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VENTILATED TERMINAL IGNITION DISTRIBUTOR CAP

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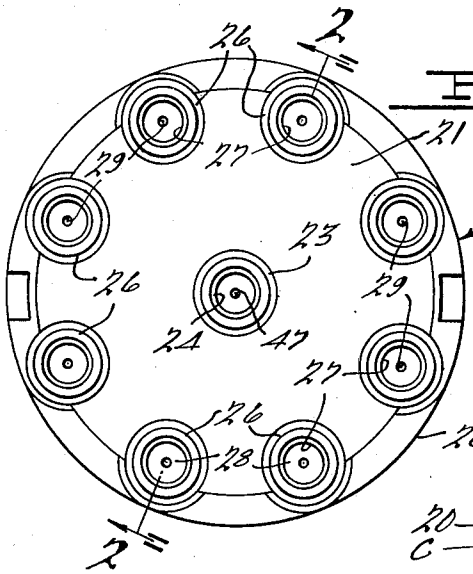


Fig. 1.

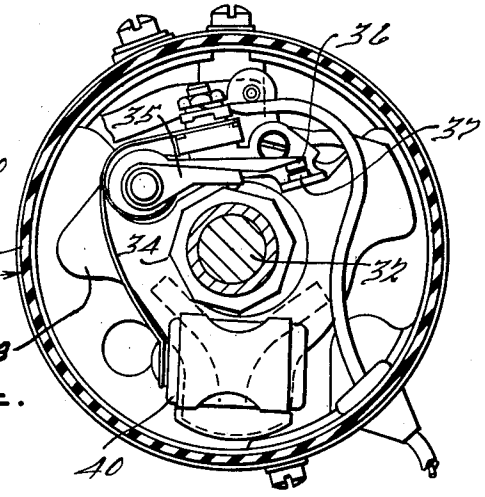
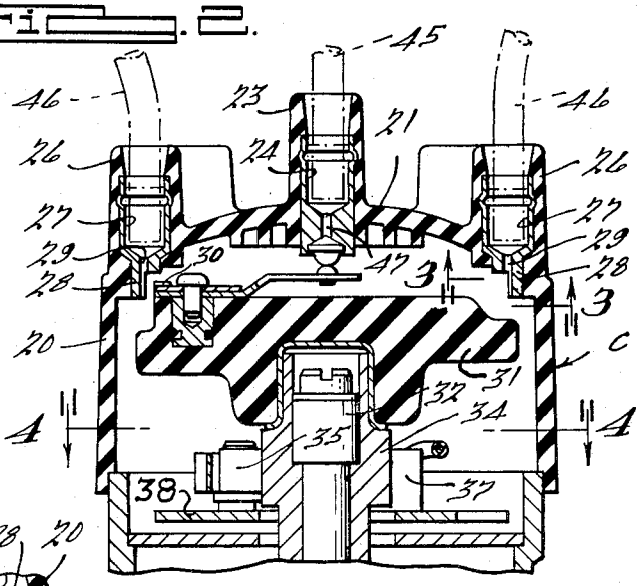


Fig. 4.

Fig. 2.



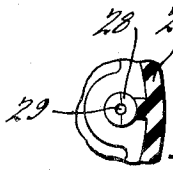


Fig. 3.

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VENTILATED TERMINAL IGNITION DISTRIBUTOR CAP

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This invention relates to internal combustion engine ignition distributor caps and particularly to a ventilation means for the cap interior to materially extend the life of the cap to prevent failure of the cap during high humidity engine operation.

There has been a long existent and bothersome problem of hard engine starting, particularly during rainy spells or under high humidity operating conditions, which problem has been found to center in the ignition distributor. This problem has been aggravated in certain vehicle installations due to the fact that the distributor location in the vehicle engine compartment may have very little road water splash protection and/or air inlet apertures or ducting for the engine compartment tend to pass large volumes of moisture saturated air around the distributor unit such that moisture is deposited on the exterior of and introduced to the interior of the distributor cap. As a result of extensive tests run on distributor caps that were associated with hard engine starting problems, it has been determined that distributor cap conductivity resulting from deterioration of the interior surface of the phenolic cap material was a major cause of hard engine starting. This cap surface deterioration results in the cap interior surface becoming easily wetted by moisture in the surrounding air. When the interior surface of the distributor cap becomes wetted a conductive film may be established that shorts out adjacent spark plug terminals of the distributor cap and prevents the cap from functioning in its intended manner. Not only does the moisture film on the cap's interior surface reduce the resistance of the cap, but in addition the moisture laden air within the cap fosters the formation of acids that attack the cap's spark plug terminals and produce conductive salts that are deposited on the cap's interior. The aforedescribed deteriorating action on the cap interior occurs in the following manner. The high voltage sparking which normally occurs within the distributor cap results in the formation of nitrogen oxides due to breakdown of the air within the cap. These oxides in the presence of any water inside the cap form nitric acid. Nitric acid and ozone, which is formed by the sparking occurring within the cap, cause deterioration of the phenolic cap material. Nitric acid attacks the aluminum or other metal spark plug terminal inserts which results in the formation of conductive salts within the cap.

In almost all cases of cap failure, a white deposit could be observed in varying amounts on the inside of the cap. This deposit when analyzed spectrochemically and by X-ray diffraction proved to be beta-$Al_2O_3.H_2O$, beta-$Al_2O_3.3H_2O$ and $Al(NO_3)_3.H_2O$. This was not unexpected and was easily explainable. Nitric acid is formed by electrical discharge through moist air within the cap, according to the following chemical reaction.

$$N_2+O_2 \rightarrow 2NO$$
$$2NO+O_2 \rightarrow 2NO_2$$
$$3NO_2+H_2O \rightarrow 2HNO_3+NO$$

The nitric acid thus formed is able to attack the aluminum or other metal spark plug terminal inserts of the distributor cap, and nitric acid being an oxidizing agent, may oxidize the aluminum or the other metals to one of its oxide forms, or may directly combine with the aluminum or other metals to form the nitrate thereof.

As indicated from the foregoing description, distributor cap failure is due to two specific factors namely (1) chemical decomposition of the organic cap material and (2) formation of highly conductive salts on the inside of the cap. After running numerous distributor caps to failure, it was evident that cap failure occurred in stages and these stages could be directly related to the wettability of the cap. If steam is allowed to condense in a new cap, tiny water beads form on the cap surface, but as the resistance of the cap decreases, the water droplets enlarge and finally the cap surface is wettable. The water is then able to form a continuous layer over the interior surface of the cap and, water being conductive, will conduct electricity across the surface of the cap and between the terminals thereof. Subsequently, it is only a matter of time before the cap surface is tracked by carbon paths and the cap fails completely. In a like manner, any salt formations that are formed within the distributor cap, such as aluminum nitrate, provide conductive paths and accelerate the time to cap failure after the cap has become wettable.

To prevent the occurrence of wettability of the cap interior and to prevent the formation of detrimental salts or other deposits on the cap interior surface and/or on the distributor ignition contact points located within the distributor cap, it has been found that ventilation of the cap interior by means of relatively small bores that pierce the spark plug terminals of the cap has provided a novel and satisfactory means for overcoming most hard starting problems associated with the ignition distributor. Not only does this ventilation means overcome the hard starting problem but it has also been found that the life of both the cap as well as the distributor contact points and the associated condenser element are materially increased. Furthermore this improvement is simple and economical to achieve in existing distributor caps.

Now looking at the drawings:

FIG. 1 is a top plan view of a distributor cap for an eight cylinder spark ignition internal combustion engine;

FIG. 2 is a sectional elevational view taken along the line of and in the direction of the arrows 2—2 of FIG. 1;

FIG. 3 is a fragmentary sectional elevational view taken along the line of and in the direction of the arrows 3—3 of FIG. 2; and

FIG. 4 is a sectional elevational view taken along the line of and in the direction of the arrows 4—4 of FIG. 2.

The distributor cap C embodying this invention comprises a cup-shaped housing element 20 formed of an insulating plastic material such as a phenol-formaldehyde resin. The closed bottom end 21 of the cup 20 has a centrally positioned tower 23 projecting outwardly therefrom. This central tower 23 has seated therein and projecting through the cup bottom 21, a tubular contact terminal 24. Terminal 24 is adapted to receive one end of a wire conductor element 45 that is adapted to be connected to the high tension winding of an ignition coil (not shown). Extending about the periphery of the cup bottom 21 and projecting outwardly therefrom are eight circumferentially spaced towers 26 that each seat a tubular contact terminal 27. Tubular contacts 27 receive the ends of condutcor cables 46 that are connected to the spark plugs (not shown) of the associated internal combustion engine. The rod-like, inner or lower ends 28 of the terminals 27 project through the bottom 21 of the cup 20 to provide stepped terminal portions. These stepped terminal portions 28 are pierced by longitudinally extending bores 29 that provide the ventilation ducts or passageways for permitting elimination of moisture from within the distributor cap. Contact portions 28 are positioned for intermittent spark connection with the contact portion 30 of the distributor rotor 31. Rotor 31 is carried

by rotor shaft 32 that is drivingly connected to the associated engine camshaft (not shown).

Mounted on the upper end of rotor shaft 32 is an eight-sided cam 34 that is engaged by the pivotally mounted, spring-pressed, follower arm 35. Follower 35 carries one contact 36 of the set of distributor breaker plate contact points. The other contact 37 of the set is fixedly mounted on the breaker plate 38. A condenser element 40 is also fixedly mounted on the breaker plate assembly 38. The operation of the cam 34, the breaker points 36, 37 and the condenser 40 is more or less conventional and further description of these elements is not thought to be necessary. Suffice it to say that because of the improved ventilation within the cap C, because of the terminal bores 29, it has been found that the life of the contact points 36, 37 and the condenser 40, as well as the cap C, have been materially extended. It is believed that these ventilating bores 29 prevent the build-up of ozone and nitric acid within the distributor cap C thereby decreasing the rate of cap interior surface deterioration. With the bores 29 providing a means for ventilation of the cap interior area, the problems associated with wettability of the cap's interior surface are eliminated. It is also possible that the spark plug conductor cables 46 and the high tension coil cable 45 act somewhat as wicks to absorb or withdraw moisture from the interior of the cap C through the ventilation bores 29 and 47 respectively. Whether there is a combination of wick effect and ventilating effect or just ventilation effect alone that prevents the build-up of moisture, ozone, nitric acid and/or any other detrimental deposits within the cap C is not the important point but rather the fact that the bores 29 and 47 resist cap deterioration and produce a material improvement in distributor life and elimination of the hard engine starting problems frequently associated with the distributor of a spark ignition type internal combustion engine. Not only is cap life extended but distributor contact points and condenser life seem to be extended as well.

It should be noted that while the piercing of a distributor body or casing with a ventilation port is known to be old, still the ventilation ports used in the past were not located so as to be shielded by the ends of the associated conductor cables. Likewise, the ventilation ports were not so located with respect to the conductor cable ends that moisture absorbing wick structures were located at each bore outlet. The bored terminal posts of the disclosed distributor cap provide moisture eliminating structure that accomplishes both of these functions while preventing the introduction of water or any other foreign matter to the interior of the distributor cap. By eliminating moisture from the cap interior area the formation of ozone and nitric acid within the cap during distributor sparking is eliminated. Likewise, the possibility of formations of conductive or corrosive salt deposits within the cap is prevented and cap life is improved materially.

I claim:

1. An engine spark ignition distributor cap comprising an imperforate, cup-shaped housing of insulator material having a plurality of conductor cable receiving terminals extending through the bottom wall of the cup-shaped cap, at least one of said terminals having a ventilation passage therethrough connecting the interior arc supporting portion of the cap to the exterior thereof, said passage extending longitudinally of the terminal and being located such that the exteriorly disposed end thereof will be covered by the adjacent end of the conductor cable to be received in said one terminal.

2. A spark ignition internal combustion engine distributor cap comprising an inverted cup-shaped housing member formed of electrical insulator material and having a plurality of spark plug conductor receiving terminals piercing the top of cup-shaped member around the periphery thereof and another conductor receiving terminal piercing the central area of the top of said cup-shaped member, each of said conductor receiving terminals having an outwardly opening tubular end to matingly receive a conductor element and a substantially solid, rod-like, inwardly disposed, end that extends into the cap interior and is pierced by a longitudinally extending ventilation bore that connects the tubular outer end of the terminal to the cap interior area adjacent the arcing portion of the terminal.

3. A spark ignition internal combustion engine distributor cap comprising an inverted cup-shaped housing member formed of electrical insulator material and having a plurality of spark plug conductor receiving terminals piercing the top of cup-shaped member around the periphery thereof and another conductor receiving terminal piercing the central area of the top of said cup-shaped member, each of said spark plug conductor receiving terminals having an outwardly opening tubular end to matingly receive a conductor element and a substantially solid, rod-like, inwardly disposed, end that extends into the cap interior and is pierced by a longitudinally extending ventilation bore that connects the tubular outer end of the terminal to the cap interior area at the arcing portion of the terminal.

4. A spark ignition internal combustion engine distributor cap comprising an inverted, imperforate, cup-shaped housing member formed of electrical insulator material and having a plurality of spark plug conductor receiving terminals piercing the top of cup-shaped member around the periphery thereof and another conductor receiving terminal piercing the central area of the top of said cup-shaped member, each of said spark plug conductor receiving terminals having an outwardly opening tubular end to matingly receive a conductor element and a substantially solid, rod-like, inwardly disposed, end that extends into the cap interior and is pierced by a longitudinally extending ventilation bore that connects the tubular outer end of the terminal to the cap interior area, said inwardly disposed end portion of each of said spark plug conductor receiving terminals having a step formation therein to intermittently receive the associated rotatable distributor rotor contact to provide an arc supporting structure, the inner end of said ventilation bore being positioned at the arc supporting portion of said terminal.

5. In a spark ignition internal combustion engine having a rotatable distributor rotor journaled in a cup-like casing and a cap to close the top of said casing comprising an inverted, imperforate, cup-shaped housing member formed of electrical insulator material and having a plurality of spark plug conductor receiving terminals piercing the top of the cup-shaped housing member around the periphery thereof and another conductor receiving terminal piercing the central area of the top of said cup-shaped housing member, each of said spark plug conductor receiving terminals having an outwardly opening tubular end to matingly receive a conductor element and an inwardly disposed end that extends into the cap interior and is pierced by a longitudinally extending ventilation bore that connects the tubular outer end of the terminal to the cap interior area at the portion of the terminal that provides the intermittent electrical arc supporting portion thereof.

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