Nov. 27, 1956 F. E. McKINLEY 2,771,736

EXHAUST GAS PURIFYING APPARATUS

Filed March 3, 1955 2 Sheets-Sheet 1

Fig. 1

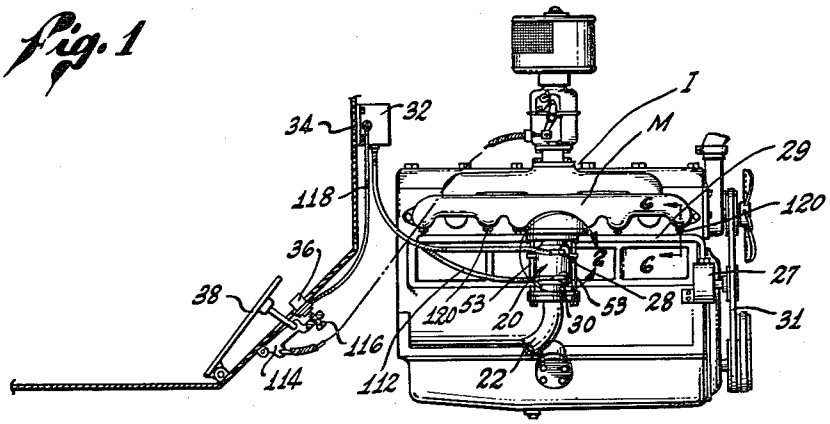


Fig. 2

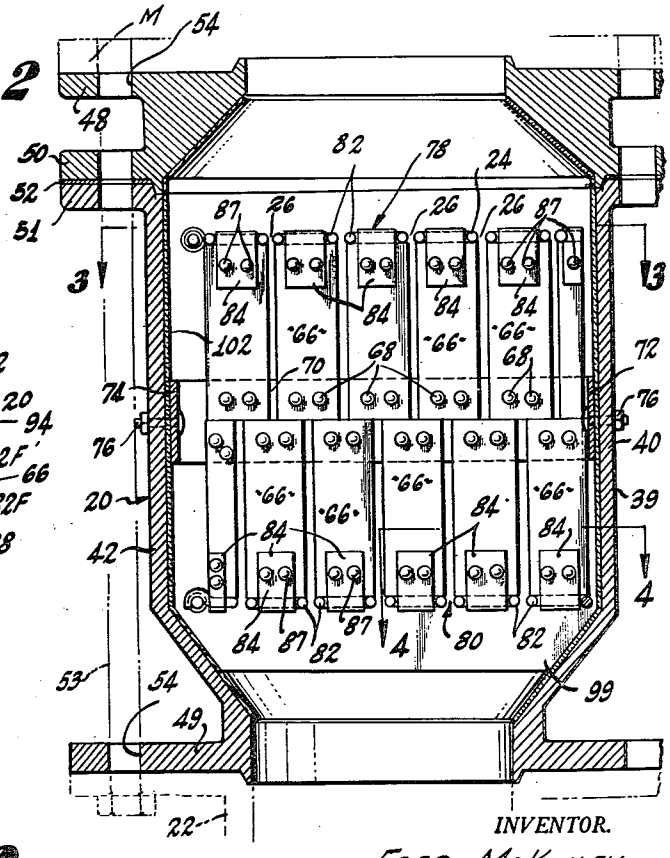


Fig. 4

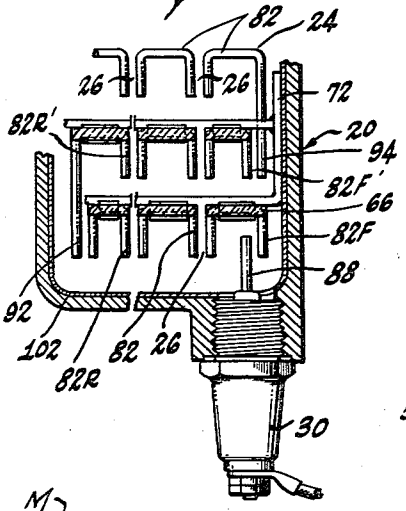
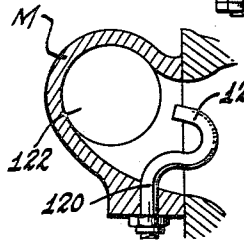


Fig. 6



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Fig. 3

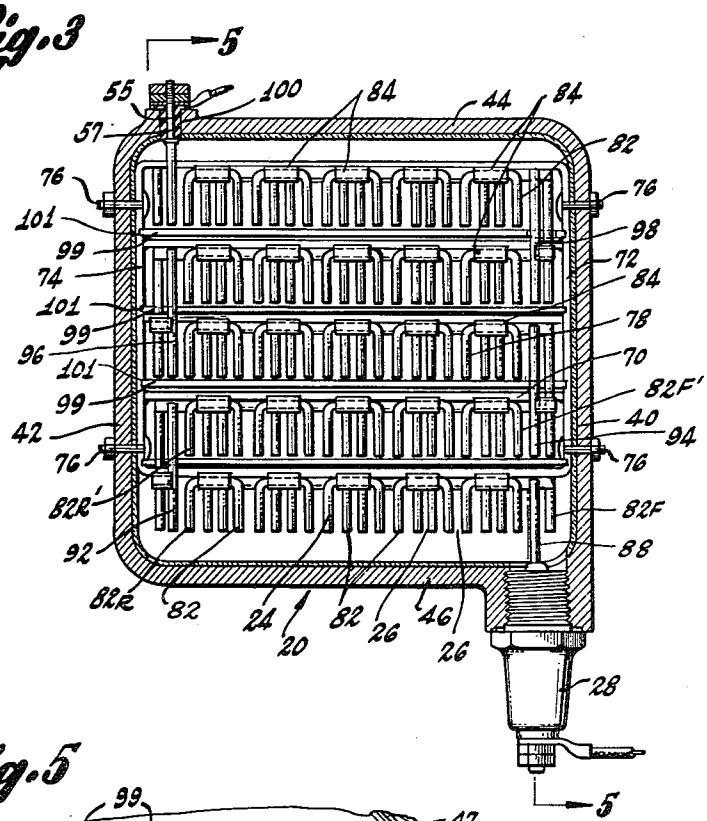
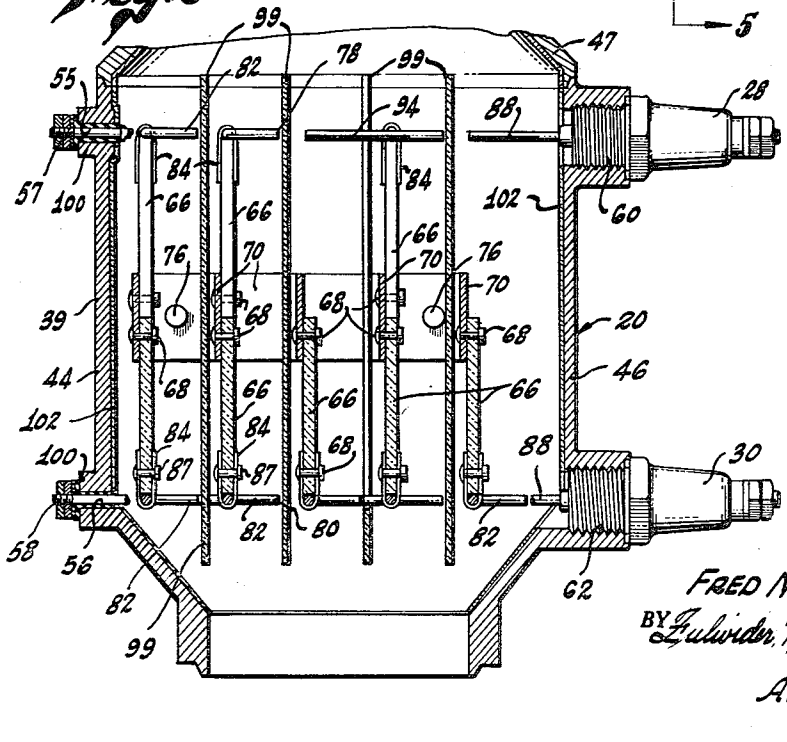


Fig. 5



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EXHAUST GAS PURIFYING APPARATUS

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10 Claims. (Cl. 60—30)

The present invention relates generally to the field of internal combustion engines and more particularly to a novel apparatus for purifying the exhaust gases issuing therefrom.

It is well known that the exhaust gases issuing from the internal combustion engines of automotive vehicles constitute a prime source of the so-called "smog" which exists in and around the principal population centers of the country. The harmful effects of this smog upon both animate and inanimate objects is likewise very well known. Although many forms of apparatus for purifying exhaust gases have been heretofore proposed, such devices have for various reasons proven to be unsatisfactory and accordingly are not now in general usage.

It is a major object of the present invention to provide an effective apparatus for purifying the exhaust gases issuing from an internal combustion engine.

Another object of the invention is to provide an apparatus of the aforedescribed nature which may be readily installed upon the engine of any conventional automotive vehicle.

It is another object of the invention to provide an exhaust gas purifying apparatus that includes a housing through which the exhaust gases are passed, a plurality of grids or electrodes disposed within said housing that define a plurality of gaps, and electrical means connected to said grid means for producing a high voltage spark across the gaps, the passage of the exhaust gases through these sparks serving to substantially purify it of contaminants.

A further object is to provide apparatus of the aforedescribed nature that is comparatively simple in design and rugged of construction whereby it may afford a long and trouble-free service life.

It is yet another object to provide apparatus of this nature that is foolproof and entirely automatic in operation.

An additional object is to provide apparatus of the aforedescribed nature which will not cause any increase in the back pressure exerted upon the engine by the exhaust gases.

Another object is to provide such apparatus wherein the sparking takes place only while the operating conditions of the engine are such as to cause its exhaust gases to contain a comparatively high percentage of contaminants.

A further object is to provide an apparatus of the aforedescribed nature which is compact in size and light in weight.

These and other objects and advantages of the present invention will become apparent from the following detailed description, when taken in conjunction with the appended drawings, wherein:

Figure 1 is a side elevational view of a preferred form of apparatus embodying the present invention mounted upon an internal combustion engine;

Figure 2 is an enlarged central vertical sectional view

taken through the housing disposed within the encircled portion designated 2 in Figure 1;

Figure 3 is a horizontal sectional view taken along line 3—3 of Figure 2;

Figure 4 is a horizontal sectional view taken along line 4—4 of Figure 2;

Figure 5 is a vertical sectional view taken along line 5—5 of Figure 3; and

Figure 6 is a fragmentary enlarged vertical sectional view taken along line 6—6 of Figure 1.

Referring to the drawings and particularly Figure 1 thereof, a preferred form of apparatus embodying the present invention is shown mounted upon the side of a conventional internal combustion engine I having an exhaust manifold M. The apparatus includes a housing, generally designated 20, having its upper end connected to the engine's exhaust manifold M and its lower end connected to a discharge pipe 22 which is in turn connected to a conventional muffler (not shown). With reference to the remaining figures in the drawings, mounted within the housing 20 are a plurality of electrodes or grid means 24 that define gaps 26 through which the exhaust gases issuing from the engine I are passed. The grid means 24 are connected to suitable electrical means (to be fully described hereinafter) adapted to produce high voltage sparks across the gaps 26. The passage of the exhaust gases through these sparks serves to purify it of contaminants to the point where it no longer tends to produce "smog."

The electrical means referred to hereinabove includes a pair of special spark plugs 28 and 30 mounted at one side of the housing 20, an induction coil 32 secured to the fire wall 34 and an electric switch, generally designated 36, which is operated by the accelerator pedal 38.

It is important to the efficient operation of the preferred form of apparatus that fresh air be supplied to the exhaust gas before such gas enters the upper end of the housing 20. Such fresh air may be supplied by a suitable blower or compressor 27 that is connected to the exhaust manifold M by means of tubing 29. This blower or compressor 28 may be driven by the engine's fan belt 31.

With regard to the detailed description of the preferred embodiment of the invention, the housing 20 includes main body 39 having a pair of vertically extending front and rear walls 40 and 42 that are connected by a pair of side walls 44 and 46, the side wall designated 44 being disposed proximate one side of the engine I. The housing 20 also includes a frusto-conical cover 47 for the main body 39. The lower portion of the main body 39 is of frusto-conical configuration, also. The upper end of the cover 47 and the lower end of the main body 39 are formed with mounting flanges 48 and 49 for connection with the exhaust manifold M and the discharge pipe 22, respectively. The lower end of the cover 47 and the upper end of the main body 39 are formed with abutting flanges 50 and 51, respectively, between which is disposed a suitable gasket 52. The main body 39 and the cover 47 may be releasably secured together, as well as being affixed to the exhaust manifold M and the discharge pipe 22, by a plurality of bolts 53 extended through vertically aligned bores 54 formed in the flanges, as shown in Figure 2. As shown in Figures 3 and 5, the side wall 44 is formed with a pair of vertically aligned and spaced bores 55 and 56 which receive terminal electrode elements 57 and 58, respectively. The side wall 46 is formed with a pair of vertically aligned and spaced threaded sockets 60 and 62 which mount the spark plugs 28 and 30, respectively.

The grid means 24 may be supported by a plurality of rectangular plates 66 formed of a ceramic such as porce-

lain. These plates 66 are rigidly secured, at one of their ends as by rivets 68, to metallic bars 70 extending horizontally between the front and rear walls of the housing. The bars 70 may be formed of stainless steel and preferably they will be integrally secured at their front and rear ends to a pair of mounting bars 72 and 74 which are removably mounted to the front and rear housing walls 44 and 46, respectively, as by bolt and nut combinations 76.

The grid means 24 include an upper screen member 78 and a similar lower screen member 80. Each of these screen members include a plurality of U-shaped metallic electrodes 82 that are rigidly secured to the ends of the porcelain plates 66 remote from the mounting bars 70. The U-shaped electrodes may be secured to the porcelain plates 66 by means of stainless steel strap elements 84 which are in turn affixed to the plates 66 by rivets 87. Referring to Figures 2 and 3, it should be particularly noted that the U-shaped electrodes 82 of the upper member 78 are staggered vertically with respect to those of the lower screen member 80 whereby any exhaust gases flowing downwardly through the interior of the housing 20 which misses the gaps 26 of the upper screen member will pass through those of the lower screen member. It should be observed that although two screen members 78 and 80 are employed in the preferred embodiment disclosed herein, a single screen member may prove adequate in some instances. On the other hand, more than two screen members may be required in other cases.

Referring to Figures 3 and 4, each of the spark plugs 28 and 30 include a coaxial electrode 88 which extends a considerable distance away from the base 90 of the plug into the housing. The free ends of these electrodes 88 are spaced adjacent the most forwardly located U-shaped electrodes 82F of the bank of electrodes most proximate to the side wall 46. The most rearwardly disposed electrode 82R in this bank is arranged adjacent a straight connector electrode 92. The opposite half of this connector electrode 92 is in turn spaced adjacent the most rearwardly disposed U-shaped electrode 82R' of the next bank of electrodes. The most forwardly located U-shaped electrode 82F' in this second bank of electrodes is disposed adjacent a second straight connector electrode 94. A similar straight connector electrode 96 serves to connect the most rearwardly located U-shaped electrodes of the third and fourth banks of electrodes. Yet a fourth straight connector electrode 98 connects the front U-shaped electrode of the fourth bank of electrodes with that of the bank of electrodes disposed most proximate the side wall 44. The most rearwardly located U-shaped electrode of this last bank is disposed adjacent the straight terminal electrodes 57 and 58 which are secured within the bores 55 and 56, respectively, of the side wall 44. These last-mentioned electrodes are each insulated from the housing 20 by a suitable grommet 100. With this arrangement, when a high voltage current is impressed upon the spark plugs 28 and 30, a spark will pass from the electrodes 88 of the spark plugs to the terminal electrode 57 and 58 by means of the various U-shaped electrodes 82 and the connector electrodes 92, 94, 96 and 98, the spark moving rearwardly along the first bank of electrodes, forwardly along the second, rearwardly along the third, forwardly along the fourth and again rearwardly along the fifth bank. The spark will be prevented from short-circuiting and thereby taking any other path by a plurality of vertically extending separators 99 which are interposed between each of the banks of electrodes. These separators 99 are formed of a material having high electrical insulating qualities, as well as being capable of withstanding high temperatures over extended periods of time. They may thus be formed of porcelain or of a porcelainized metal. Vertical slots 101 are formed in the mounting bars 72 and 74 for maintaining these separators 99 in place. Preferably, a coating of electrical insulating material 102 is applied to the interior of the housing 20 to assist in preventing short-circuiting of the spark.

The high voltage necessary for producing sparking between the gaps 26 is provided by means of the induction coil 32. This coil 32 receives low voltage electric current from a suitable storage battery (not shown) and/or an electrical generator (also not shown). Such battery and generator may be the same ones utilized in operating the conventional electrical components of the automotive vehicle. A high tension lead 112 connects the windings of the coil and the spark plugs 28 and 30.

Preferably, the coil 32 will only draw electric current during the time that the operating conditions of the engine I are of such a nature that its exhaust gases contain a prohibitive percentage of contaminants. In most instances such a condition exists while the engine is idling and decelerating. It is possible, however, that this condition may also exist when the engine is operating at a partial throttle setting.

Referring to Figure 1, the switch 36 is adapted to effect the desired intermittent operation of the coil 32. This switch 36 is connected to the accelerator pedal 38 by means of a link 114 in such a manner that it will normally permit electric current to flow to the coil 32 only when the pedal is disposed in a raised position, i. e. only during idling and decelerating conditions. An adjusting bolt 116 is interposed between the link 114 and the switch 36. By the use of this adjusting bolt 116 the point at which the switch 36 is to be opened may be accurately controlled.

A lead 118 connects the switch 36 and the coil 32. The latter includes a conventional vibrator mechanism (not shown) which automatically interrupts the electric current flow through the windings of the coil several times a second so long as current is supplied to the coil by means of the switch 36 and the battery or generator.

Referring now to Figures 1 and 6, the tubing 29 is connected to a number of branch tubes 120. Each of the latter extend upwardly into the exhaust manifold M, as shown in Figure 6, so as to convey fresh air from the blower 27 to a point adjacent the exhaust valves 122. The portion of the branch tubes 120 disposed within the exhaust manifold is formed with a curve 124 so as to direct the fresh air as close to the exhaust valves 122 as possible without actually projecting such cold air on the hot valves. Preferably, the tubing 29 and its branch tubes 120 are formed of stainless steel.

The operation of the preferred form of apparatus should be readily apparent from the foregoing detailed description. As the exhaust gases flow through the housing 20 they will pass through the gaps 26 while sparking takes place between these gaps. A certain percentage of the unburned constituents of the exhaust gases will be ignited by the electric sparks. The presence of the fresh air from the blower 27 will tend to accelerate this combustion operation. It should be noted that the size of the housing 20 is to be so chosen that its presence will not increase the back pressure exerted by the exhaust gases. It should also be noted that the U-shaped electrodes 82 are substantially self-adjusting with respect to their gapping. This is true inasmuch as the major portion of each spark will pass across the narrowest portion of the gaps 26 thereby tending to burn away the excess electrode material.

While the exhaust gas purifying apparatus shown and described herein is particularly adapted for use with automotive vehicles, it may also find use in conjunction with purifying the discharge of industrial heating units, incinerators and the like. Thus, it will be understood that various modifications and changes may be made with respect to the foregoing description without departing from the spirit of the invention or the scope of the following claims.

I claim:

1. Exhaust gas purifying apparatus for use with an internal combustion engine having an exhaust manifold, and an accelerator pedal that controls the speed of

said engine, comprising: a housing in communication with said manifold through which said exhaust gas is passed; grid means disposed within said housing in the path of said gas, said grid means defining a plurality of gaps; an induction coil connected to said grid means for producing high voltage sparks across said gaps so long as electric current is supplied to said coil; and switch means for controlling the flow of electric current to said coil, said switch means being operatively connected to said accelerator pedal whereby it will permit current to flow to said coil only when said pedal is in a raised position.

2. Exhaust gas purifying apparatus for use with an internal combustion engine having an exhaust manifold, and an accelerator pedal that controls the speed of said engine, comprising: a housing in communication with said manifold through which said exhaust gas is passed; means for introducing air into said exhaust gas before it enters said housing; grid means disposed within said housing in the path of said gas, said grid means defining a plurality of gaps; an induction coil connected to said grid means for producing high voltage sparks across said gaps so long as electric current is supplied to said coil; and switch means for controlling the flow of electric current to said coil, said switch means being operatively connected to said accelerator pedal whereby it will permit current to flow to said coil only when said pedal is in a raised position.

3. Exhaust gas purifying apparatus for use with an internal combustion engine having exhaust valves that discharge exhaust gas into an exhaust manifold, comprising: a housing in communication with said manifold through which said exhaust gas is passed; an air pump driven by said engine; tubing interconnecting the discharge of said air pump with said exhaust manifold adjacent each of said exhaust valves; grid means disposed within said housing in the path of said gas, said grid means defining a plurality of gaps; and, electrical means connected to said grid means for producing high voltage sparks across said gaps.

4. Exhaust gas purifying apparatus for use with an internal combustion engine having exhaust valves that discharge exhaust gas into an exhaust manifold, and an accelerator pedal that controls the speed of said engine, comprising: a housing in communication with said manifold through which said exhaust gas is passed; an air pump driven by said engine; tubing interconnecting the discharge of said air pump with said exhaust manifold adjacent each of said exhaust valves; grid means disposed within said housing in the path of said gas, said grid means defining a plurality of gaps; an induction coil connected to said grid means for producing high voltage sparks across said gaps so long as electric current is supplied to said coil; and switch means for controlling the flow of electric current to said coil, said switch means being operatively connected to said accelerator pedal whereby it will permit current to flow to said coil only when said pedal is in a raised position.

5. Exhaust gas purifying apparatus for use with an internal combustion engine having an exhaust manifold, and an accelerator pedal that controls the speed of said engine, comprising: a housing in communication with said manifold through which said exhaust gas is passed; a screen member disposed within said housing transverse to the direction of exhaust gas flow, said screen member including a plurality of straight banks of generally U-shaped electrodes, the proximate ends of said banks being connected by a conductor electrode, said electrodes cooperating to define a plurality of gaps; a spark plug secured to said housing and having an electrode disposed adjacent the end of one of said banks; a terminal electrode secured to said housing and terminating adjacent the end of one of said banks; means insulating said electrodes from said housing; an induction coil connected to said spark plug so as to produce high voltage sparks across said gaps so long as electric current is supplied to said coil; and switch means for controlling the flow of electric current to said coil, said switch means being operatively connected to said accelerator pedal whereby it will permit current to flow to said coil only when said pedal is in a raised position.

6. Exhaust gas purifying apparatus for use with an internal combustion engine having exhaust valves that discharge into an exhaust manifold, and an accelerator pedal that controls the speed of said engine, comprising: an air pump driven by said engine; tubing interconnecting the discharge of said air pump with said exhaust manifold adjacent each of said exhaust valves; a housing in communication with said manifold through which said exhaust gas is passed; a screen member disposed within said housing transverse to the direction of exhaust gas flow, said screen member including a plurality of straight banks of generally U-shaped electrodes, the proximate ends of said banks being connected by a conductor electrode, said electrodes cooperating to define a plurality of gaps; a spark plug secured to said housing and having an electrode disposed adjacent the end of one of said banks; a terminal electrode secured to said housing and terminating adjacent the end of one of said banks; means insulating said electrodes from said housing; a separator formed of an electrical insulating material disposed between each of said banks; an induction coil connected to said spark plug for producing high voltage sparks across said gaps so long as electric current is supplied to said coil; and switch means for controlling the flow of electric current to said coil, said switch means being operatively connected to said accelerator pedal whereby it will permit current to flow to said coil only when said pedal is in a raised position.

7. Exhaust gas purifying apparatus for use with an internal combustion engine having an exhaust manifold, and an accelerator pedal that controls the speed of said engine, comprising: a housing that is connected at one of its ends to said exhaust manifold and at its other end to a discharge pipe, exhaust gas from said engine flowing through said housing; a plurality of electrically insulated separators extending through said housing parallel to the direction of exhaust gas flow therethrough; a bank of U-shaped electrodes disposed between each of said separators, said banks being aligned with each other in a plane transverse to the direction of exhaust gas flow; a straight connector electrode electrically coupling the U-shaped electrodes at the proximate ends of said banks; a spark plug secured to said housing and having an electrode disposed adjacent the end of one of said banks; a terminal electrode secured to said housing and terminating adjacent the end of one of said banks; means insulating said electrodes from said housing; an induction coil connected to said spark plug for producing high voltage sparks across said gaps so long as electric current is supplied to said coil; and switch means for controlling the flow of electric current to said coil, said switch means being operatively connected to said accelerator pedal whereby it will permit current to flow to said coil only when said pedal is in a raised position.

8. Exhaust gas purifying apparatus for use with an internal combustion engine having an exhaust manifold, and an accelerator pedal that controls the speed of said engine, comprising: a housing that is connected at one of its ends to said exhaust manifold and at its other end to a discharge pipe, exhaust gas from said engine flowing through said housing: a plurality of electrically insulated separators extending through said housing parallel to the direction of exhaust gas flow therethrough; a bank of U-shaped electrodes disposed between each of said separators, said banks being aligned with each other in a plane transverse to the direction of exhaust gas flow; a straight connector electrode electrically coupling the U-shaped electrodes at the proximate ends of said banks; a spark plug secured to said housing and having an electrode disposed adjacent the end of one of said banks; a

terminal electrode secured to said housing and terminating adjacent the end of one of said banks; means insulating said electrodes from said housing; an induction coil connected between said spark plug and said terminal electrode for producing high voltage sparks across said gaps so long as electric current is supplied to said coil; switch means for controlling the flow of electric current to said coil; a link connecting said accelerator pedal and said switch; and, adjustment means between said link and said switch.

9. Exhaust gas purifying apparatus for use with an internal combustion engine having exhaust valves that discharge into an exhaust manifold, and an accelerator pedal that controls the speed of said engine, comprising: an air pump driven by said engine; tubing interconnecting the discharge of said air pump with said exhaust manifold adjacent each of said exhaust valves; a housing that is connected at its upper end to said exhaust manifold and at its lower end to a discharge pipe, exhaust gas from said engine flowing downwardly through said housing; a plurality of vertically extending and horizontally spaced electrically insulated separators extending through said housing parallel to the direction of exhaust gas flow therethrough; first and second vertically spaced screen members, each screen member including a plurality of horizontally aligned banks of U-shaped electrodes, a single bank being disposed between each of said separators, and a straight connector electrode coupling the U-shaped

electrodes at the proximate ends of said banks; first and second spark plugs secured to said housing in line with said screen members and having an electrode disposed adjacent the end of one of the banks thereof; first and second terminal electrodes secured to said housing in line with said screen members and terminating adjacent the end of one of the banks thereof; means insulating said electrodes from said housing; an induction coil connected between said spark plugs and said terminal electrodes for producing high voltage sparks across said gaps so long as electric current is supplied to said coil; switch means for controlling the flow of electric current to said coil; a link connecting said accelerator pedal and said switch; and, adjustment means between said link and said switch.

10. Apparatus as set forth in claim 9 where the U-shaped electrodes of said first screen member are vertically staggered with respect to those of said second screen member.

References Cited in the file of this patent

UNITED STATES PATENTS

977,336	Shaffner et al.	Nov. 29, 1910
1,400,795	Bradley	Dec. 20, 1921
1,756,897	Bilsky	Apr. 29, 1930
1,843,999	White	Feb. 9, 1932

FOREIGN PATENTS

834,510	France	Aug. 22, 1938