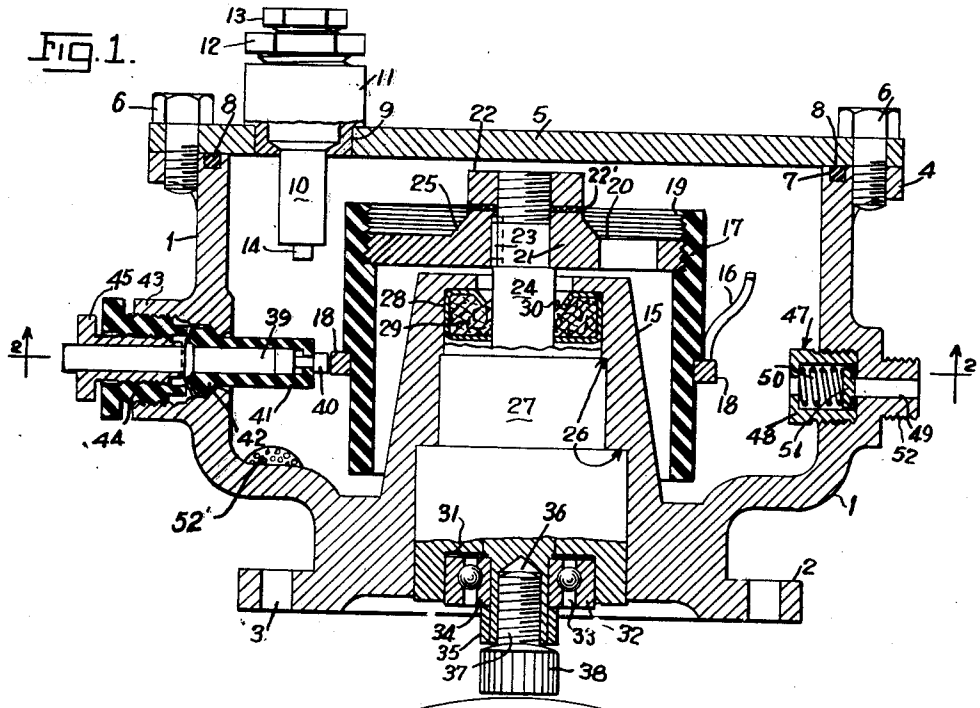
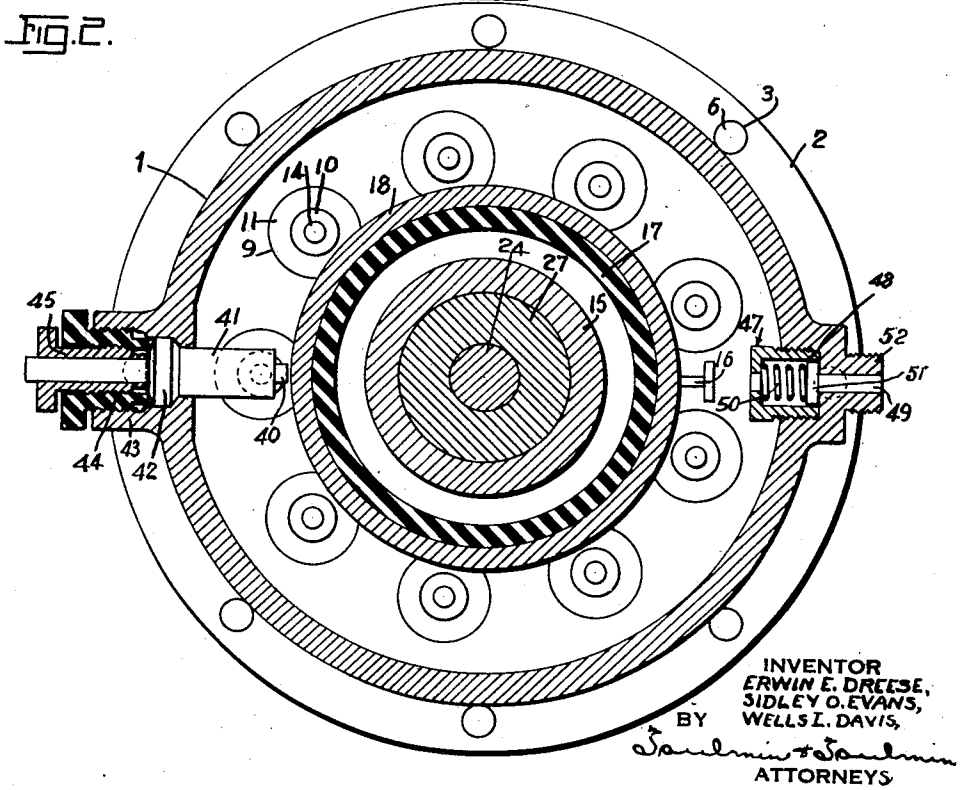


Fig. 2.



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FIG. 3.

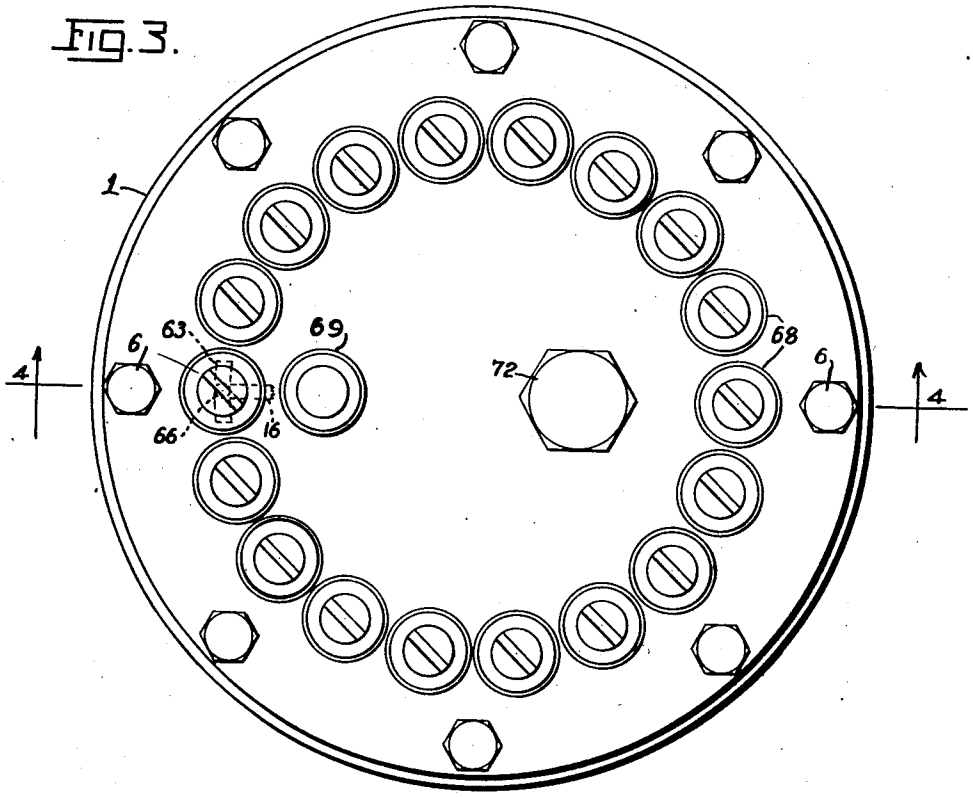
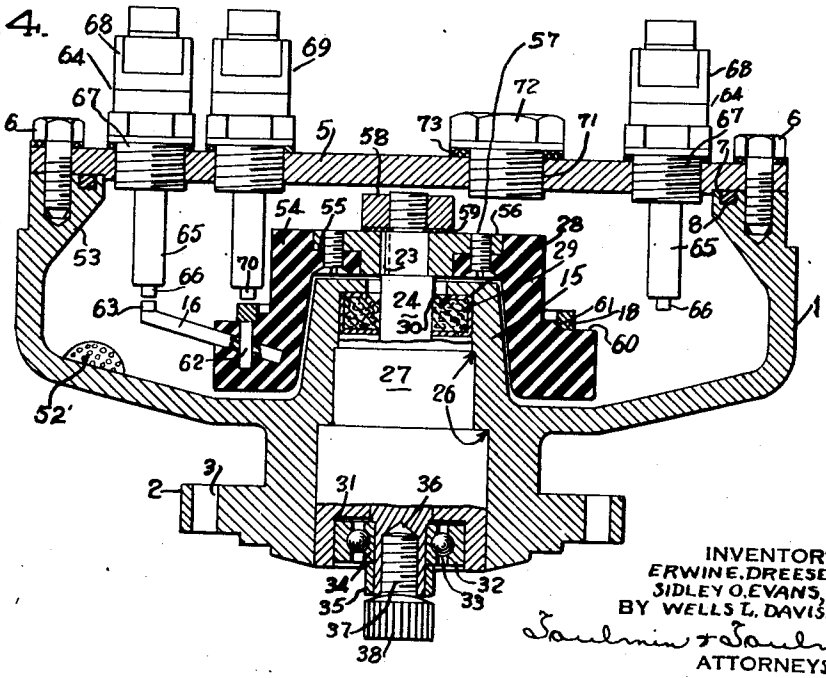


FIG. 4.



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FIG. 5

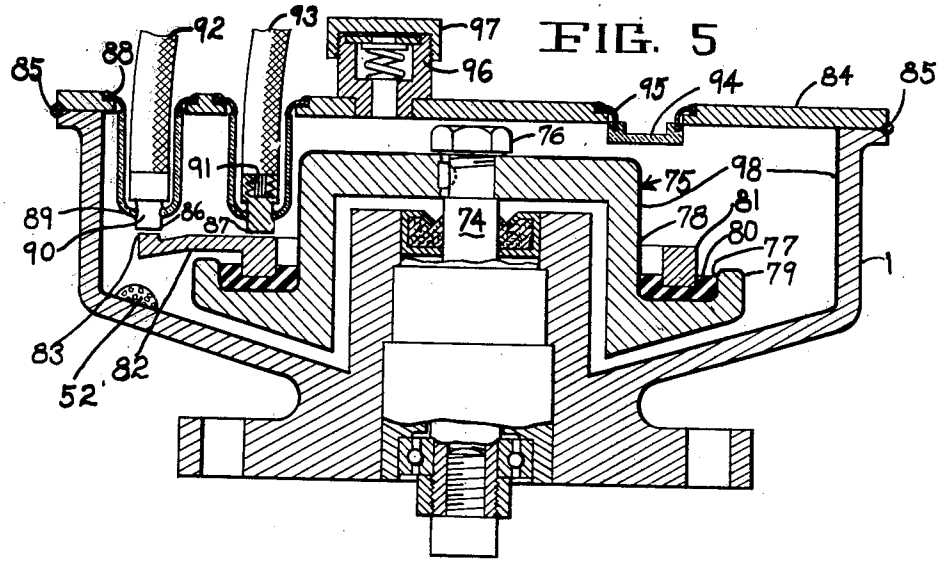


FIG. 6

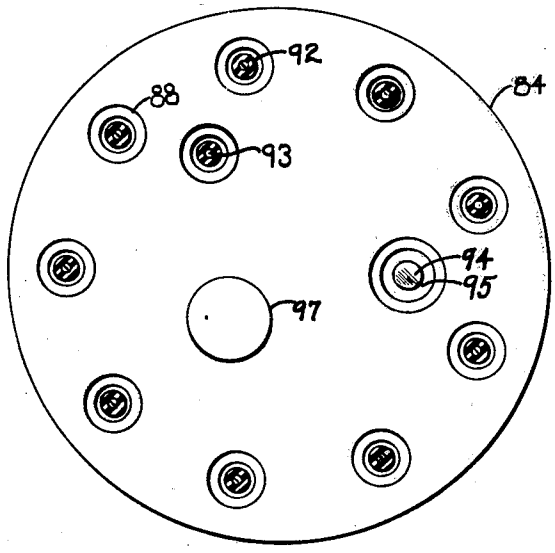
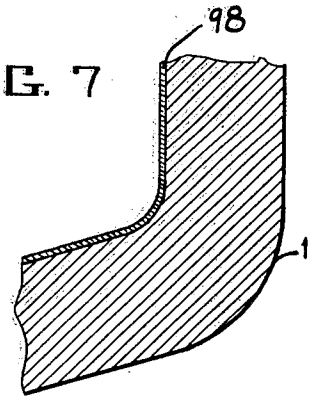


FIG. 7



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2,365,064

SWITCH

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Application June 8, 1942, Serial No. 446,264

12 Claims. (Cl. 200—24)

The present invention relates to electrical switches for distributing high voltage electrical energy to electrical circuits, and more particularly to voltage distributors for use on internal combustion engines.

Airplane engines are subjected to all kinds of weather, fast-changing atmospheric conditions and pressure, and abrupt changes in position, particularly when the plane is speedy, is a fast climber and has a high degree of maneuverability. These variations in atmospheric conditions may cause erratic performance of the engine because the condition of the dielectric material immediately surrounding the contacts and across which the current must be conducted during the sequential make-and-break operations is continually changing. Moreover, due to the non-metallic character of the ordinary distributor casing, sparks within the distributor may introduce deleterious effects in near-by radio sets. The opposite condition may also be caused, and for the same reason, in that sparks which originate exterior of the distributor, such as in the spark plugs of the engine, may deleteriously affect the sparks or sparking distance within the distributor.

The primary object of the present invention is to provide a rotary switch of rugged character which is impervious to the weather and to changes in atmospheric pressure and humidity.

Another object is to provide a distributor in which the interior thereof is physically shielded or sealed from the exterior.

Still another object is to provide an electrical distributor in which the jump spark electrodes are electrically shielded from extraneous electrical disturbances, and any near-by radio receivers are shielded from sparks present within the distributor.

Other objects are to provide a distributor mechanism including jump spark electrodes which are contained in and surrounded by fluid of constant dielectric strength, regardless of the dielectric conditions of the fluid which immediately surrounds the distributor mechanism; to provide a switch distributor which is hermetically sealed and contains either a vacuum or a suitable gas under pressure; to provide a switch distributor in which the electrodes are immersed in a chemically inert or non-ignitable gas; to provide a switch distributor contained in a hermetically sealed casing and in which a gaseous medium is introduced having a predetermined period of deionization time; to provide a rotary switch contained in a strictly hermetic casing of simple construction which may be readily assembled and disassembled for inspection or replacement purposes; to provide a casing for a rotary switch which may be made preferably of metal in order to impart ruggedness, infrangibility and electrical shielding without complicating or otherwise adding to the difficulties of rendering the casing completely air or gas-tight; to provide a distributor fabricated of air or gas-impervious material with glass-to-metal seals at the position of the leading-in conductors, and a cover hermetically sealed to the body of the distributor; to provide a rotary switch or distributor of an inexpensive character, employing a casing made of a relatively cheap metal and readily procurable sealing materials.

In carrying out the above objects we provide a distributor formed of a metal casing and containing the necessary movable and stationary contacts, the casing including improved sealing facilities and an arrangement by which an inert gas at suitable pressure may be admitted. The improved construction is such that the movable electrode may be rotated by means of a shaft which extends through the casing and is sealed within the casing. The use of a gas or other fluid within the casing lends itself to the provision by which the dielectric strength of the medium immediately surrounding the electrodes may be made greater than that of the earth's atmosphere so that increased insulating properties are obtained which permit a reduction in size and weight of the distributor. Thus another object of the invention is to provide a rotary switch or distributor which is capable of handling and translating the current and voltage values of ordinary distributors, but the size of the improved distributor may be considerably less than in the case of the earlier devices.

The invention will be better understood when the specification is perused in connection with the accompanying drawings, in which:

Fig. 1 represents a longitudinal sectional view of one form that the improved distributor may take, while Fig. 2 is a transverse sectional view taken along the line 2—2 in Fig. 1.

Fig. 3 is a plan view of a modified form of the improved distributor.

Fig. 4 is a longitudinal sectional view taken along the line 4—4 in Fig. 3.

Fig. 5 is a sectional view of still another form of the improved distributor.

Fig. 6 is a plan view of the structure shown in Fig. 5, while Fig. 7 is a fragmentary view of one portion of the casing shown in Fig. 5.

Referring to the drawings, reference numeral 1 designates a cup-shaped casing which is preferably made of a non-porous metal such as aluminum. The casing is cylindrical in shape, open at the top but closed at the bottom except for an opening which receives the actuating shaft and terminates in a flanged foot portion 2. Openings 3 are provided about the foot flange to receive bolts for securing the casing to the main casting of the engine. The upper end of the casing is provided with an outward radially extending flange or lip portion 4 on which rests a closure plate 5, preferably of metal and secured to the casing by means of a plurality of equi-distantly spaced cap screws 6.

In order to provide a strictly hermetic seal at the upper end of the casing, an annular groove 7 is formed at the upper edge surface, this groove being adapted to receive in a tight fit an annular gasket 8 of rubber-like material, such as "Neoprene." The upper surface of the gasket 8 projects slightly above the upper surface of the casing so that when the screws 6 are tightened the closure plate is clamped against the "Neoprene" gasket. The closure plate 5 is provided with a circular group of openings 9, preferably equidistantly spaced, as shown in Figure 2, and adapted to receive porcelain-supported electrodes. Each of these members, of which only one has been typically illustrated in Figure 1, may comprise a porcelain column 10 which is supported by a bushing 11 of any suitable material, this bushing having a shouldered portion which fits snugly within the openings 9 of the cover plate.

The bushing 11 has a recessed bore which is threaded to receive the threads of an outer sleeve nut 12. The latter, in turn, is provided with a threaded bore into which an inner sleeve nut 13 may be screwed. The sleeve 13 is adapted to receive an insulated cable, the end of which has been bared to expose the conductor, and the latter is soldered or otherwise secured to a hardened metal electrode 14. The electrode extends for a short distance below the porcelain column 10. The arrangement is such that when the outer and inner sleeves 12, 13 have been tightened the cable is held snugly within the terminal as a whole. It will be understood that as many of these electrodes are provided as are necessary to accommodate the cylinders of a combustion engine to which high voltage is to be distributed in a predetermined sequence.

The lower or base portion of the casing 1 is provided with an integral projection 15 which may be reentrant and of a conical configuration, positioned in the center of the casing and serving as a support for a bearing for the shaft which actuates the movable electrode. The latter is designated 16 and is constituted preferably of a metal rod which extends upwardly and outwardly from a cylinder 17 made of any suitable insulating material, such as a ceramic, but preferably formed of a resinous plastic which is sold on the market as "Textolite." The movable electrode pin 16 is supported on the cylinder 17 by means of a metal ring 18 which extends around and is embedded within the material of the cylinder 17. The height of the electrode 16 is such that when the cylinder is rotated, in a manner to be explained hereinafter, the upper surface of the electrode just barely clears the lower surface of each of the stationary electrode members 14.

The cylinder 17 is hollow and of such size as readily to clear the conically shaped projection 15. The upper end of the cylinder is provided with a threaded bore 19 which receives the threads of an exteriorly threaded circular plate 20. The bore 19 terminates at the bottom in a shoulder on which the plate 20 is seated. The latter is provided with a centrally positioned hub 21 which is keyed, as indicated at 23, to a shaft 24. The upper end of the shaft is threaded for receiving a nut 22 and a washer 22', which secure the shaft and plate 20 together. A rotary movement of the shaft will therefore impart motion to the cylinder 17 and the electrode mounted thereon.

The shaft 24 is taken through the lower end of the casing in any suitable manner, which will provide a frictionless bearing and a hermetic seal. An exemplary form of sealed ball bearing is illustrated in Fig. 1, but it will be understood that any and all types of suitable bearings may be employed for this purpose. As illustrated, the reentrant projection 15 is provided with an interior stepped bore to leave a number of shoulders, indicated at 26, against which is pressed, by means of a tight fit, a cylindrical multi-shouldered bearing and seal unit given the general reference numeral 27. The upper end of the shaft 24 is received by a self-lubricating bearing 28 which is contained within an annularly shaped metal matrix 29. The material 28 may constitute pieces of textile or leather, held together by a ceramic or plastic. The bearing may be given an inverted conical configuration at the top, indicated at 30, for receiving a spring washer which bears against the shaft and serves to prevent the movement of fluid along the shaft.

The lower end of the bearing unit 27 is counterbored, as indicated at 31, to receive the outer and stationary race 32 of a ball bearing indicated generally at 33. The inner race 34 of the ball bearing is seated against a shoulder on the shaft 24 and is held in position by a sleeve 35 driven with a tight fit onto the shaft. The latter at its lower end is provided with a counterbored threaded opening 36 which is adapted to receive the threaded shank 37 of a cap screw 38. The head of the latter is provided with splines which engage the splines of an actuating rod (not shown) mechanically connected, in any suitable manner, to the crankshaft of the engine. Thus as the latter is rotated the rotary effort is transferred through the cap screw 37 to the shaft 24 so that the cylinder 17 and the pin 16 carried thereby are rotated within the casing. It has been pointed out that a seal of any suitable type and in as many sections as are necessary may be provided about the shaft 24 so that the rotary effort is communicated to the cylinder 17 through a sealed bearing.

In order to charge the electrode 16 with high voltage, a conductor 39 of any suitable metal may be inserted at the side of the casing, this conductor terminating at its inner end in an extended portion 40. The latter is brought as close to the ring 18 as possible without actually causing frictional contact. The conductor 39 is secured within the casing by a hermetic seal which will now be described. A porcelain column 41 immediately surrounds the conductor and extends into the interior of the casing as far as the portion 40. The column 41 also extends into the material of the casing in order to reduce the possibility of short-circuiting or grounding effects. The porcelain column terminates at its outer end in an enlarged head portion 42 which is seated on the shoulder of a counterbored opening formed in the casing 1. The latter is provided with an out-

wardly extending boss 43 at the position of this opening, the boss being interiorly threaded to receive a sleeve screw 44 of a suitable insulating material, such as "Textolite," which is adapted to bear against the head portion 42 of the column 41. A smaller sleeve screw 45, preferably of metal, is provided within the screw member 44 in order to maintain the conductor 39 rigidly in position. When the screws 44 and 45 have been tightened the porcelain column is caused to bear tightly against the casing and a hermetic seal is provided for the conductor 39.

High voltage is supplied to the conductor 39 from the spark coil accessory of the engine, and assuming that the cylinder 17 has been caused to rotate by the rotation of the shaft 24, high voltage is transferred from the conductor portion 40 to the annular ring 18, across the small gap between the last-mentioned elements. This high voltage is therefore available at the rotating electrode 16. As the latter moves past each of the electrodes 14 in succession, high voltage is transferred to these electrodes so that electrical impulses are transmitted through their respective cables and thence to the spark plugs. It will be noted that the conductor 39 constitutes the high voltage side of the circuit and for that reason is well insulated from the metal casing 1 by means of the porcelain column 41 and the insulating bushing 44. The porcelain column 10 serves to insulate the entire length of each electrode 14 from the casing except for a short exposed portion in order to prevent a direct short-circuit between the conductor 39, or any part thereof, and the casing 1.

A metal casing such as described is not only inexpensive to make, since it is constituted solely of a casting and a closure plate, but serves the important function, when made of a magnetic metal (such as cast iron), of magnetically shielding the switch points within the casing from extraneous electrical disturbances, for example, sparks which originate at the vibrator of the spark coil or at the spark plugs. Consequently, the switching mechanism is both magnetically and electrostatically shielded from extraneous electrical disturbances, and also external electrical apparatus is shielded from sparks occurring within the distributor. Therefore the metal type of distributor provides a better operation over distributors in which the casing is made of a non-magnetic insulating material.

Other advantages of the metal distributor over a device which is formed of a molded plastic material are:

1. The difficulty in making a complex molded plastic part is eliminated.

2. The possibility of disturbing mechanical tolerances and clearances by warping of molded parts is eliminated. Therefore mechanical tolerances may be held much closer, thus permitting the use of fluids of higher dielectric strength. In this way electrical clearances may be reduced, and size and weight of the distributor will be reduced.

3. A metal distributor is easier to seal than a plastic one. If the seal be effected by a gasket, metal parts deflect less than plastic parts under load and hence are less likely to leak. Metals can be soldered, brazed or welded, and plastics cannot.

4. A metal distributor provides its own metallic shielding with respect to electrical disturbances which originate within and without the casing.

5. Possible contamination of the sealed-in fluid by plasticizers or gases from the plastic is eliminated.

6. Metal distributor cases may be made of machined castings, die castings or by pressing or stamping operations. The kind of metal may be any metal selected because of its strength, weight, chemical and processing characteristics.

7. There is no danger of "tracking" of the casing material if an occasional arc-over should occur, as there might be when the solid insulating parts of the distributor are made of other than a ceramic material.

In the operation of aircraft at high altitudes there is much difficulty in operating the conventional type of distributor. Low atmospheric pressure, moisture and other atmospheric conditions cause arcing to ground and to the wrong electrodes, thus causing misfiring of the engine and other deleterious effects. In accordance with the principles of the invention, these difficulties are eliminated by surrounding the operating parts of the distributor mechanism by an insulating medium of constant dielectric and chemical properties. For this purpose any non-combustible gas, such as carbon dioxide or any of the chemically inert gases, such as argon, neon, etc., may be introduced into the casing 1 at a pressure which depends on the voltage being handled by the distributor, the distance between the various electrodes and the dielectric strength of the insulation members. This pressure may vary considerably, but in general, we prefer to use a pressure slightly above atmospheric and in particular a pressure differential between the interior and exterior medium of eight to ten pounds per square inch at sea level.

For this purpose a check valve, indicated generally by the reference numeral 47, may be provided in the casing. This valve may take any suitable form, but as illustrated consists of a sleeve 48 of metal which is threaded into the casing and has a shouldered bore at the interior. This bore communicates with an opening 49 which extends transversely of the casing through a thickened portion thereof, as illustrated. There is a compression spring 50 contained within the enlarged bore of the sleeve 48, this spring pressing against a solid washer 51 which abuts the inner surface of the casing. A threaded projection 52 is provided on the casing to receive a conduit (not shown) leading to a tank of suitable gas. When the gas is released from the tank (through valves not shown) the washer 51 is caused to move against the spring, thus bringing the opening 49 into communication with the interior of the casing so as to permit entry of the gas. A tank containing gas under a predetermined pressure may be permanently screwed onto the casing automatically to admit gas from time to time, and thus to keep the gas pressure within the casing absolutely constant. When the supply of gas is stopped, spring 50 forces the washer 51 against the casing to close the opening 49 and to hermetically seal the same.

Instead of introducing inert gas within the casing, we may simply admit air at suitable pressure, in which case the corrosion effects of oxygen or its derivatives may be minimized or eliminated by the inclusion of a chemical scavenger of suitable properties and confined within a perforate inclosure indicated at 52'. For example, metallic iron in powdered form, and particularly when heated, may be employed chemically to combine with the oxygen, or activated charcoal may be used to adsorb the oxygen. Consequently, in the case of air being admitted to the casing, the contents of the casing are mainly nitrogen which

serves the same function as the other gases referred to hereinbefore.

If desired, the interior of the casing can be evacuated before the inert gas is supplied, or the latter may be introduced by displacing the air within the casing. Obviously gases at attenuated pressure, i. e., less than atmospheric pressure, may be sometimes employed to advantage, depending on the electrical and insulating requirements of the distributor. Under some conditions insulating liquids may be introduced into the casing rather than gases, particularly when the voltages being handled are less than those which cause the liquid to disintegrate and to form gases. In such case, the currents might be distributed by capacitive effect between the electrodes. But regardless of the character of the gaseous or liquid fluid contained within the casing, the insulating properties of that fluid will not change with variations in outside atmospheric conditions, so that the arcing or sparking break-down potentials at the electrodes 40 and 14 always remain constant even though the engine is operated at one time under atmospheric conditions which prevail on the ground and then at another time under conditions which prevail in the stratosphere.

While we have described the use of the insulating medium of constant dielectric properties in connection with a metal casing, it is apparent that the advantages of a constant dielectric may be obtained when a casing of ceramic material is employed provided that the material is not of a porous character. In such case the insulation immediately surrounding the high potential conductors 14, 39 need not be as effective as in the case of the metal casing since the ceramic or plastic material is an insulator. However, we prefer to employ metal for the casing since it offers all of the advantages of a plastic material insofar as a hermetic seal is concerned, and in addition provides magnetic and electrostatic shielding.

It is evident that if desired we may introduce into the ceramic casing a fluid, gaseous or liquid, whose dielectric strength is greater than that of the earth's atmosphere, and this increase in dielectric strength may be obtained either by reason of the nature of the material, as in the case of a liquid, or by properly regulating the pressure of the material, in the case of a gas. Thus it is possible to reduce the size and weight of the distributor by this means since the increased insulation necessary when the casing is reduced in size may be supplied by the fluid itself.

The modified structure shown in Figs. 3 and 4 differs from that illustrated in Figs. 1 and 2 mainly in positioning the side electrode in the top cover, and also in providing a greater number of electrodes than in Fig. 1 to which the high potential is distributed. Thus the distributor of Figs. 3 and 4 is better suited to engines having a greater number of cylinders than in the case of the structure shown in Figs. 1 and 2. In Figs. 3 and 4 similar reference numerals have been employed to designate the corresponding elements found in Figs. 1 and 2. The casing 1 of Fig. 4 differs slightly from the corresponding casing shown in Fig. 1 in that there are no openings in the side of the casing for the introduction of the high potential lead and the gas inlet valve, and the casing is also provided with an upwardly and inwardly extending portion 53 which is sufficiently thick to accommodate the cap screws 6, thus eliminating the necessity for a flange 4 (Fig. 1).

The cylinder or rotor 54, which is carried on the shaft 24, is somewhat different from that shown in Fig. 1 in that the upper part of the rotor is provided with a shoulder 55 which rests on the flange of a retaining plate keyed to a turned-down portion of the shaft 24. Machine screws 57 are provided for securing the rotor 54 to the plate 56. The upper end of the shaft 24 is threaded to receive a nut 58 and washer 59 for locking the plate 56 endwise on the shaft. The annular conducting ring 18 is supported on a flanged seat 60, and is held in position by a shoulder 61 provided on the rotor. The electrode or pin member 16 extends outwardly from the rotor 54, as shown, and is preferably molded in position in the material of the rotor. The electrode at its lower end is electrically connected, in any suitable manner, to a vertical wire rod 62 which is also molded in the material of the rotor and makes contact with the annular ring 18. The electrode member 16 terminates in a head 63, and directly above this head and spaced equi-distantly about the closure plate 5 there is a plurality of electrode terminals, generally designated 64. These electrodes may be constructed similarly to those described in connection with Fig. 1, and in general employ a porcelain column 65 which surrounds a wire rod 66, of which only the lower portion extends beyond the column. The wire rod 66 is insulatingly carried within a screw member 67 which is threaded in the closure plate, and above the screw member there is a structure 68 which is designed to receive and clamp the metal end of an insulating cable (not shown) which leads to one of the spark plugs of the engine.

As illustrated in Fig. 3, there are eighteen of these electrodes provided in the closure member 5, so that the distributor shown in Fig. 4 is adapted to supply and distribute high potential current to the spark plugs in any desired sequence. The metal tips 66 are so arranged that the head 63 will present itself directly under each of the tips in succession as the rotor 54 is rotated by the shaft 24, and only the smallest space is left between the members 63, 66 to preclude frictional contact. The high potential current is supplied to the annular ring 18 through a single porcelain electrode terminal, indicated generally at 69, which may have the same construction as the terminal 64. A wire cable is inserted in the upper end of the terminal 69, as is well known in the art, and current at high potential is delivered through the terminal to the metal tip 70 which is positioned directly above and almost contacts the annular ring 61.

The gas or other dielectric fluid may be introduced into the casing through a threaded opening 71, employing any suitable form of check valve, one example of which is shown in Fig. 2, and the threaded opening may be later closed by a cap screw 72 provided with a suitable gasket 73. If desired, the check valve may be left in position in the cover to make permanent connection with a gas supply source in order automatically to maintain the gas pressure within the container absolutely constant. However, it has been found that when gas at proper pressure is introduced into the casing, if the latter has been made strictly hermetic by the gasket 8 and leakage around the electrode terminal 68 has been eliminated, the check valve may be removed and the cap screw inserted into the threaded opening 71 to prevent even the slightest reduction in pressure of the contained gas.

The casing shown in Fig. 4 may contain any of

the gases or fluids which are described in connection with Fig. 1 in order to increase the dielectric or insulating effects within the casing. The latter, instead of being formed of cast iron as in the case of Figs. 1 and 2, may be cast from aluminum in order to reduce weight, and the cover plate **5** may be made of aluminum or a stronger material, such as iron or steel. The structure shown in Fig. 4 has the advantage over that illustrated in Fig. 1 in that all of the machine work necessary to accommodate the electrode terminals **64**, **69**, also to accommodate the fluid-introducing check valve, is done on a single part of the distributor, i. e., the closure plate. The aluminum casting **1** can therefore be inexpensively made since it contains no openings except those required for the cap screws **6** and the openings **3** for bolting the distributor onto the engine. The aluminum casing **1** serves electrostatically to shield all of the interior conducting parts from extraneous electrical disturbances, and to shield the exterior apparatus from the sparks originating within the casing.

In Figs. 5, 6 and 7 we have shown various other changes that could be made in the improved distributor within the concept of the present invention. The structure shown in Fig. 5 differs from that illustrated in Fig. 4 in that it eliminates the cap screws **6**, so that the closure plate is welded to the casing and glass-to-metal seals are employed at positions where the electrode terminals enter the casing through the closure plate. The casing **1** is similar to the corresponding element shown in Fig. 4 except that it is made of a metal which may be readily welded, soldered, brazed or roll-welded, and the upper end is provided with a flange to facilitate the welding operation. The central part of the casing is practically the same as that shown in Fig. 4 in that it provides for a hermetically sealed bearing which carries a shaft, indicated at **74**. The shaft, at the upper end, is keyed to a rotor **75** preferably made of steel, the latter being secured to the shaft in the axial direction by a nut **76** which is threaded on the shaft.

The steel rotor **75** is provided with an annular groove **77** formed between the hub **78** and the annular lip **79**. Within the groove **77** there may be provided any suitable and well known form of insulating plastic **80** which is adapted to receive and permanently fix in position and insulate an annular metal ring **81** which serves the same purpose as the ring **61** shown and described in connection with Fig. 4. A metal arm **82** is integrally joined to the annular ring **81**, this arm terminating in an upwardly extending electrode **83** which is positioned directly under one of a series of electrodes which are provided in the closure plate **84**. Nine of these electrodes are shown to indicate that the distributor is employed in connection with a nine-cylinder engine. The closure plate **84** is made of a weldable or otherwise fusible metal, and it will be noted that a small annular groove is provided at the periphery of the closure plate and of the casing to receive the weld metal, indicated at **85**. Directly above the annular ring **81** there is an electrode terminal secured to the closure plate **84** through a glass-to-metal seal, and serving to supply high potential current to the annular ring and thence to the arm **82**, from which it is distributed to the various electrodes directly above the electrode **83** as the element **75** is rotated.

The electrodes **86**, **87** are preferably supported on the closure plate by glass-to-metal seals in order to assure a perfect hermetic joint. As illustrated, each of these seals may include a metal ring **88**, welded, soldered, brazed or roll-welded to the closure plate and extending into the casing through an opening in the plate. A piece of glass tubing may be sealed onto the end of the metal ring **88**, this glass being especially made so as to have the same coefficient of expansion as the metal of the ring **88**. It is well known that alloys of iron, nickel and cobalt can be matched from the thermo-expansion standpoint, with certain kinds of boro-silicate glass. The lower end of the glass tubing **89** is drawn inwardly to provide a seat on which is supported a metal member **90** which projects downwardly through the opening left in the tubing. A tight fit is provided between the glass tubing and the metal member **90** so that the two elements can be fused together to form a hermetic seal, as is well known in the art. The metal member **90** may also be made of a "fernico" alloy. The metal member **90** extends upwardly into the reentrant space formed within the tubing **89**, and is provided with a countersunk opening **91** which is threaded to receive the threaded end of a cable, on which the insulating covering is indicated at **92**. The high potential supply wire **93** may also be led into the casing through a glass-to-metal seal similar to that described in connection with the cable **92**.

In view of the fact that the closure plate **84** and the casing **1** are welded together, it may be desirable to provide a window, indicated at **94**, to observe the operation and adjustment of the various parts, particularly the space between the lower ends of the electrode terminals **92**, **93** and the electrode **83** and annular ring **81**, respectively. This window may be secured to the closure plate by means of a glass-to-metal seal, in which the window is formed of glass or other transparent material, and is fused to the "fernico" ring **95**. The "fernico" ring **95**, is, in turn, fused to the cover plate by means of welding or other suitable operation. A suitable opening is provided in the cover plate for this purpose. A check valve **96**, similar to that described in connection with Fig. 1, may also be provided on the closure plate in order to permit the admission of a gas or other fluid into the casing so as to increase the dielectric effects within the casing. In Fig. 5 the check valve is closed by a metal cap **97**, thus effectively sealing the valve. In this distributor, in which both the casing and rotor are made of metal, it may be advantageous to partially coat the metal with a ceramic **98**, such as enamel, which has high dielectric strength. This increases the insulation between parts at ground potential and those at high potential, thus permitting smaller clearances and hence a smaller distributor.

It is evident that while we have shown and described the electrodes as being secured within the casing by glass-to-metal seals, these electrodes may, if desired, be held in position in the same manner as was described in connection with Figs. 1 and 4, i. e., without the use of glass-to-metal seals. However, these seals, together with the welded joint indicated at **85**, are intended to prevent leakage of gas or other fluid from the container, even when the pressure of the fluid was considerably above or considerably below atmospheric pressure. It is also evident that if desired we may entirely eliminate the window **94**, or place this window at any desired position within the casing itself rather than in

the closure plate, and the same change in position applies to the check valve 96.

From the foregoing it is evident that we have disclosed an improved form of distributor which may be made of metal or plastic material, and provides uniform operation regardless of variations in the outside atmospheric conditions. When the casing is made of metal, the additional advantages of enhanced electrostatic and electromagnetic shielding are obtained, as well as certain advantages by way of manufacturing costs.

It will be understood that we desire to comprehend within our invention such modifications as come within the scope of the claims and the invention.

Having thus fully described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A distributor for combustion engines comprising a hermetically sealed metal casing formed of a cup-shaped element, a closure plate for covering the open end of said element, a journal formed at the closed end of said element and comprising a reentrant portion, a shaft extending through said journal and being hermetically sealed with respect to said casing, a rotary member within said casing and carried by said shaft, a rotary electrode mounted on said rotary member, a plurality of stationary electrodes secured to said casing and adapted to be presented to said rotary electrode when said shaft is rotated, means for supplying current at high potential to said rotary electrode, and a fluid of predetermined dielectric strength contained within said casing and surrounding said electrodes.

2. A distributor for combustion engines comprising a hermetically sealed metal casing formed of a cup-shaped element, a closure plate for covering the open end of said element, a journal formed at the closed end of said element and comprising a reentrant portion, a shaft extending through said journal and being hermetically sealed with respect to said casing, a cylinder within said casing and carried by said shaft, a rotary electrode mounted on said cylinder, a plurality of stationary electrodes secured to said casing and adapted to be presented to said rotary electrode when said shaft is rotated, means for supplying high voltage current to said rotary electrode, said means comprising an annular ring secured to said cylinder and connected with said rotary electrode, and a conductor hermetically sealed in the side of the casing but insulated therefrom, said conductor being adapted to present current at high potential from an exterior source of voltage to said annular ring.

3. A switch comprising a hermetically sealed casing containing rotary switch mechanism and an inert gas, the interior of said casing being coated with a material of high dielectric strength.

4. A switch comprising a hermetically sealed casing containing a switch element carried on a rotor, said element cooperating with stationary switch elements secured to said casing, and a coating of material of high dielectric strength on said rotor.

5. A switch comprising a hermetically sealed casing containing a switch element carried on a rotor, said element cooperating with stationary switch elements secured to said casing, and a coating of enamel of high dielectric strength on said casing and on said rotor.

6. A distributor for combustion engines comprising a casing containing a movable electrode member and a plurality of stationary electrodes, said movable electrode member being carried on a rotor, and a shaft projecting through said casing in a gas-tight manner to actuate said rotor whereby the movable electrode is moved successively past said stationary electrodes, said rotor being formed of metal and provided with an annular depression for receiving an insulating material in which a metal annular ring is embedded, said movable electrode being electrically connected to said annular ring.

7. A distributor for combustion engines comprising a metal casing and a metal cover plate, a plurality of high potential-receiving electrodes and a high potential-supplying electrode, all insulatingly mounted on said cover plate by means of glass-to-metal seals, and means within said casing for distributing the high potential from said supply electrode to the receiving electrodes in a successive manner.

8. A switch comprising a metal casing closed at one end and provided with a reentrant metal portion, the other end of the casing being open, a closure plate for covering said open end, electrodes on said plate, said reentrant portion being hollow and adapted to receive a sealed bearing, a shaft within the bearing, a rotor carried on said shaft and surrounding said reentrant portion, and an electrode secured to said rotor and adapted to transmit high potential current to the electrodes on the closure plate when the rotor is rotated by said shaft.

9. A switch comprising a metal casing closed at one end and provided with a reentrant metal portion, the other end of the casing being open, a closure plate for covering said open end, a hollow rotor surrounding said reentrant portion, an electrode secured to said rotor, a plurality of electrodes secured to said closure plate, conductor means for supplying high potential to the rotor electrode, and conductors for withdrawing high potential current from the electrodes in said closure plate as the last-mentioned electrodes are successively charged by the electrode on the rotor when the latter is rotated.

10. A switch comprising a metal casing closed at one end and provided with a reentrant metal portion, the other end of the casing being open, a closure plate for covering said open end, electrodes on said plate, said portion being hollow and adapted to receive a sealed bearing, a shaft within the bearing, a rotor carried on said shaft, said rotor comprising a hollow cylindrical element of insulating material which surrounds said portion, and an electrode secured to said rotor and adapted to transmit high potential current to the terminals on the cover plate when the rotor is rotated by said shaft.

11. A switch comprising a metal casing closed at one end and provided with a reentrant metal portion, the other end of the casing being open, a closure plate for covering said open end, electrodes on said plate, said portion being hollow and adapted to receive a sealed bearing, a shaft within the bearing, a rotor carried on said shaft, said rotor comprising a hollow cylindrical element of insulating material which surrounds said portion, and an electrode secured to said rotor and adapted to transmit high potential current to the electrodes on the cover plate when the rotor is rotated by said shaft, said casing containing a dielectric fluid at a predetermined pressure.

12. A switch comprising a metal casing closed

at one end and provided with a reentrant circularly shaped metal portion, the other end of the casing being open, a closure plate for covering said open end, electrodes on said plate, said portion being hollow and adapted to receive a sealed bearing, a shaft within the bearing, a rotor carried on said shaft, said rotor comprising a hollow cylindrical element of insulating material which surrounds said portion, and an electrode secured to said rotor and adapted to transmit high potential current to the electrodes on the cover plate when the rotor is rotated by said shaft, said casing containing carbon dioxide at a pressure differential of 8 to 10 pounds per square inch greater than atmospheric pressure at sea level.

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