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J. OLDHAM ET AL

2,997,531

INSULATING SUPPORT FOR IGNITION CONDUCTORS

Filed Dec. 8, 1958

3 Sheets-Sheet 1

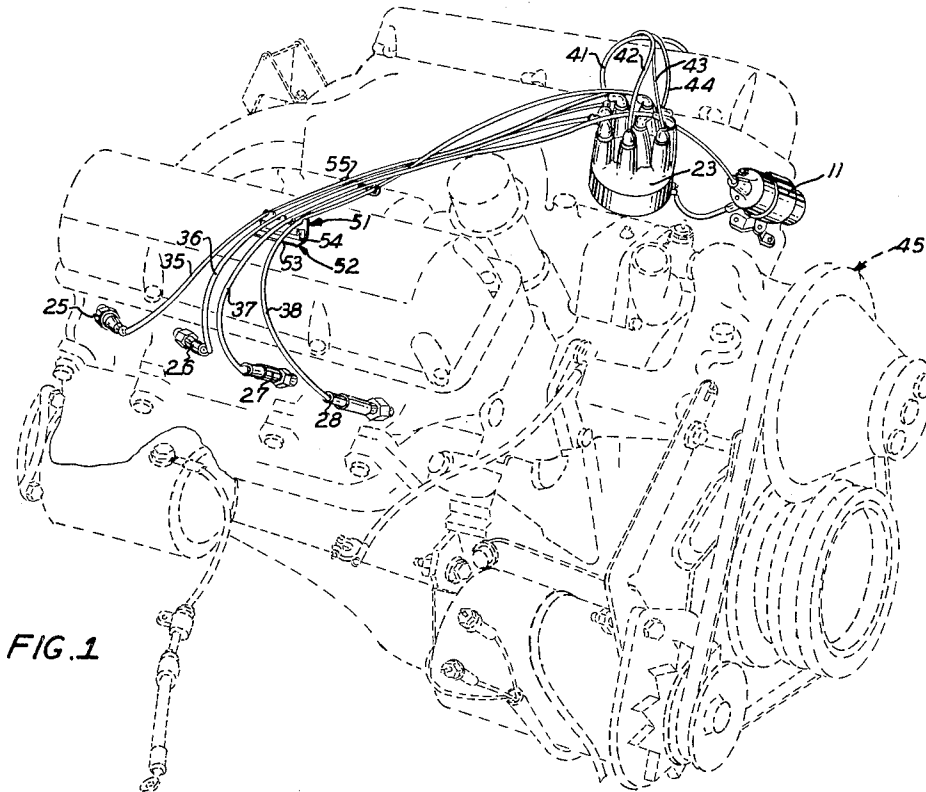


FIG. 1

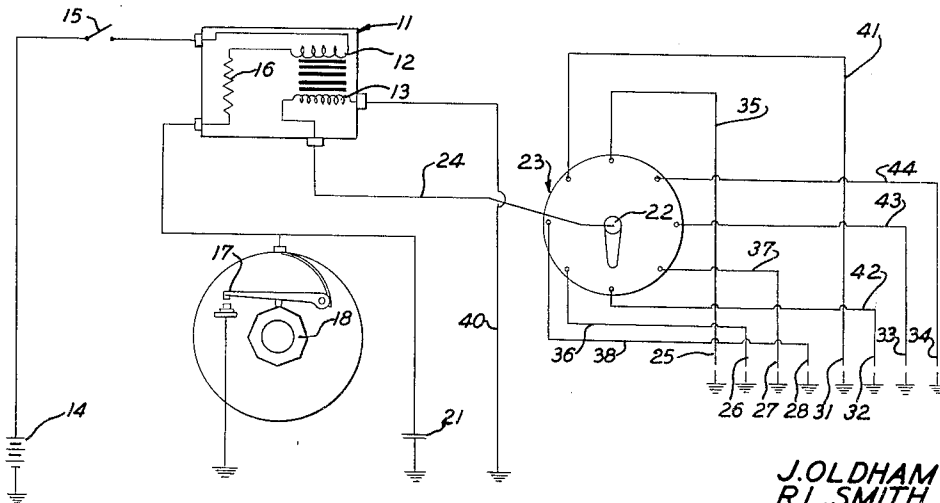


FIG. 2

J. OLDHAM
R. L. SMITH
INVENTORS

BY

E. C. McKee
J. H. Oster
A. L. Zerschling
ATTORNEYS

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J. OLDHAM ET AL

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3 Sheets-Sheet 2

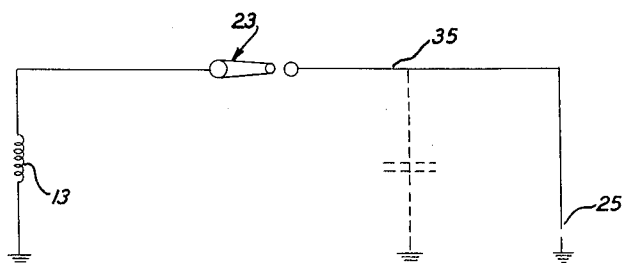


FIG. 3

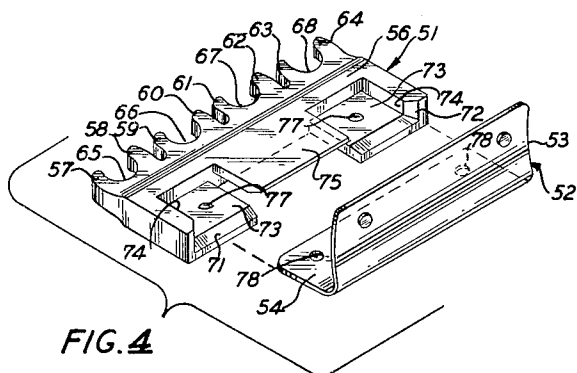


FIG. 4

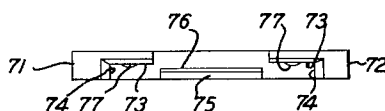


FIG. 5

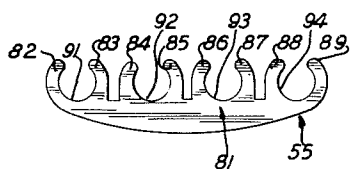


FIG. 6

J. OLDHAM
R. L. SMITH
INVENTORS

BY *E. C. McLa*
J. H. Oster
H. L. Zerschling
ATTORNEYS

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J. OLDHAM ET AL

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3 Sheets-Sheet 3

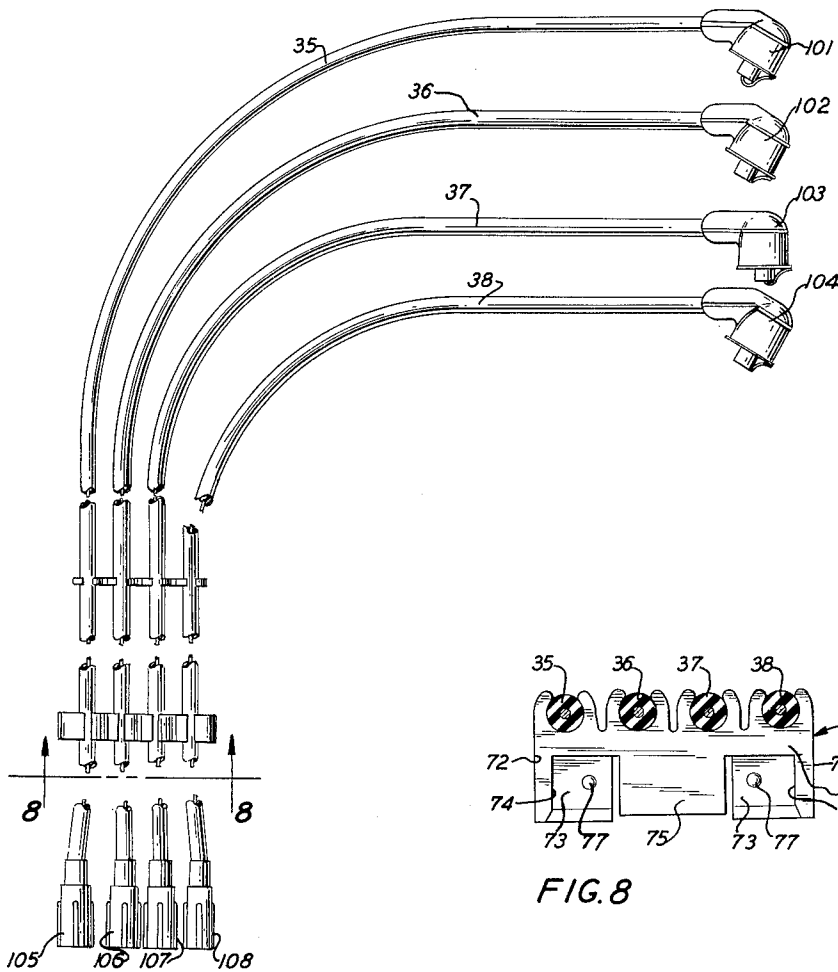


FIG. 8

FIG. 7

J. OLDHAM
R. L. SMITH
INVENTORS
BY *E. C. McRae*
J. H. Oster
K. L. Zerachling
ATTORNEYS

1

2,997,531

INSULATING SUPPORT FOR IGNITION CONDUCTORS

James Oldham, Allen Park, and Robert L. Smith, Grosse Ile, Mich., assignors to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

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3 Claims. (Cl. 174—158)

This invention relates to an ignition system of an internal combustion engine and more particularly to means in an ignition system of an internal combustion engine for reducing the capacitance between electrical conductors carrying oscillating high voltage low power electrical energy and the internal combustion engine.

In ignition systems for internal combustion engines, the electrical conductor which connects the secondary winding of the ignition coil with the distributor and the electrical conductors which connect the distributor with the spark plugs carry oscillating high voltage low power electrical energy. The oscillating wave form carried by these electrical conductors can readily be analyzed by standard electrical engineering techniques to determine that the oscillating wave form contains high frequency components which may find a low capacitive reactance path to the ground reference point of the internal combustion engine, if the capacitance between the electrical conductors and the internal combustion engine is high. These high frequency components may thus be eliminated from the voltage present at the spark gap of the spark plug thereby lowering the peak voltage present and resulting in failure to fire the fuel mixture in the combustion chambers, particularly during high speed operation and cold weather starting conditions.

The present invention has been developed to obviate these difficulties and to provide a convenient means of mounting the electrical conductors, which connect the distributor with the spark plugs, in spaced relationship with respect to the engine components. According to the construction of the present invention, a clip member constructed of insulating material is provided and it comprises a main body portion having a plurality of fingers extending therefrom to receive and hold the electrical conductors. A metal plate is affixed to the internal combustion engine at some convenient point between the distributor and the spark plugs, for example, on the top of the rocker arm cover. The clip member is provided with legs which engage either side of the metal plate so that the clip member may be placed over said metal plate after the electrical conductors are positioned in engagement with the fingers of the clip member. Cooperating means are also provided on the metal plate and the clip member for frictionally retaining these two members in engagement. The main body portion of the clip member is thus positioned between the electrical conductors and the metal plate and since this main body portion is constructed of insulating material and is of substantial thickness, the capacitance between the electrical conductors and the internal combustion engine is reduced. By the selection of the proper materials and dimensions the capacitive reactance between the electrical conductors and the internal combustion engine may be made sufficiently great so that the drain of the high frequency components of the oscillating electrical energy carried by these conductors is negligible.

An object of the present invention is the provision of an ignition system for an internal combustion engine in which the capacitance between electrical conductors in said system and the engine components is reduced to a minimum.

Another object of the invention is to provide a means for mounting electrical conductors of an ignition system

2

for an internal combustion engine such as that the capacitive reactance between the electrical conductors and the engine components is made sufficiently great so that the drain of high frequency components from the oscillating electrical energy carried by said electrical conductors is substantially negligible.

A further object of the invention is the provision of a means for mounting electrical conductors of an ignition system on an internal combustion engine which is simple and readily assembled.

Other objects and attendant advantages of the present invention will become more readily apparent as the specification is considered in connection with the annexed drawings in which:

FIGURE 1 is an elevational view of an internal combustion engine employing the present invention;

FIGURE 2 is a circuit diagram of the ignition system employed with the internal combustion engine shown in FIGURE 1;

FIGURE 3 is a partial circuit diagram of the ignition system shown in FIGURE 2;

FIGURE 4 is a perspective view of the clip member and metal plate of the present invention;

FIGURE 5 is an end view of the clip member shown in FIGURE 4;

FIGURE 6 is an elevational view of a separator of the present invention;

FIGURE 7 is a plan view of a sub-assembly of ignition wires, clip member and separator ready for installation on an internal combustion engine;

FIGURE 8 is a view taken along the lines 8—8 of FIGURE 7.

Referring now to the drawings in which like reference numerals designate like parts throughout the several views thereof there is shown in FIGURES 1 and 2 an ignition coil 11 having a primary coil 12 and a secondary coil 13. The primary coil is energized by a battery 14 through a switch 15 and is grounded through a ballast coil 16 and the breaker points 17 when the points are closed. When the breaker points 17 are closed current flows from the battery, one terminal of which is grounded, through the primary coil 12, through the ballast coil 16, and then to ground through the breaker points. When the cam 18 opens the breaker points 17, the magnetic field in the primary coil collapses very rapidly with a substantial amount of the energy being absorbed by the capacitor 21. The rapid collapse of the magnetic field in the primary induces a high voltage electromotive force in the secondary coil 13. As this action is repeated, that is, as the breaker points open and close due to the action of cam 18, oscillating high voltage low power electrical energy is induced in the secondary winding 13 and is conveyed to rotor 22 of the distributor 23 by means of a conductor 24. This electrical energy is then distributed to the spark plugs 25, 26, 27, 28, 31, 32, 33 and 34 of the internal combustion engine by means of insulated conductors 35, 36, 37, 38, 41, 42, 43 and 44 which are connected to the spark plugs and terminals of the distributor cap. The oscillating electrical energy must possess sufficient peak voltage at each spark plug to arc across the spark plug gap, one electrode of which is grounded, and thus complete the circuit to the secondary coil through the ground wire 40 of the secondary coil under all operating conditions of the internal combustion engine and must also possess sufficient electrical energy to ignite the charge present in the cylinders under all operating conditions of the engine.

All of these components are mounted on an internal combustion engine such as a standard production type V-8 engine 45 shown in FIGURE 1. It is evident that the insulated conductors leading from the distributor 23

to the spark plugs must pass directly over a portion of the internal combustion engine and unless supported in some way would be in direct contact with a portion of the engine, and in the particular engine illustrated, the rocker arm cover. With the electrical conductors supported upon the rocker arm cover either directly or by means of a metallic support structure affixed thereto, the capacitance between the insulated conductors and the engine which is the ground reference point of the electrical system is relatively high and the capacitive reactance therebetween is relatively low thereby causing a loss of high frequency components from the voltage present at the spark plug gap. This can be more readily understood by reference to FIGURE 3 in which the capacitance between one of the insulated electrical conductors leading from the distributor to the spark plugs and the internal combustion engine is shown in dotted lines.

A study of FIGURE 3 will show that the capacitance between the insulated electrical conductors, for example conductor 35, which connect the distributor 23 with the spark plugs, and the internal combustion engine is in parallel with the resistance and the spark gap of the spark plugs. If the capacitance reactance of this path is low, the high frequency components of the electrical energy emanating from the secondary coil 13 will tend to follow this path to ground—the internal combustion engine—and will thus be eliminated from the voltage present at the spark gap of the spark plugs, for example spark plug 25. Thus to have maximum voltage present at the spark gap it is necessary to provide a high capacitive reactance between the insulated conductors and the internal combustion engine. The capacitive reactance of this path is determined by the formula:

$$X_c = \frac{1}{2\pi f C}$$

C=capacitance

f=frequency

X_c=capacitive reactance

It can be determined from this formula that at a given frequency the capacitive reactance varies inversely as the capacitance and thus to increase the capacitive reactance of this path it is necessary to reduce the capacitance. It is well known that the capacitance between two conductive members varies inversely as the distance between them. By increasing the distance between the conductors which connect the distributor with the spark plugs and the engine, the capacitance can be lowered and the capacitive reactance can be increased.

The present invention accomplishes a decrease in the capacitance between the insulated electrical conductors designated by the numerals 35 thru 38 and the numerals 41 thru 44 and the internal combustion engine by mounting these conductors in a clip member 51 which is constructed of an insulating material having a dielectric constant approximately equal to the dielectric constant of the insulation covering these conductors. This clip is mounted on a plate member 52 which has a first portion 53 lying against and affixed to the rocker arm cover of the engine and a second portion 54 which receives the clip member 51 and extends at approximately a right angle to the first portion 53. A separator 55 is positioned between the clip member 51 and the distributor 23 to align the electrical conductors so that they may be properly positioned in the clip member.

Referring now to FIGURES 4 and 5, there is shown the clip member 51 and the plate member 52 in detail. The clip member 51 is constructed of an insulating material having a dielectric constant approximately equal to the dielectric constant of the insulation of the conductors carried thereby, for example nylon, and includes a main body portion 56. The main body portion has a plurality of arcuate fingers designated by the numerals 57 thru 64 and these fingers together with the main body portion form a plurality of generally circular shaped

slots 65 thru 68 which are open along one side thereof to receive the electrical conductors on one side of the engine, for example conductors 35 thru 38. As can best be seen by reference to FIGURE 8, the width of these openings is slightly smaller than the diameter of the insulated electrical conductors so that the insulated conductors may be pressed into the slots through the opening and securely held therein by the arcuate shaped fingers. The main body portion 56 of the clip member also has a first angularly shaped leg 71 and second angularly shaped leg 72 extending therefrom. Each of these legs has a first surface 73 and a second surface 74 which are disposed at right angles to one another. The first surface 73 of the legs 71 and 72 lie in the same plane, while the surfaces 74 lie in spaced parallel planes which are substantially at right angles to the plane containing the surfaces 73 and are spaced from one another a distance approximately equal to or slightly greater than the width of the second portion 54 of the metal plate 52. A third leg 75 extends from the main body portion 56 and has a surface 76 which lies in a plane parallel to the plane containing the first surface 73 of the first and second legs 71 and 72 and spaced therefrom a distance approximately equal to the thickness of the portion 54 of metal plate 52. This can best be seen by reference to FIGURE 5. The first surface 73 of each of the legs 71 and 72 has a small integral protuberance 77 which is adapted to be received in the apertures 78 in the second portion of the metal plate 52.

Referring now to FIGURE 6, there is shown an elevational view of the separator 55. This separator has a main body portion 81 with arcuate fingers 82 through 89 extending therefrom to form with the main body portion a plurality of circular shaped slots 91 thru 94 which have openings along one edge thereof to receive the insulated conductors, for example conductors 35 thru 38.

In the assembly of this invention the first portion 53 of the metal plate 52 is spot welded or otherwise suitably affixed to the rocker arm of the internal combustion engine. As can best be seen by reference to FIGURE 7, the insulated electrical conductors 35, 36, 37 and 38 which have affixed to one end thereof terminals 101 thru 104 and have affixed to the other end thereof terminals 105 thru 108 are positioned within the circular shaped slots 65 thru 68 of the clip member 51. As can best be seen by FIGURE 8, this can readily be accomplished by forcing the insulated conductor through the opening in these circular slots. The conductors are similarly positioned in the circular shaped slots 91 thru 93 of the separator member 55. The terminals 101 thru 104 are then snapped into the proper position in the distributor 23 and the clip member 51 is positioned over the second portion 54 of the plate member 52. When so positioned, the second portion 54 extends into the space between the first surfaces 73 of the first and second legs 71 and 72 and the surface 76 of the third leg 75 and the protuberances 77 on the surfaces 73 are received in the apertures 78 so that the clip member is frictionally engaged and retained on the second portion 54 of the plate member 52. The terminals 105 thru 108 are then positioned in engagement with the spark plug members 25 thru 28 and the assembly is complete for half of the engine. Of course, the same procedure and the same apparatus are employed with the other half of the engine.

When the assembly operation is complete the clip member 51 and plate member 52 position the insulated electrical conductors in spaced relationship with respect to the rocker arm cover so that the distributed capacitance between the electrical conductors and the rocker arm cover is an inverse function of the distance therebetween. Also, there is interposed between the electrical conductors and the edge of the second portion 54 of the metal plate 52 the insulating material of the main body portion 56 of the clip member 51 and the capacitance therebetween is an inverse function of the thickness of this main body

5

portion. This effectively lowers the capacitance between the insulated conductors connecting the distributor with the spark plugs and the internal combustion engine over existing structures of this type.

It is thus apparent that the applicant has provided a means for lowering the capacitance between the ignition conductors leading from the distributor to the spark plugs and the internal combustion engine and thus lowering the loss of high frequency components of the high voltage low power electrical energy carried by these conductors. This is accomplished by the clip member and cooperating structure which also greatly facilitates the positioning of the electrical conductors connecting the distributor to the spark plug during assembly operations. It is also very convenient when repairs are necessary as the clip member 51 may be readily disengaged from the plate member 52 by a sharp pull in an upward direction.

It will be understood that the invention is not to be limited to the exact construction shown and described, but that various changes and modifications may be made without departing from the spirit and scope of the invention, as defined in the appended claims.

What is claimed is:

1. A support structure for ignition conductors of an internal combustion engine comprising a plate adapted to be affixed to the internal combustion engine, a clip member constructed of an insulating material, said clip member comprising a main body portion having a plurality of arcuate fingers extending therefrom and defining with said main body portion a plurality of generally circularly shaped slots being open along a portion thereof, a plurality of legs extending from one edge of said main body portion and having surfaces lying in one plane, another leg extending from said edge of said main body portion and having a surface lying in a plane parallel to the plane containing the surfaces of said first mentioned legs and spaced therefrom a distance substantially equal to the thickness of said plate so that said clip member may be positioned upon said plate, with the plate being positioned between said legs and engaging the surfaces of said legs and so that the main body portion is positioned between said plate and said ignition conductors, and cooperating means on said clip member and said plate for frictionally retaining said plate between the legs of said clip member.

2. A support structure for ignition conductors of an internal combustion engine comprising, a plate adapted to be affixed to the internal combustion engine, a clip member constructed of an insulating material, said clip member comprising a main body portion having a plurality of arcuate fingers extending therefrom and defining with said main body portion a plurality of generally

6

circularly shaped slots open along a portion thereof, a first and a second angularly shaped leg extending from said main body portion, each of said legs having a first surface and a second surface disposed at right angles to each other, the first surface of each of said legs lying in one plane, and the second surface of one of said legs lying in a plane parallel to a plane containing the second surface of the other of said legs, said last mentioned two planes being spaced at a distance substantially equal to the width of said plate, a third leg extending from said main body portion and having a surface disposed in a plane parallel to the plane containing the first surface of said other two legs and being spaced therefrom a distance substantially equal to the thickness of said plate, a protuberance positioned on the first surface of each of said first and second legs, a pair of apertures positioned in said plate to receive said protuberances, said clip member being positioned over said plate such that the first surface of said first and second legs and said surface of said third leg engage said plate on opposite sides thereof and said protuberances on the first surface of said first and second legs are received in the apertures in said plate and such that the second surface of said first and second legs overlies opposite edges of said plate.

3. A support structure for ignition conductors of an internal combustion engine comprising, a plate adapted to be affixed to the internal combustion engine, a clip member constructed of an insulating material, said clip member comprising a main body portion having means for receiving and retaining the ignition conductors, a plurality of legs extending from one edge of said main body portion and having surfaces lying in one plane, another leg extending from said edge of said main body portion and having a surface lying in a plane parallel to the plane containing the surfaces of said first mentioned legs and spaced therefrom a distance substantially equal to the thickness of said plate so that said clip member may be positioned upon said plate, with the plate being positioned between said legs and engaging the surfaces of said legs and so that the main body portion is positioned between said plate and said ignition conductors, and cooperating means on said clip member and said plate for frictionally retaining said plate between the legs of said clip member.

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