

[54] ADAPTABLE PHOTOELECTRIC
AUTOMOTIVE DISTRIBUTOR
COMBINATION

3,693,023	9/1972	Wasserman.....	250/233 X
2,084,267	6/1937	Hicks.....	200/19 A UX
3,594,518	7/1971	Bates.....	200/19 M

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[57] **ABSTRACT**

[52] U.S. Cl. **250/233**, 200/19 R, 123/148 R,
315/149, 315/209 R

[51] Int. Cl. **G01d 5/36**

[58] Field of Search... 200/19 R, 19 M; 250/217 SS,
250/229, 233; 256/47; 123/148; 315/149, 209

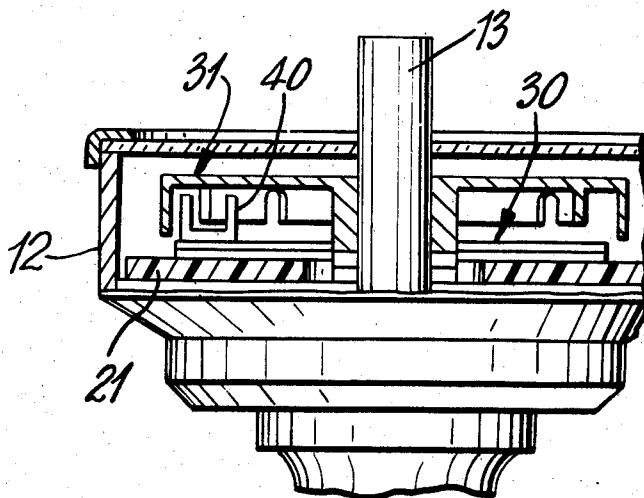
A combination adaptable to replace conventional breaker points of an automotive distributor. It includes a printed circuit unit having a photoelectric contact breaker assembly attached and electrically connected to it. The unit is designed for mounting on the breaker plate. The distributor has a shutter that includes an inner flange with openings to cooperate with the photoelectric assembly, plus an outer peripheral flange, all to be attached to the distributor rotor.

[56] **References Cited**

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13 Claims, 10 Drawing Figures



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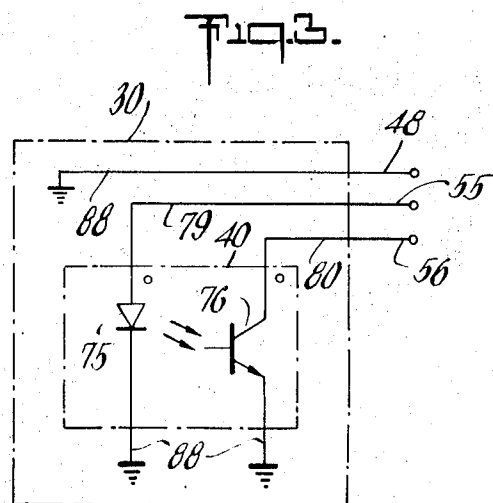
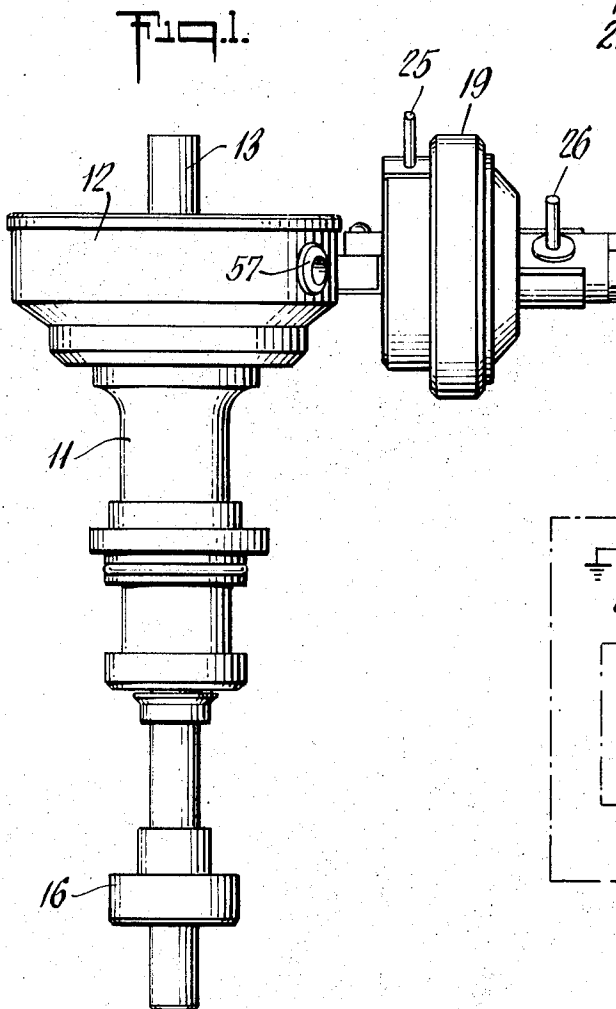
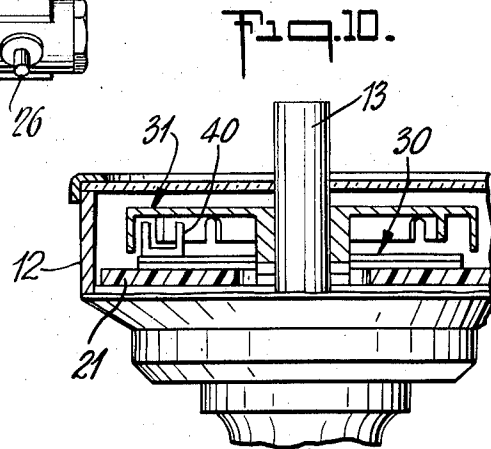
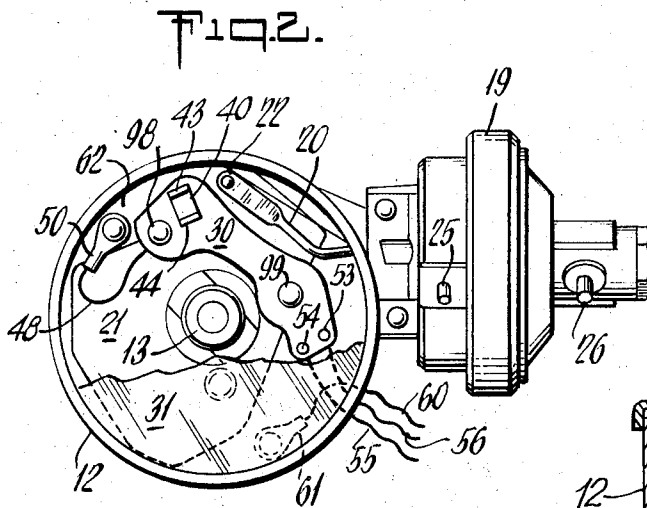


Fig. 4.

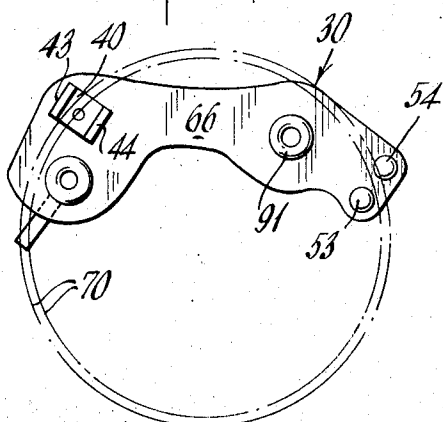


Fig. 9.

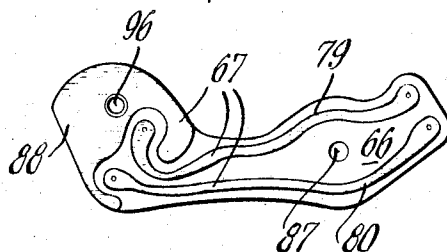


Fig. 5.

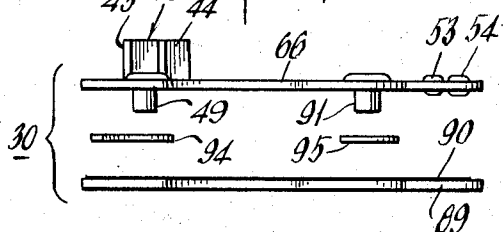


Fig. 8.

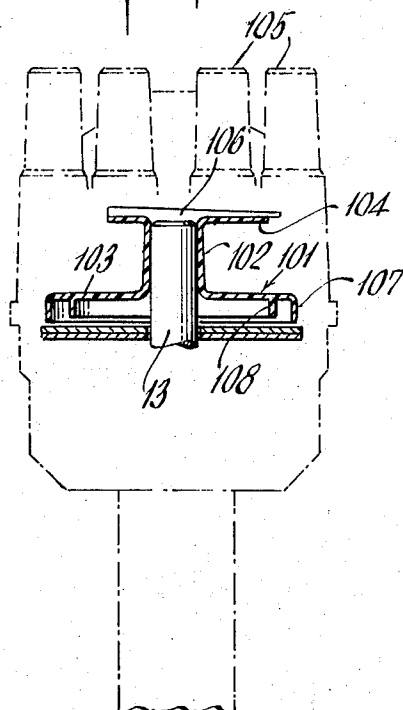


Fig. 7.

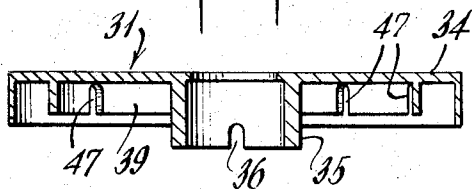
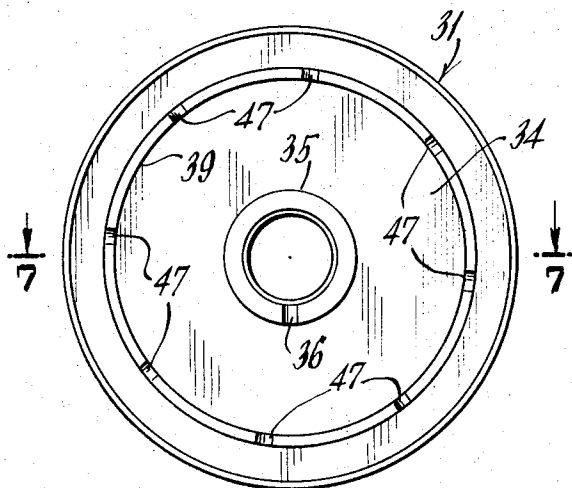


Fig. 6.



ADAPTABLE PHOTOELECTRIC AUTOMOTIVE DISTRIBUTOR COMBINATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention concerns automotive distributors in general and, more specifically, relates to a combination that provides for adapting a photoelectric engine-timing unit to a conventional distributor structure.

2. Description of the Prior Art

While there have been heretofore a considerable number of proposals made for making use of photoelectric or other similar devices to control the spark-timing of an internal combustion engine, they have not been of such nature as to be adaptable to standard distributor structures. Consequently, it is an object of this invention to provide for a combination including a photoelectric unit, a printed circuit and a shutter element, all so as to be adaptable to conventional distributor structure for automobiles.

SUMMARY OF THE INVENTION

Briefly, this invention relates to an automotive distributor that has a breaker plate, a rotor shaft, and means for mounting breaker points on said plate. The invention concerns a combination that comprises a photoelectric unit having a radiation source and a radiation-sensitive element. It also comprises a printed circuit and first means for mounting said photoelectric unit on said printed circuit in electrical contact therewith. It also comprises second means for mounting said printed circuit on said breaker-mounting means to replace said breaker points on said plate.

Once more, briefly, the invention relates to an automotive distributor that has a breaker plate, a rotor shaft, and holes in said breaker plate for mounting breaker points on said plate. It comprises, in combination, a photoelectric unit having an infrared radiation source and a silicon phototransistor adapted for receiving said radiation across a gap. It also comprises a printed circuit mounted on an insulating material board, and said board is adapted for mounting on said breaker plate in replacement of said breaker points. It also comprises a protector board adapted for being fastened over said printed circuit, and holes in said board adapted to match said breaker-plate holes. It also comprises eyelet fasteners adapted for attaching said insulating material and protector boards together, and bolt means for attaching said boards to said breaker plate through said eyelets and holes. It also comprises electric terminal means attached to said printed circuit and said insulating material board for making circuit connections to said radiation source and the said transistor. In addition, it includes shutter means that comprises the following elements: a flat circular disk having a hub adapted for attaching said disk to said rotor shaft for rotation therewith at all times; an outer depending flange on said disk for protecting said photoelectric unit, and an inner depending flange being opaque to said infrared radiation and adapted for rotating in said radiation gap. The said inner flange has a plurality of windows corresponding to the number of cylinders in the engine of said automobile.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects and benefits of the

invention will be more fully set forth below in connection with the best mode contemplated by the inventors of carrying out the invention, and in connection with which there are illustrations provided in the drawings, wherein:

FIG. 1 is a side elevation illustrating the exterior of a largely conventional distributor unit;

FIG. 2 is a plan view with the rotor partly broken away, illustrating the same distributor shown in FIG. 1, and with elements of the invention mounted thereon;

FIG. 3 is an electrical circuit diagram showing the circuit for the electronic elements;

FIG. 4 is an enlarged plan view of a photoelectric spark-timing unit according to the invention;

FIG. 5 is an exploded side elevation of the unit illustrated in FIG. 4;

FIG. 6 is an enlarged bottom plan view of one preferred modification of the shutter rotor according to the invention;

FIG. 7 is a transverse cross-section taken along the lines 7-7 of FIG. 6 looking in the direction of the arrows;

FIG. 8 is a partial interior side elevation with the rotor in transverse cross-section and another preferred modification of the shutter rotor with the relationship to an automotive distributor indicated;

FIG. 9 is a bottom view of the top board element of the unit illustrated in FIGS. 4 and 5; and

FIG. 10 is a side cross-sectional view of the distributor unit shown in FIGS. 1 and 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

This invention provides improved structure for a photoelectric-type spark-timing unit, which is adaptable for use directly on a conventional automotive distributor.

Thus, referring to FIGS. 1 and 2, there is illustrated a largely conventional distributor unit 11. It includes the usual circular housing 12 that surrounds a rotor shaft 13. Also, there is schematically indicated the usual gear 16 on the lower end of the rotor shaft 13. It is for making positive connection with a timing shaft (not shown), or it is otherwise directly connected to the crank shaft (not shown) of the automotive engine.

Conventional structure of the distributor unit 11 also includes a spark-advance-control unit 19. It is attached radially to the housing 12 in the usual manner, and it has a connecting rod 20 (FIG. 2) extending therefrom. This connecting rod 20 is actuated by a bellows arrangement (not shown) to adjust the angular position of a conventional breaker plate 21. Such angular position adjustment is transmitted from the extremity of arm 20 to the breaker plate 21 via a hinge pin 22. This may be any conventional control arrangement for creating spark advance in dependency upon the amount of vacuum being developed at the engine carburetor. Thus, there are pipes 25 and 26 that are connected internally with the bellows in unit 19 so that the carburetor pressure differentials may be applied via flexible hoses (not shown) in the usual manner.

This invention includes means for mounting spark-timing-control unit 30 on the breaker plate 21 in place of conventional breaker points (not shown) which will have been removed. The details of unit 30 will be described more fully below in connection with FIGS. 4, 5 and 9. The invention also includes a combination with

a shutter-rotor 31 (see FIGS. 2, 6 and 7). This shutter is attached onto the shaft 13 by means of a pin (not shown), or the like, so as to be fixed for rotation with the shaft 13 at all times. It has a flat disk-like top 34 that is integral with a hub 35 that fits over the shaft 13. There is a slot 36 in hub 35. Slot 36 is designed for fitting over the pin (not shown) in the shaft 13 so as to securely fix the shutter unit 31 for rotation with the shaft 13. The whole unit 31 is preferably constructed of aluminum. However, it will be appreciated that other metals might be employed, or even nonmetallic material so long as the shutter portion is opaque to infrared radiation.

The shutter portion of unit 31 comprises a depending flange 39. This flange 39 is designed so as to extend downward underneath the disk 34 when the unit is mounted on a vertically situated distributor 11. It is located so as to be situated in the ray path, or gap of a photoelectric unit 40. Unit 40 is mounted on the upper surface of the spark-timing unit 30 toward the periphery of the distributor housing 12. The unit 40 has a radiation source moulded into one side 43 thereof, while there is a radiation-sensitive element moulded into another side 44 of the unit 40. These sides 43 and 44 extend at right angles to a connecting base that is mounted on the unit 30. It will be appreciated that the two sides 43 and 44 might be mounted in the reverse position without changing the operation of the photoelectric unit 40.

As already indicated, the flange 39 of the rotor unit 31 extends downward into a ray path between photoelectric elements in the sides 43 and 44 of the unit 40. Consequently, whenever any one of a plurality of windows or slits 47 is positioned in the path between the photoelectric elements in sides 43 and 44, the radiation path will not be interrupted and a signal will be created for controlling the generation of a spark signal.

It is to be noted that the spark-advance or retard control for the engine will continue to act in substantially the same manner as it did with the use of breaker points. Thus, bellows-actuated movements of the connecting rod 20 will cause rotation of the breaker plate 21 concentrically around the shaft 13 so as to modify the angular location of the spark-timing control which determines the timing of each spark relative to a corresponding piston location in its cylinder in the engine.

The spark-timing unit 30 has both internal and external electrical connections. The external connections include a ground wire 48 (FIGS. 2 and 3) that leads from an eyelet or hollow rivet 49 (FIGS. 4 and 5) to a grounded electrical connector lug 50 (FIG. 2). Also, there are a pair of electrical terminal connectors 53 and 54 that are electrically and physically connected to elements of a printed circuit which is part of the internal circuit to be described in more detail below. Continuing with the external circuit, there are electrical circuit wires 55 and 56 that are connected to connectors 53 and 54, respectively (FIG. 2). These wires extend out through the housing 12 of the distributor, via a hole 57 (FIG. 1). There is also another wire 60 that extends through the hole 57. This is part of the external ground circuit which includes the wire 48 and the lug 50 as well as a lug 61 which is firmly attached to a metallic base plate 62 that also has the lug 50 attached thereto.

Details of the spark-timing unit 30 are illustrated in FIGS. 4, 5 and 9. The unit 30 is made up of an upper insulating material board 66 that has a printed circuit

67 embossed onto the underside thereof, as shown in FIG. 9. The board 66 has mounted on the upper side thereof the photoelectric unit 40. It is situated, as shown, in such a position as to permit the flange 39 to extend down between the sides 43 and 44 so as to control the radiation path therebetween. This is indicated by dashed lines 70 shown in FIG. 4. These lines 70 illustrate the path of the flange 39 when the spark-timing unit rotor 31 is in operative position on the distributor.

The photoelectric unit 40, per se, does not constitute the invention, and it might take various forms. However, it is preferably one like a so-called "optical Switch" that is commercially available from, and manufactured by, HEI Inc. of Chaska, Minnesota in accordance with its brochure designated HEI-132, dated Sep. 1, 1971. Also, it may be noted that the electrical circuit diagram of such a unit will take the form that is generally illustrated in FIG. 3. As there shown, there is a diode 75 that acts to emit infrared light which is focused onto the sensitive element of a silicon phototransistor 76. These elements have their electrical connections made in a conventional manner with the diode 75 and transistor 76 moulded into the unit 40 which was described heretofore.

The internal electrical circuits for the spark-timing unit 30 include two conductive paths 79 and 80 (FIG. 9) of the printed circuit 67. Such paths are represented in the FIG. 3 circuit diagram as indicated by the same reference numbers. Also, the common internal ground circuit is provided by a printed circuit path or area 88 which surrounds, and is electrically connected to, the eyelet 49 described above. It will be noted that the printed circuit paths 79 and 80 diverge around a hole 87 through which passes another eyelet 91 without making any electrical contact.

The physical construction of the unit 30 also includes a lower matching board 89 that is constructed of an insulating material. It is fastened underneath the board 66 for protection of the printed circuit 67 and, preferably, the unit is made up by employing an epoxy glue 90 that is applied to the upper surface of the board 89. The glue is clamped between the two boards 66 and 89 by rolling or riveting the lower ends of eyelets 49 and 91 after the boards 66 and 89 have been pressed together with spacers 94 and 95 inserted to keep from squeezing out all of the epoxy glue 90.

An important feature of the invention is the ability to mount the spark-timing unit 30 in replacement of conventional breaker points. Consequently, the location of the hole 87 and a hole 96 is designed to match the corresponding holes (not shown) in the breaker plate 21 which were part of the means for mounting the breaker points on the conventional distributor. Therefore, the unit 30 is mounted on the breaker plate 21 in a feasible manner such as by using bolts 98 and 99 (FIG. 2) that are passed through the respective eyelet 49 and 91 (FIGS. 4 and 5).

FIG. 8 illustrates another embodiment of a shutter-rotor unit 101. In this modification, it is constructed of a unitary molded sleeve 102 and disk portion 103, together with an upper radially extending support 104 for a conventional distributor conductor arm 106. The arm 106 is a conventional element of automotive distributors, and it acts to connect a high-voltage electrical path from the common high-voltage wire (not shown) to a selected one of the individual spark-plug conductors (not shown), which would be individually plugged

into the castles 105 (indicated in dashed lines) in a conventional manner.

It will be observed that this modification of the unit 101 includes both an outer depending flange 107 and an inner depending flange 108. The latter will extend down into the radiation path when the unit is mounted on a distributor. Thus, it would act in a similar manner as was described above in connection with the flange 39 of the disk 34 in the other modification. In this modification the unit 101 is molded of a nonconductive material which is opaque to infrared radiation, and there will be the same windows or slits (not shown) in the inner flange 108. Also, the unit 101 will be keyed or splined to the shaft 13 to maintain fixed rotation therewith.

It will be appreciated that the combinations according to this invention are particularly applicable to use with an electronically controlled ignition system such as the one described in a co-pending application Ser. No. 263,803, filed June 19, 1972.

While the invention has been described above in considerable detail and in accordance with the applicable statutes, this is not to be taken as in any way limiting the invention but merely as being descriptive thereof.

I claim:

1. In combination with an automotive distributor having a breaker plate, a rotor shaft, and means for mounting breaker points on said plate, the improvement comprising

a photoelectric unit having a radiation source and a radiation-sensitive element,
a printed circuit,

first means for mounting said photoelectric unit on said printed circuit in electrical contact therewith, and second means for mounting said printed circuit on said breaker-mounting means to replace said breaker points on said breaker plate.

2. The invention according to claim 1, wherein said printed circuit is mounted on a board, and said board is mounted on said breaker plate.

3. The invention according to claim 2, wherein said breaker-mounting means comprises holes in said breaker plate, and

said second means for mounting comprises fasteners cooperating with said holes.

4. The invention according to claim 1, wherein the improvement comprises

shutter means for interrupting the radiation path of said photoelectric unit, and
means for rotating said shutter means in synchronism with said rotor shaft.

5. The invention according to claim 4, wherein said shutter means comprises a circular rotor having a flange of a material opaque to said radiation and including windows in said flange for transmitting said radiation.

6. The invention according to claim 5, wherein said circular rotor is adapted for being attached to said rotor shaft for rotation therewith, and said flange depends from said circular rotor into the path of radiation from said source to said sensitive element.

7. The invention according to claim 6, wherein said circular rotor also has an outer flange depending from said circular rotor for protecting said photoelectric unit,
said radiation source emits infrared radiation, and

said windows are transparent to infrared radiation.

8. In an automotive distributor having a breaker plate, a rotor shaft, and holes in said breaker plate for mounting breaker points on said plate, the combination comprising

a photoelectric unit having an infrared radiation source and a silicon phototransistor adapted for receiving said radiation across a gap,

a printed circuit mounted on an insulating material board,

said board being adapted for mounting on said breaker plate in replacement of said breaker points,

a protector board adapted for being fastened over said printed circuit,

holes in said board adapted to match said breaker-plate holes,

eyelet fasteners adapted for attaching said insulating material and protector boards together,

bolt means for attaching said boards to said breaker plate through said eyelets and holes,

electric terminal means attached to said printed circuit and said insulating material board for making circuit connections to said radiation source and to said transistor, and

shutter means, comprising

a flat circular disk having a hub adapted for attaching said disk to said rotor shaft for rotation therewith at all times,

an outer depending flange on said disk for protecting said photoelectric unit, and

an inner depending flange being opaque to said infrared radiation and adapted for rotating in said radiation gap,

said inner gap having a plurality of windows corresponding to the number of cylinders in the engine for said automobile.

9. The invention according to claim 8, wherein said infrared source comprises a light-emitting diode.

10. In combination with an automotive distributor having a rotor shaft and an electrically conductive arm extending radially relative to said shaft, said distributor being adapted for use with an ignition system that employs a photoelectric engine-timing unit, the improvement comprising

a unitary molded rotor adapted for mounting on said shaft, said rotor including
electrically insulating means for supporting said conductive arm,

means for engaging said shaft to support said rotor for synchronous rotation with said shaft, and
shutter means integral with said engaging means for actuating said photoelectric unit.

11. The improvement according to claim 10, wherein said shutter means comprises a circular rotor having a depending flange with windows therein.

12. The improvement according to claim 11, wherein said shutter means also comprises an outer flange depending from said circular rotor for protecting said flange with windows.

13. The improvement according to claim 12, wherein said engaging means comprises an electrically insulating sleeve, and
said circular rotor comprises an electrically insulating disk.

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