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B. H. SHORT ET AL

2,640,174

INTENSIFIER

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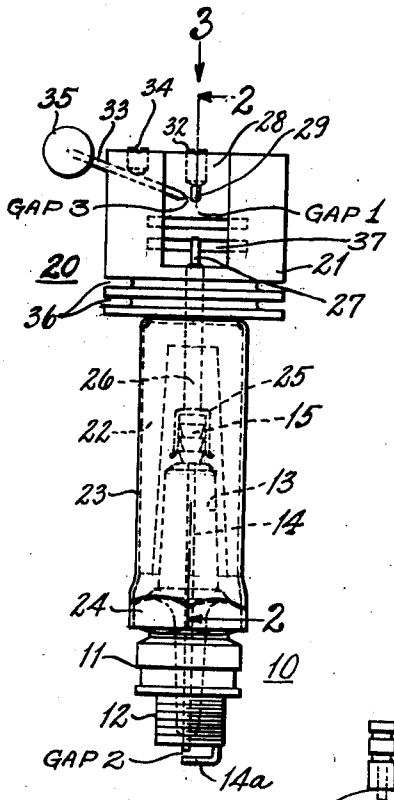


Fig. 1.

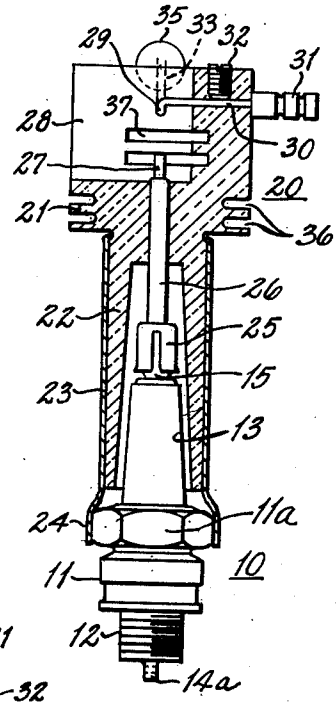


Fig. 2.

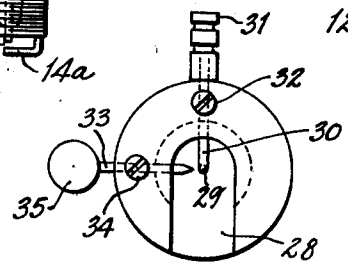


Fig. 3

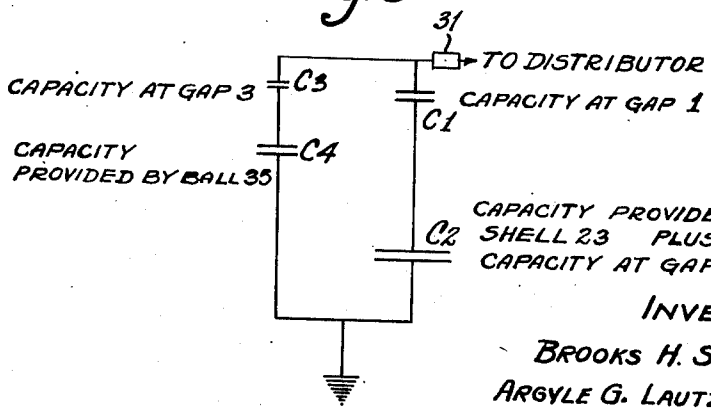


Fig. 4.

INVENTORS
BROOKS H. SHORT AND
ARGYLE G. LAUTZENHISER
By Willits, Hardman & Fehr
THEIR ATTORNEYS

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INTENSIFIER

Brooks H. Short and Argyle G. Lautzenhiser, Anderson, Ind., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

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10 Claims. (Cl. 315—60)

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This invention relates to spark intensifiers for ignition systems used on automotive vehicles. Spark intensifier is a term applied to a device which provides a relatively wide spark gap in series with a gap of a spark plug for the purpose of withholding application to the spark plug gap of the secondary voltage of an ignition coil until said secondary voltage has reached a value such as to cause a spark to jump across the spark plug gap, although that plug may be fouled by carbon deposit. In spark intensifiers, known heretofore, the secondary voltage is caused to attain a value substantially higher than that required to cause a fouled plug to fire.

An object of the present invention is to provide a spark intensifier which will cause a fouled plug to fire at a secondary voltage substantially less than that required heretofore by a conventional spark intensifier. In the disclosed embodiment of this invention, this object is accomplished by augmenting the capacity of the spark plug gap by a capacity provided by a grounded metal shell surrounding the spark plug electrode so that the total effective capacity of the spark plug gap is much larger in value than the capacity of the intensifier gap whereby the impressed secondary voltage is so divided that, prior to firing, the voltage impressed at the spark plug gap is small as compared with the voltage applied at the intensifier gap. By thus dividing the voltage in inverse proportion to the capacities of the gaps, the leakage at the fouled spark plug gap is low in value and coil energy is not dissipated to any material extent during the time required for rise of secondary voltage to the value for current to jump to the intensifier gap. Therefore, the attained secondary voltage is a relatively small amount in excess of that required to jump the intensifier gap.

A further object of the invention is to provide stability of operation of the intensifier and this is accomplished by means provided for irradiation of ultra-violet rays at the intensifier gap.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred embodiment of the present invention is clearly shown.

In the drawing:

Fig. 1 is a side view of a spark plug with the present intensifier attached thereto.

Fig. 2 is a sectional view on line 2—2 of Fig. 1.

Fig. 3 is a view in the direction of arrow 3 of Fig. 1.

Fig. 4 is a diagram of capacity circuits effecting the operation of the intensifier.

In the drawing, a spark plug 10 includes a

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metal shell 11 having a threaded portion 12 to be received by a threaded hole in an engine cylinder head, not shown. The shell 11 supports a porcelain insulator 13 which supports an electrode wire 14, the lower end of which is spaced from an electrode 14a attached to the shell 11 to provide the spark plug gap referred to hereafter as gap #2. The electrode wire 14 is attached to a terminal 15.

An intensifier 20 comprises a porcelain body 21 which includes a tubular portion 22 surrounded by a metal shell 23 having a hexagonal flange 24 which fits snugly around the hexagonal portion 11a of the shell 11, thus providing a support for the intensifier. The portion 22 surrounds the upper portion of the spark plug and a socket 25 which engages the spark plug terminal 15. The socket 25 is attached to a rod 26 which extends through the body 21 and terminates in an electrode 27 located in a recess 28 of the body and in alignment with the end portion of an electrode 29 provided by a rod 30 which extends through the body 21 and is connected with a terminal 31 for making connection with a wire connected with the ignition distributor which distributes sparking impulses from the secondary winding of an ignition coil. A screw 32 threaded thru the body 21 secures the rod 30 in position. The gap between the electrodes 27 and 29 is known hereafter as gap #1 which is the main intensifier gap.

The body 21 supports a rod 33 secured by a screw 34 threaded in the body. The rod 33 extends within the recess 28 and is provided with a point spaced from the electrode 29 and located slightly above its lower end. The gap between rod 33 and electrode 29 provides what is known as gap #3. The outer end of rod 33 is attached to a ball 35.

To minimize the tendency for leakage on the surface of the body 21, it is provided with grooves 36 and 37.

Referring to Fig. 4, the capacities effecting the operation of the intensifier may be considered as being four in number and they are arranged in parallel circuits between terminal 31 and ground. Capacity C1 is the capacity at gap #1 between the electrodes 27 and 29. Capacity C2 is the capacity provided by the shell 23 plus the capacity at gap #2. Capacity C3 is the capacity at gap #3. Capacity C4 is the capacity of the ball 35 and the rod 33 with respect to ground.

Assume that 14.5 kv. secondary voltage is required to cause a spark to jump across the spark plug gap 2. If the spark plug is fouled by accumulation of carbon deposit, this deposit pro-

vided a path for leakage of secondary voltage so that it never attains 14.5 kv. to fire the plug. An ordinary spark intensifier which provides a wide gap in series with the distributor and the spark plug serves to withhold secondary current flow until the secondary voltage is at a value much higher than 14.5 kv. in order that there will be a voltage sufficient to cause a spark at the gap.

In order to prevent the required supply voltage from increasing to a value substantially higher than required to fire the plug, the capacity of the spark gap 2 is augmented by the capacity provided by the shell 23 to provide a total capacity C2 much greater than capacity C1 of the intensifier gap 2. Therefore the share of available voltage required by capacity C2 is small as compared with the share required by capacity C1. For example, if the ratio of capacities C1 and C2 is about 2/12.5, when supply voltage has increased to 14.5 kv., the voltage impressed on gap 1 will be 12.5 kv. and the voltage impressed on gap 2 will be 2 kv. During the increase of voltage at gap 2 to 2 kv., leakage of energy is relatively small during the time required to increase the voltage to 2 kv. When voltage impressed on gap 1 has increased to 12.5 kv., this gap breaks down and instantly the voltage at gap 2 is increased to 14.5 kv. and the spark plug fires.

If the ratio of capacities C1 and C2 were nearly unity as in the case of an ordinary spark intensifier the required voltage for the intensifier and the plug would approach two times the plug voltage, and in the example a potential of 29 kv. would be required. Increasing the capacity of C2 with respect to C1 lowers the required voltage for the combination, as has been indicated.

The relation of capacities C3 and C4 is such that sparking at gap 3 called the teaser gap occurs before sparking at the intensifier gap 1. Sparking at gap 3 irradiates intensifier gap 1 with ultra-violet rays so that the intensifier gap breaks down at a consistant voltage, for example 12 to 13 kv. If the teaser gap 3 were not present, the voltage at which gap 1 would break down might vary between 12 and 30 kv. Thus the teaser gap 3 stabilizes the operation of the present intensifier.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. An intensifier adapted for use with a spark plug comprising conductors providing, in series with the spark plug gap, a gap of a length greater than the spark plug gap; a non-conducting body supporting the conductors; means attached to the body for raising the capacity of the spark plug gap to a value of a plurality of times greater than the capacity of the intensifier gap whereby the plug-firing voltage required for the gap combination is substantially less than otherwise; a teaser gap provided by an additional conductor supported by said body and having one end spaced from one of the conductors at the intensifier gap; and a metal body attached to the other end of the additional conductor and having dimensions such that its capacity with respect to ground is greater than the capacity of the teaser gap.

2. An intensifier adapted for use with a spark plug comprising, a body of insulating material having a recess at each end; a conductor extending axially through the body and providing a spark plug terminal in one recess and a sparking terminal in the other recess; an adjustable

electrode carried by the body having one end extending into the said one recess to provide a relatively large spark gap; a second adjustable rod carried by the body and having one end extending into the said one recess, said end being slightly above the lower end of the electrode to provide a small gap; a metallic sleeve having one end secured to the body about the recess containing the spark plug terminal and having the other end formed so as to fit snugly around and in direct contact with metal member of the spark plug.

3. An intensifier adapted for use with a spark plug comprising, a terminal support comprising a body of insulating material having a radially disposed notch at one end extending inwardly from the periphery of the body and having an axially disposed pocket extending from the other end of the body, said recess and pocket being separated by a partition wall; an electrode fixed in the partition wall and having one end exposed in the recess and having the other end exposed in the pocket, said pocket adapted to receive one end of a spark plug for electrical connection with its insulated electrode; a plurality of rods supported by the body to which an electrical conductor is adapted to be connected to one of the rods, each rod having an end extending into the recess and spaced from each other to provide a relatively small gap and spaced from the electrode to provide a relatively large gap, and means to minimize the electrical leakage on the surface of the recess and the exterior of the body, said means comprising a plurality of relatively deep grooves in the marginal walls of the recess and on the exterior of the partition wall; and a metallic sleeve having one end secured to the body and having the other end adapted to receive and rest on a metal part of the spark plug to support the body in correct position with respect to the plug.

4. An intensifier adapted for use with a spark plug having a centrally disposed electrode wire; a body of insulating material having a tubular portion on its lower side for the reception of the electrode wire and having a recess on its upper side; a conductor extending axially through the body having one end exposed within the recess and having the other end exposed within the tubular portion; a metallic socket electrically connected with the conductor adapted to engage the electrode wire of the spark plug; a detachable terminal supported by the body having one end adapted to be connected with a wire adapted to be connected with a distributor which distributes sparking impulses from a secondary coil of an ignition coil, said terminal having its other end extending into the recess of the body and spaced from the conductor; a detachable metallic rod supported by the body and having an end located within the recess and above the terminal end; and a metallic sleeve having one end fitting snugly around the tubular portion of the body and having its other end formed so that it will receive a metallic shell of the plug.

5. In combination; a body of insulating material having a recess at one end extending inwardly from the periphery of the body and beyond the axis of the body and having a pocket at the other end extending axially from the other end thereof said pocket having a contour for receiving an insulated electrode of a spark plug; a conducting rod embedded in the body and having its opposite ends exposed in the recess and the pocket; a split sleeve carried by the electrode for making electrical connection with the electrode; adjustable conducting rods supported in

the side wall of the body and extending into the recess above the electrode and having their ends spaced to provide a relatively small gap between the rods and a relatively large gap between the ends of the rods and the electrode; and a metal sleeve having one end fixed to the body and having the other end adapted to make direct contact with a metallic member of the spark plug and assisting to support the sleeve in proper position.

6. An intensifier adapted for use with a spark plug having a centrally disposed electrode adapted for connection with a cable, having its upper end provided with circular beads comprising a non-conducting body having one end provided with a recess extending radially inward from the periphery of the body and having a tubular pocket extending upwardly from the other end for enclosing the electrode; a rod embedded in the body and having its opposite ends exposed respectively in the recess and pocket, a split sleeve carried by the rod for the reception of the ribs of the electrode; a pair of adjustable rods supported by the body; each having one end located within the recess and spaced to provide a relative small gap therebetween and a relative large gap between said ends and the electrode; and a metallic sleeve having one end secured to the tubular pocket portion of the body and having the other end formed for seating engagement with a metallic part of the plug to maintain the sleeve in proper position.

7. An intensifier comprising in combination a body of insulating material having an axial recess at one end adapted to receive an insulated electrode of a spark plug and having a side recess at the other end, said body having a spaced radial opening for receiving a pair of adjustable rods to be inserted from the outside and converge toward each other within the side recess to provide a small gap therebetween; a conductor carried by the body and having its opposite ends exposed in the recesses, said end of the electrode exposed within the axial recess being adapted to engage the electrode of the spark and having the other end exposed within the side recess spaced from the rod ends to provide a relative large gap between the electrode and the ends of the rod; and a metal sleeve having one end attached to the body around the axial recess and having the other end formed so as to seat on and in direct contact with a metal part of the spark plug.

8. An intensifier adapted for use with a spark

plug which includes a central electrode which forms a spark gap at one end thereof with a portion of the body of the plug comprising, an insulating body adapted for mechanical connection with a spark plug, a conductor in said body adapted to connect electrically the center electrode of said plug, and a pair of electrodes carried by said body spaced from each other and disposed in spaced relation to the upper end of said electrode, at least one of said electrodes being spaced from the conductor a distance greater than the spark gap in the plug.

9. An intensifier adapted for use with a spark plug which includes a central electrode which forms a spark gap at one end thereof with a portion of the body of the plug comprising, an insulating body adapted for mechanical connection with a spark plug; a conductor in said body adapted to connect electrically the center electrode of said plug; and a pair of electrodes carried by said body and spaced from each other and disposed in spaced relation to the upper end of the conductor a distance greater than the spark gap in the plug, one of said electrodes adapted to be connected in the circuit; and a metal body connected with the other electrode which forms a condenser with ground.

10. An intensifier adapted for use with a spark plug comprising conductors providing, in series with the spark plug gap, a pair of conductors providing a gap of length greater than the spark plug gap; a third electrode providing a teaser gap and having one end spaced from one of said pair of conductors; a non-conducting body supporting the conductors; and a metal body attached to the other end of the third electrode and having dimensions such that its capacity with respect to ground is greater than the capacity of the teaser gap.

BROOKS H. SHORT.
ARGYLE G. LAUTZENHISER.

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