Sept. 19, 1967 R. S. BURDETTE 3,342,168

IGNITION SYSTEM HARNESS

Filed March 23, 1965 2 Sheets-Sheet 1

FIG.1

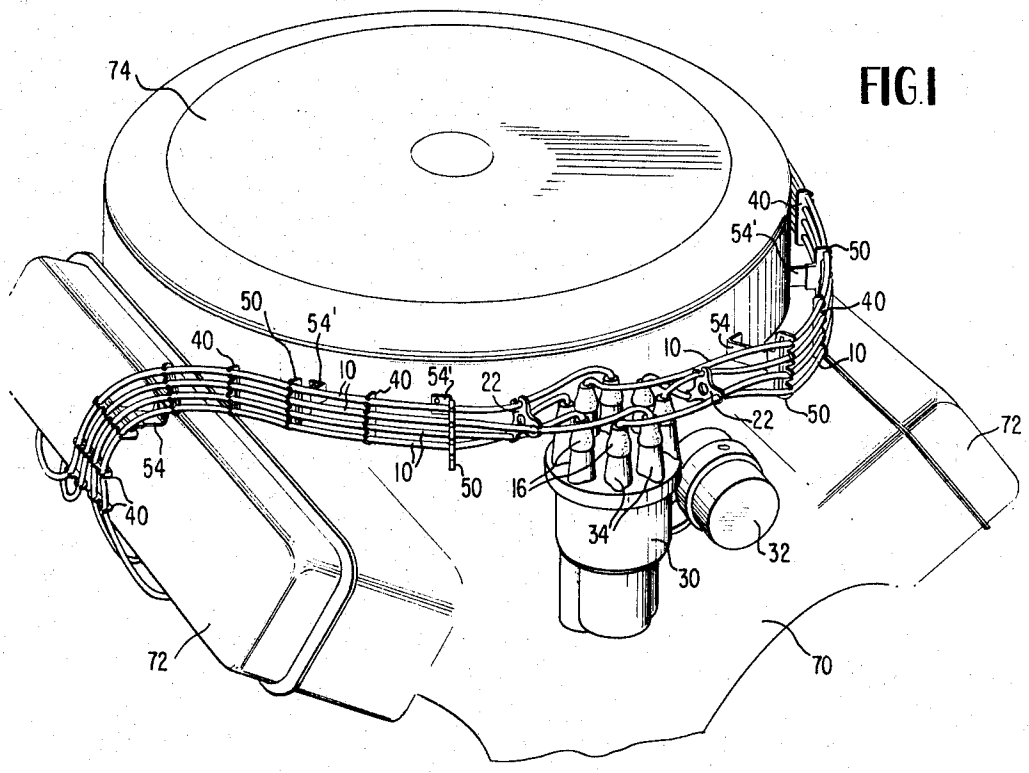
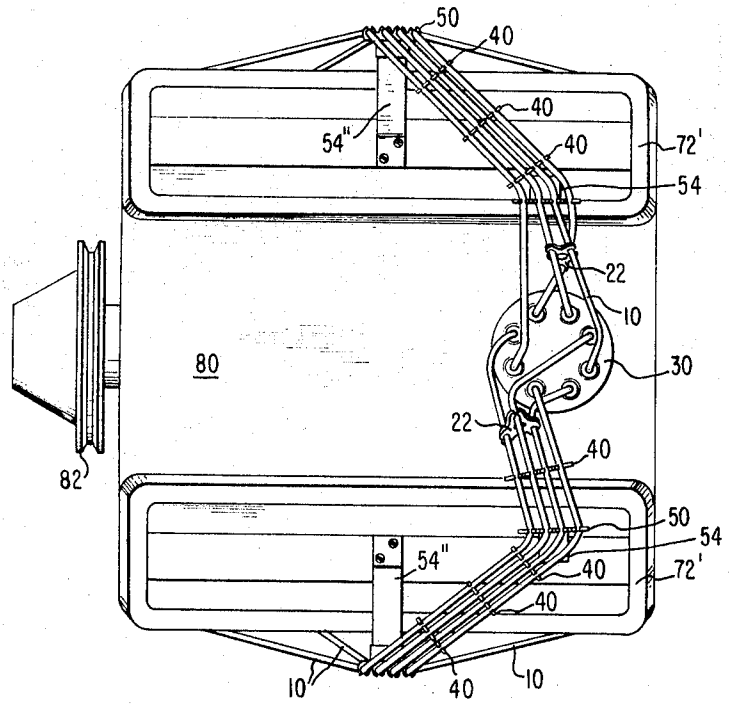


FIG.2



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FIG. 3

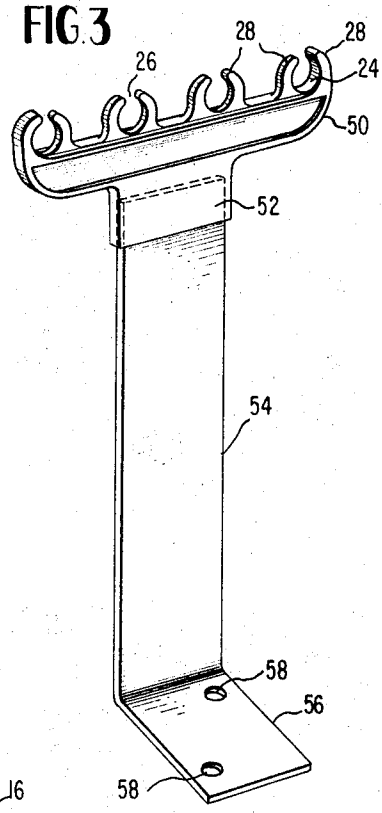


FIG. 4

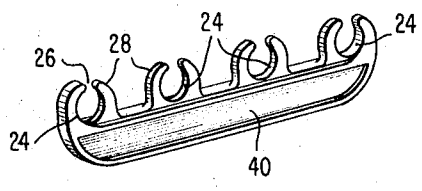


FIG. 5

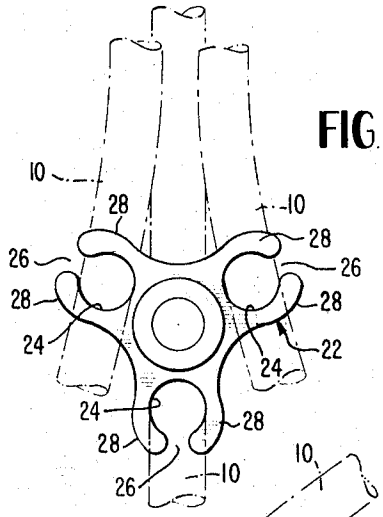


FIG. 6

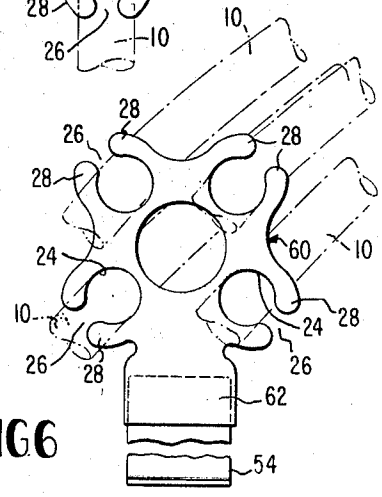
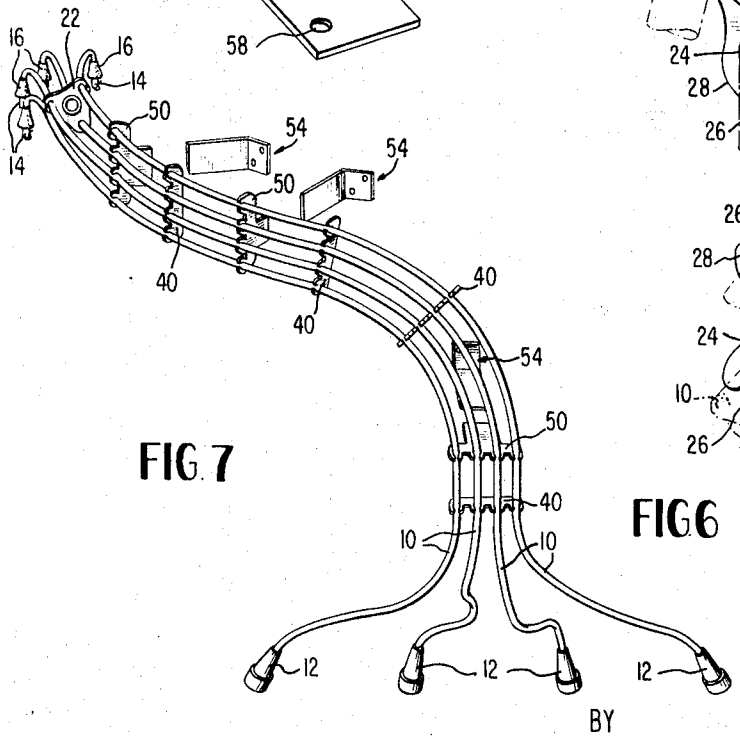


FIG. 7



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IGNITION SYSTEM HARNESS

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This invention relates to an ignition system for an internal combustion engine, and more particularly to an improved support system for ignition cable harness connecting the distributor to the engine spark plugs.

Conventional ignition sytems for internal combustion engines, as for example, in automobiles, include a spark coil whose primary winding is connected in series with the battery and means repetitively closing and opening breaker points to ground, i.e. for example, the engine block. When the breaker points open, the magnetic field in the primary coil collapses very rapidly to cause a substantial amount of electrical energy absorption by a capacitor connected across the breaker points. The rapid collapse of the magnetic field in the primary coil of the spark plug induces a rapidly increasing a nd high potential in the secondary winding of the spark coil. This action is repeated each time as the breaker points open and close repetitively, under action of a rotating cam.

The oscillating high voltage thus induced in the secondary winding of the spark coil is conducted to the rotor of a distributor which sequentially connects to the various ignition cables leading to the center electrodes of the spark plugs in the engine cylinders. The outer electrodes of the spark plugs are of course grounded, as is one end of the spark coil secondary winding, so that the oscillating voltages applied sequentially to the spark plugs cause current flow in each spark plug circuit and produce sparks which jump between the spark plug electrodes and ignite the vapor in each cylinder in proper sequence as determined by the distributor connections.

It is apparent from the above that the peak voltages applied to each spark plug must be adequate not only to create an arc across the spark plug electrodes but an arc of sufficient intensity to fire the cylinder under any and all operating conditions of the engine. If the potentials received at different spark plugs are not substantially uniform, the cylinders will not fire in a uniform manner or with equal power. It is, accordingly, very important that leakage losses due to capacitive reactions of leakage paths from the ignition cable to the engine components be held to a minimum and that the inductive losses from one cable to another also be uniform, so that each spark plug will receive, insofar as possible, an exactly equal potential.

Bearing in mind the above description of conventional ignition systems, it will be readily apparent that conventional ignition cable harnesses and their supports provided on even new automobiles, for example, are subject to a number of defects. The ignition conductors to the different cylinders of the same engine are frequently of an unequal length and of poor quality having improper resistance characteristics, so that an unequal resistance is provided in the various cables to the flow of electric energy from the secondary winding of the spark coil to the different spark plugs; the insulation provided on the ignition cables is often of poor quality and short life and subject to the development of cracks and pin holes which increases the leakage currents and renders the leakage from one cable different from that of another; the lack of uniformity of length in the ignition conductors causes a hotter spark in some cylinders than in others; the cables are allowed to touch each other, thus increasing the leakage, particularly when wet, and thereby causing differences in the mutual inductances between cables resulting in frequent misfires, or cross-fires, again particularly when the ignition cables

are wet; the cables are not retained at equal distance apart along their full lengths, again varying the mutual inductance; the ignition cables are not maintained equally spaced from the engine block yielding unequal leakage losses; in many instances the cables are sharply bent rather than maintained straight or slightly curved, the bends increasing the leakage current losses; and, of primary importance, the cables are infrequently supported along their length and allowed to sag, under stress of wind and fan currents and, particularly, with age, into engagement with metal parts of the engine, thus increasing the high frequency leakage currents. All of the above defects result in unequal potentials at the spark plugs of the various cylinders and cause irregularity of firing, uneven engine performance, loss of horsepower and loss of mileage due to the resultant engine inefficiency.

It is a primary object of the present invention to provide an improved ignition cable harness and support therefor for an internal combustion engine which will avoid all of the above described defects of conventional harnesses.

It is another object of the invention to provide an ignition cable harness of high quality conductors having proper specific resistivity and covered by long-lasting, good quality insulating material.

It is a further object of the invention to provide an ignition system for internal combustion engines in which the capacitance between conductors is held to a minimum and capacitive impedances of leakage paths between conductors to the engine block are increased to a maximum.

Still another object of the invention is to provide a support system for ignition cables in which the mutual inductance between the cables is reduced to a minimum and the mutual inductances between each cable and the remaining cables of the harness, insofar as practicable, is substantially equal, so as to equalize the inductive losses in the different cables.

A still further object of the invention is to provide an ignition cable harness for an internal combustion engine in which the cables are of substantially equal length to equalize resistive, inductive and capacitative losses and in which the cables are firmly supported by a number of insulated supports adequate to prevent displacement, touching or sagging of the cables due to wind, fan currents and the like.

Yet a further object of the invention is to provide an ignition cable harness and its support for an internal combustion engine which is simple, easy to fabricate and install, and economical, and highly efficient in operation.

The novel features that are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawings, wherein like reference characters indicate like parts throughout the several figures and in which:

FIG. 1 is a perspective view from the front of an ignition cable harness according to the invention installed on a V–8 cylinder engine having a distributor located at the front;

FIG. 2 is a plan view of another ignition harness installed on a V–8 engine having its distributor located at the rear;

FIG. 3 is a perspective view of a spacer bracket and spacer clip for holding the ignition cables, respectively, spaced from the engine and parallel to each other;

FIG. 4 is a perspective view of another clip similar to that in FIG. 3 but having no bracket support;

FIG. 5 is a plan view of another clip adapted to maintain ignition cables in spaced relation as they cross over one another, particularly adjacent the distributor;

FIG. 6 is a plan view of still another combined, spacer clip and bracket which is adapted to maintain ignition wires spaced parallel but in tubular conformation; and

FIG. 7 is an exploded perspective view of one half of an ignition harness assembled and ready to install on one side of an engine.

Referring now more particularly to the drawings, FIG. 7 shows one half of a harness according to the invention ready for installation on an 8-cylinder engine. Depending upon the physical geometry of the engine, and the location of its distributor and other components, each of the four cables **10** is cut, preferably, to substantially the same length corresponding to the longest cable required to reach from the distributor to the furthermost spark plug. Each cable **10** preferably comprises a resistance conductor of good quality such as glass filaments impregnated with a graphite compound having a suitable coefficient of resistance and covered by a good quality insulator.

Conventional terminals **12**, including protective insulating hoods, for snapping on to the central electrodes of the spark plugs are secured to one end of each cable. The other end of each cable has inserted therein a hair pin shaped spring terminal **14**, sharpened to a point at one end. The point is inserted in the end of the cable and makes good contact with the central conductor. The outside of the hair pin terminal overlies the insulation at the end of the cable and is insertable into a socket terminal, **34**, FIG. 1, in the distributor **30** for connecting the conductor of the ignition cable to a distributor terminal contact. The latter described ends of the cable have surrounding hoods **16** of insulation which, when installed, overlie the openings at the top of the distributor sockets **34** to prevent entry of water.

In FIGS. 3–6 are shown examples of spacing and holding means for retaining the ignition cables of the harness in desired positions when installed. FIG. 5, for example, illustrates a generally triangular shaped flat clip **22** made of insulating material, such as synthetic plastic, Bakelite, hard rubber, or the like, and having three equally spaced clamps **24** therein at the corners. The clamps **24** are of a diameter suitable to receive and firmly hold an insulated ignition cable **10**, which must enter through a narrower communicating slot **26** between two resilient fingers **28**. In assembling the clip with the cables, each cable is forced through the slot **26** spreading the fingers **28** until the cables snap into the larger openings of the clamp **24**.

A spacer clip of this nature is useful to prevent the cables from touching each other where it is necessary that the cables cross. For example, in FIGS. 1 and 2, spacers **22** are shown near the distributors **30** and the spark coil **32**. The cables emerging from the distributor head, because of the firing sequence of the engine cylinders, necessarily must cross in order to connect the appropriate contact in the distributor with the spark plug in the appropriate cylinder. The spacers **22** are shown separating and holding the cables near their crossing points so as to at all times prevent one cable from touching another.

In FIG. 4 is shown a spacer clip **40** having four clamps **24** along one edge for receiving and holding parallel the ignition cables. The clamps are defined by resilient fingers **28**, similar to those in the clip **22** of FIG. 5. Clips **40** are also made of synthetic plastic or other insulating materials, like clip **22**, and when installed maintain the cables parallel to one another for the most of their length in the runs from the distributor cap to the spark plugs.

In FIG. 3 a spacer clip **50** similar to clip **40** is illustrated. Clip **50** differs, however, in that a dependent portion **52** provides a socket in which is inserted the end of a bracket leg **54** for releasably and frictionally holding th spacing clip **50** in position. The bracket leg **54** is angled with respect to a supporting base leg **56** in which is provided a pair of apertures **58** for mounting screws.

Bracket **54** is preferably made of metal and of any suitable shape or angle and of suitable dimensions for adequately spacing the clip **50** and its supported cables away from an engine block or component metal parts of an engine.

In FIG. 6 is shown a square shaped clip **60** which is provided with wire holding clamps **24** at each corner and defined by resilient fingers **28** spaced by entry slots **26**. The clip **60** is formed of insulating material such as that previously described for clips **22**, **40** and **50**, and has a dependent projection **62** similar to **52** of clip **50** which provides a friction socket for releasably seating a bracket leg **54**.

The construction of the ignition cable harness, and its installation, will now be better understood by reference to FIG. 1 in which the harness is shown installed on a V-8 engine **70** with the distributor **30** near the front and a large, cylindrical air cleaner **74** on top. Referring to the left side of the harness the hairpin terminals **14** of the four ignition cables **10** are inserted into the appropriate sockets **34** of the distributor **30** with the hoods **16** covering the sockets. Where the cables cross over because of the engine cylinder firing sequence, the spacer clip **22** is snapped into holding engagement with the crossing cables. The clip **22** is disposed as closely to the distributor as possible to minimize and avoid contact between the cables **10**. The four cables are then led in parallel relation around the air cleaner **74** to the center of the left rocker arm cover **72**, where they are supported spaced from the metal by bracket leg **54** secured by machine screws in the openings **58** of the bracket base.

Between the rocker arm cover **72** and the distributor **30**, it is desirable to support the cables to prevent them from sagging by attaching them by suitable spacers to the air cleaner housing **74**. To this end additional brackets **54'** are mounted and spaced about the periphery of the air cleaner housing. Brackets **54'** usually are shorter then brackets **54**. Brackets **54**, **54'** and their clips **50** are spaced sufficiently close to prevent the cables from engaging the engine and its components. Spacer clips **40** are utilized to separate the cables and support the cables in spaced parallel relation at regular intervals between the bracket supported clips **50** and are spaced sufficiently close to prevent the cables from engaging each other.

The spacing between the clips **40** and **50** may range from 1½ to 3 inches in order to prevent the cables from sagging along their length due to age, wind, fan blown air currents, and the like. After the cables pass the rocker arm housing **72** they are continued to be spaced by additional clips **40** until it is necessary to divert the four cables toward their respective spark plugs, where their terminals in boots **12** are clipped on to the spark plugs. The right hand side of the ignition harness also consists of four cables spaced and supported in substantially identical manner to the left hand side.

In FIG. 2 is shown another 8-cylinder engine **80** of different configuration, lacking an air cleaning housing on the top and in which the distributor is mounted at the rear, the fan belt pulley **82** being shown at the front. The ignition cables **10** are run parallel to each other and prevented from touching at the cross over points near the distributor in a similar manner to the harness shown in FIG. 1. The cross over clips or spacers **22** are shown near the distributor, spacers **40** are provided approximately every two inches along the length of the cables and the cables are run directly to brackets **54** and then to brackets **54''** positioned in the centers of the rocker arm covers **72'**. The brackets **54''** are longer and differently shaped from brackets **54** so as to hold the cables slightly above and spaced outwardly of the rocker arm covers.

It should be apparent from the above description, that harnesses may be preassembled for each make and model of a car by providing two harness portions similar to that of FIG. 7, with the harness tailored to the dimensions and accessories of the particular engine for which it is in-

tended to be used. In each harness, care is taken to retain the individual cables at least one quarter inch apart along their entire lengths by use of the separators or spacers 22, 40 and 50 or 60.

The cables are prevented from sagging due to fan current, winds, age and the like by spacing the separators in a range of 1½ to 3 inches apart, any greater spacing tending to permit the cables to sag into each other or against a metal engine component. The bracket arms 54, 54′ or 54″ are also assembled to the clips 50 and may be any suitable length and shape to properly position the cables so that each can be made of equal length, in spite of the positions of the spark plugs to which they are connected, and to space the cables at least ⅞ of an inch from the metal of the engine or engine component, which forms an electrical ground for the ignition circuit.

The above described harness, for each given make and model of engine, may be installed by inserting the appropriate terminals 14 in the distributor sockets and the caps 12 on the proper spark plugs, each bracket 54 assembled on the separators 50 then falling in proper position against the metal supporting component of the engine. Self tapping metal screws are then screwed into the engine component through openings 58 to hold the harness securely. The clips 50 with the wires 10 clamped thereto may be easily removed from their supporting brackets 54, 54′, 54″ to enable removal of the air cleaner 74, rocker arm covers 72, or other parts to which the brackets may be attached.

When thus installed on the engine the leakage losses are reduced to a minimum and the inductive losses between the cables are held equal because of the equal spacing. Where sharp bends are essential extra spacers 40 or 22 are assembled to the wires to prevent the cables from touching each other. It should be further apparent that ignition kits as described may be installed either on the engines of new cars at the factory or may be tailored for later installation on used cars.

Ignition kits fashioned and installed in the manner above described have been found to provide very great advantages over the conventional and common ignition wire harnesses which are haphazardly run in helter skelter fashion between the distributor and the spark plugs. For example, use of ignition kits according to the invention has resulted in substantial engine horsepower increases, smoother running engines, and longer service life to the entire ignition system requiring far fewer engine tune ups. In addition, mileage of the vehicle per gallon of gas has increased by at least 10%, and the engines have been found to start more easily and quickly in cold and wet weather. A considerable saving in time is obtained in changing conventional ignition harness on used vehicles to effect repair thereof, because on many vehicles the ignition cable can scarcely be replaced until the engine cools off, if replacing cable in the original manner. With the present kit engine the harness can be assembled and installed immediately and engine temperature is of no concern.

Although certain specific embodiments of the invention have been shown and described, it is obvious that many modifications thereof are possible. The invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

What is claimed is:

1. In an internal combustion engine having a plurality of combustion cylinders, a distributor, a spark plug for each cylinder, an ignition cable harness including a plurality of cables connecting said distributor with the respective spark plugs, and means mounting said harness on said engine, the improvement wherein said cables are all of substantially equal length to deliver substantially uniform potentials to each of said spark plugs, and said mounting means comprises a plurality of clips, including a plurality of spacer clips and a plurality of supporting clips, holding said cables spaced apart and substantially parallel to one another during their coextensive lengths, with at least two of said cables being substantially coplanar, and for insulatedly spacing said cables from the metal portions of said engine, said clips being spaced at intervals along the cables a distance sufficient to prevent said cables from engaging each other during normal operation of said engine and being formed of a resilient insulating material and having a plurality of cable holding recesses with entry apertures leading from one edge bordered by curved fingers which admit entry of and releasably grasp the cables, there being at least one spacer clip between each two supporting clips, and brackets mounted on said engine between said distributor and said spark plugs and removably supporting said supporting clips, said brackets being spaced sufficiently to prevent any of said cables from engaging any portion of said engine during normal operation thereof.

2. In an internal combustion engine having a plurality of combustion cylinders, a distributor, a spark plug for each cylinder, an ignition cable harness including a plurality of cables connecting said distributor with the respective spark plugs, and means mounting said harness on said engine, the improvement wherein said cables are all of substantially equal length to deliver substantially uniform potentials to each of said spark plugs, and said mounting means comprises a plurality of clips, including a plurality of spacer clips and a plurality of supporting clips, holding said cables spaced apart and substantially parallel to one another during their coextensive lengths, with at least two of said cables being substantially coplanar, and for insulatedly spacing said cables from the metal portions of said engine, said clips being spaced at intervals along the cables a distance sufficient to prevent said cables from engaging each other during normal operation of said engine and being formed of a resilient insulating material and having a plurality of cable holding recesses with entry apertures leading from one edge bordered by curved fingers which admit entry of and releasably grasp the cables, and brackets mounted on said engine between said distributor and said spark plugs and removably supporting said supporting clips, said brackets being spaced sufficiently to prevent any of said cables from engaging any portion of said engine during normal operation thereof, said clips being spaced along said cables from a point adjacent the distributor to the portions of said cables which branch from said harness to the reach portions of said cables for connection to said individual spark plugs, the last of said clips before the branching reach portions being a supporting clip.

References Cited

UNITED STATES PATENTS

277,374	5/1883	Strohm	174—146
1,073,183	9/1913	Trego	123—143
1,089,642	3/1914	Honold	174—154 X
1,647,008	10/1927	Lawrence	174—154
2,997,531	8/1961	Oldham et al.	174—158
3,113,363	12/1963	Fyvie	174—146

FOREIGN PATENTS

786,728	6/1935	France.
398,146	1933	Great Britain.
897,151	5/1962	Great Britain.

OTHER REFERENCES

Cadillac Shop Manual, 1957, pages 9–2.

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