

[72] Inventors Shizuo Yagi, Asaka-shi,
Kazuo Nakagawa, Tokyo, Akira Ishizuya,
Kitaadachi-gun, Saitama-ken, Shuichi
Yamazaki, Yasuhito Sato, Iruma-gun,
Saitama-ken, and Masaharu Sekiguchi,
Sayama-shi, Japan

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[73] Assignee Honda Giken Kogyo Kabushiki Kaisha
Tokyo, Japan

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Japan

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43/38873

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F02d 37/02; F02n 5/16

[50] Field of Search 123/97(B)
97, 117.1, 117, 102, 148NC, DS, 146.5A, 119

[56]

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Primary Examiner—Wendell E. Burns

Attorney—Waters, Roditi, Schwartz & Nissen

[54] ENGINE-BRAKE INTENSIFYING DEVICE FOR
SPARK-IGNITION TYPE INTERNAL-
COMBUSTION ENGINES WITH AN AIR-
POLLUTION PREVENTIVE SYSTEM
4 Claims, 16 Drawing Figs.

[52] U.S. Cl. 123/97,
123/117, 123/119, 123/146.5

ABSTRACT: Conventional air pollution preventive devices incorporated in spark-ignition engines have principally involved a certain limitation on the extent of throttle closing and resulted in a reduced engine brake effect. This difficulty can be overcome by arranging in the ignition system an additional contact breaker which is operable with an ignition timing retarded relative to that of the normal contact breaker. The additional breaker is rendered effective in place of the latter, when the engine brake is applied, to rapidly reduce the power output of the engine.

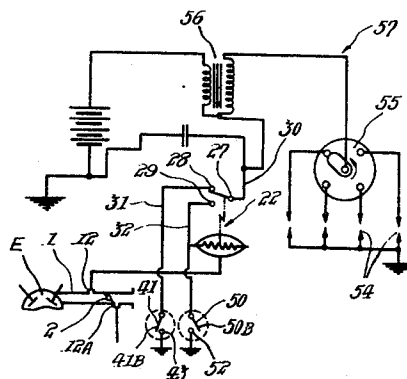
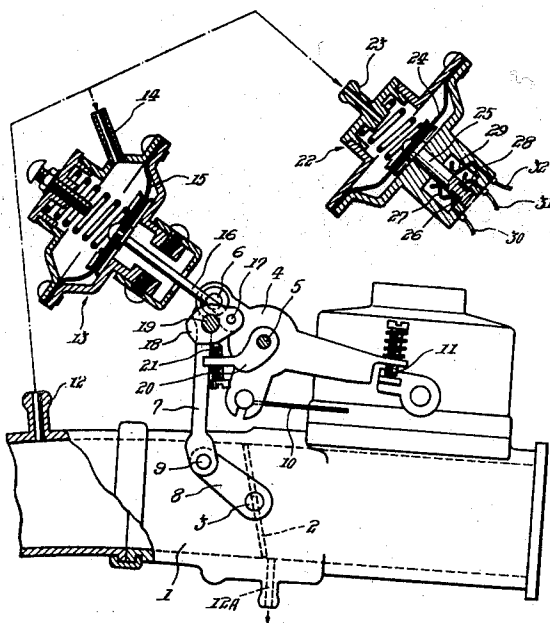


Fig. 1.

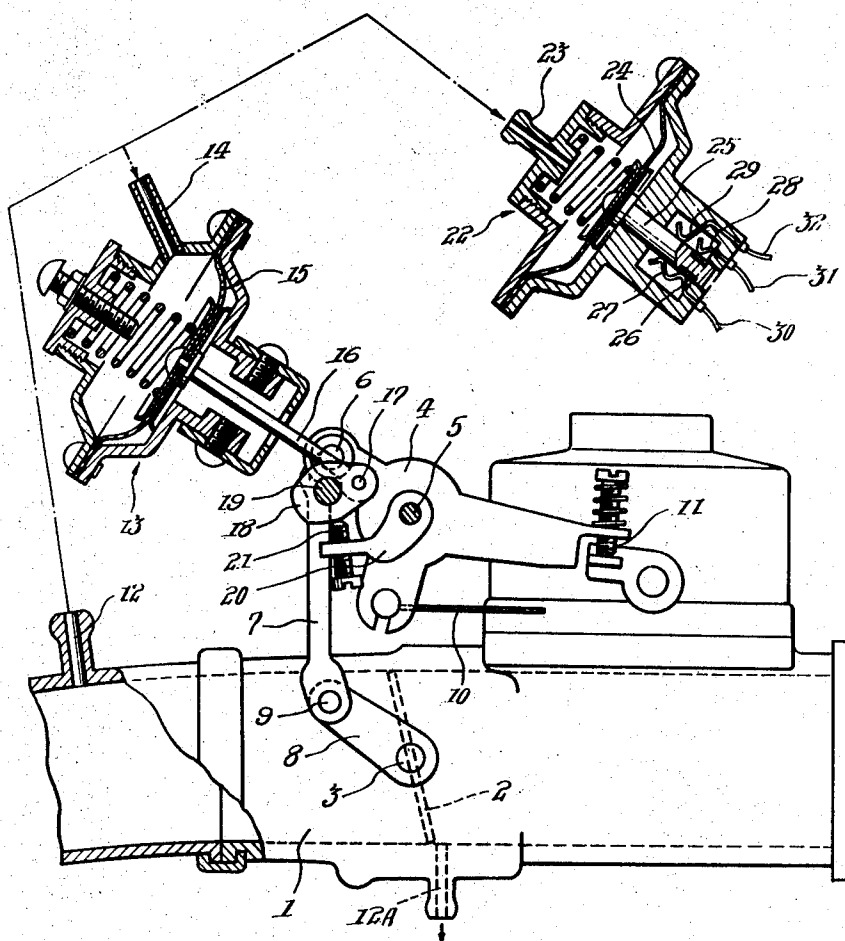


Fig. 2

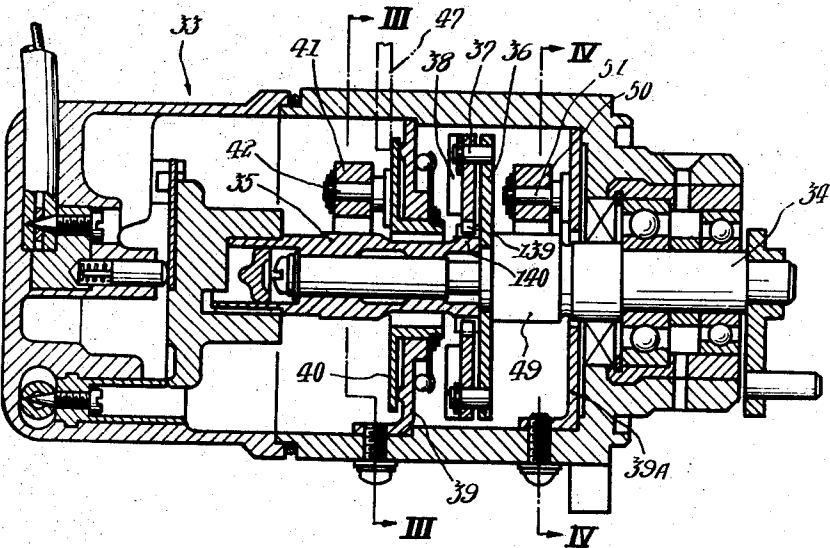


Fig. 3-

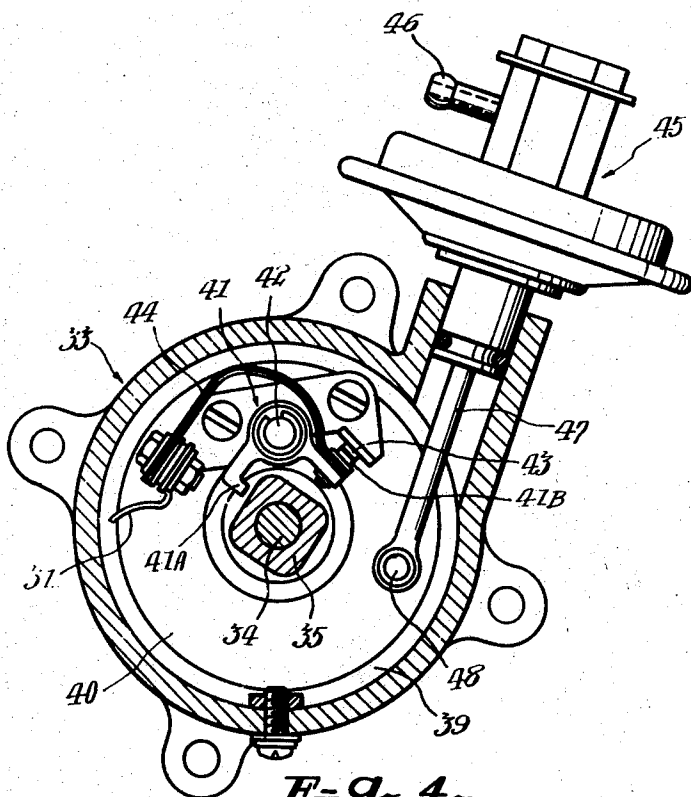


Fig. 4-

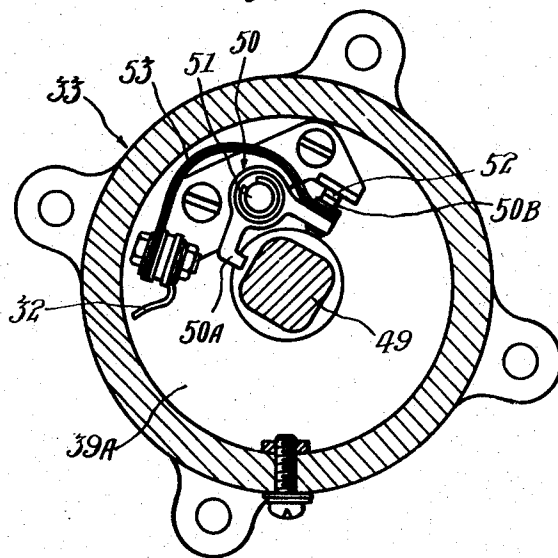


Fig. 5

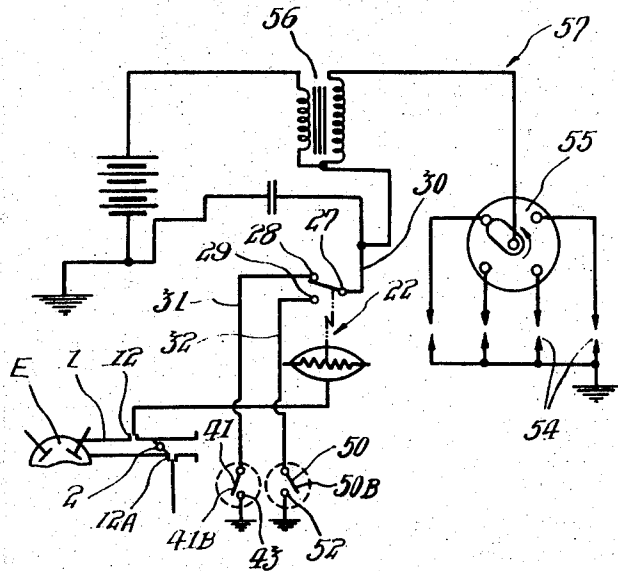


Fig. 6

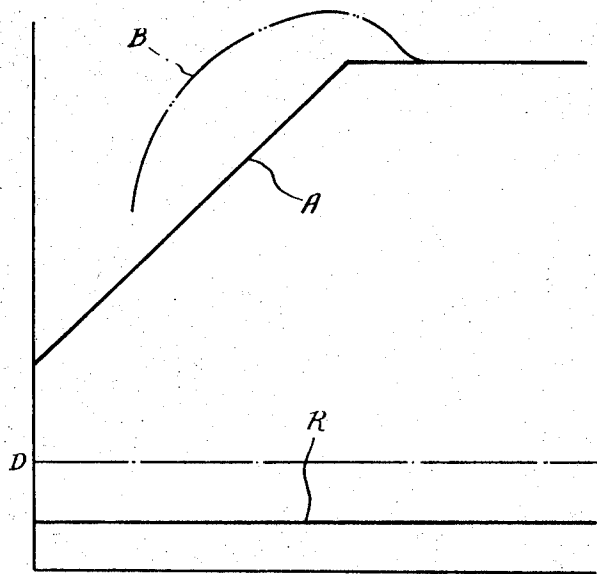


Fig. 7

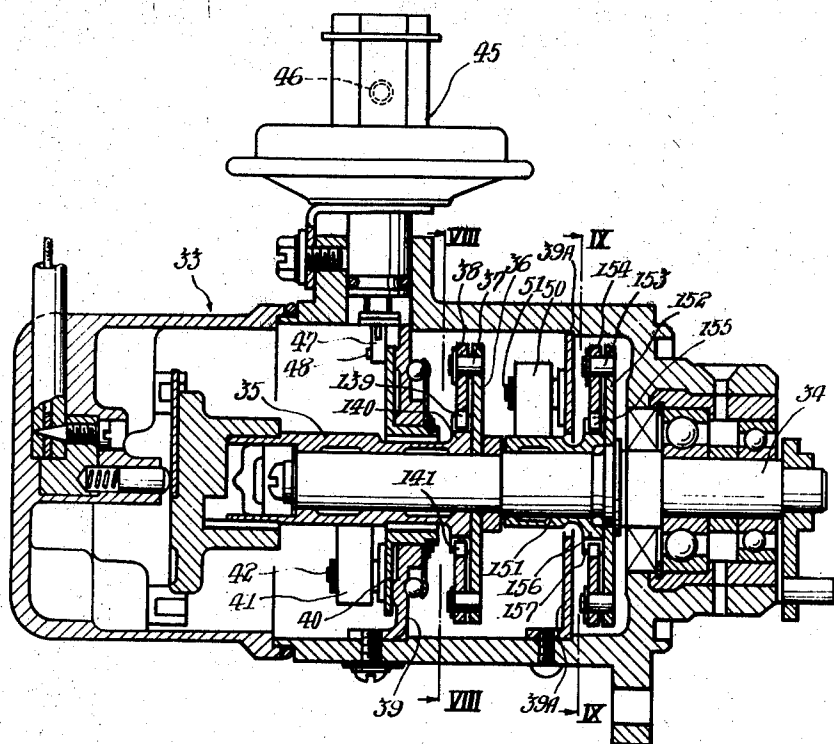


Fig. 8~

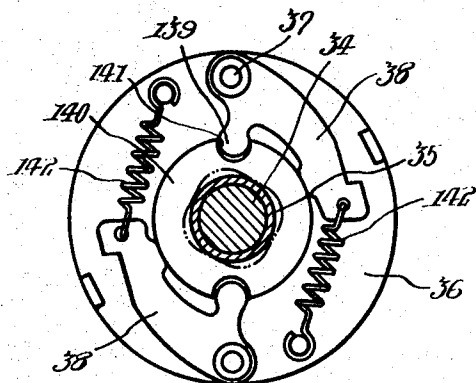


Fig. 9~

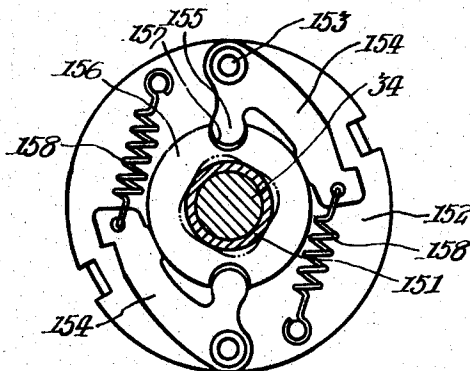


Fig. 10~

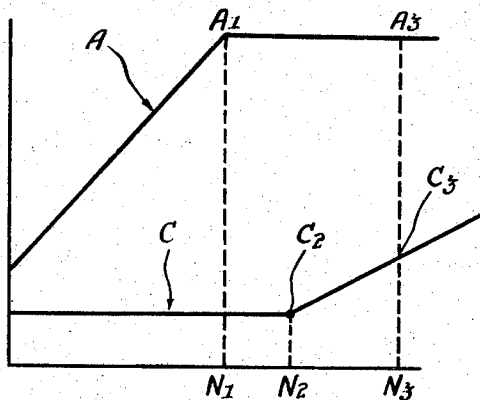


Fig. 11.

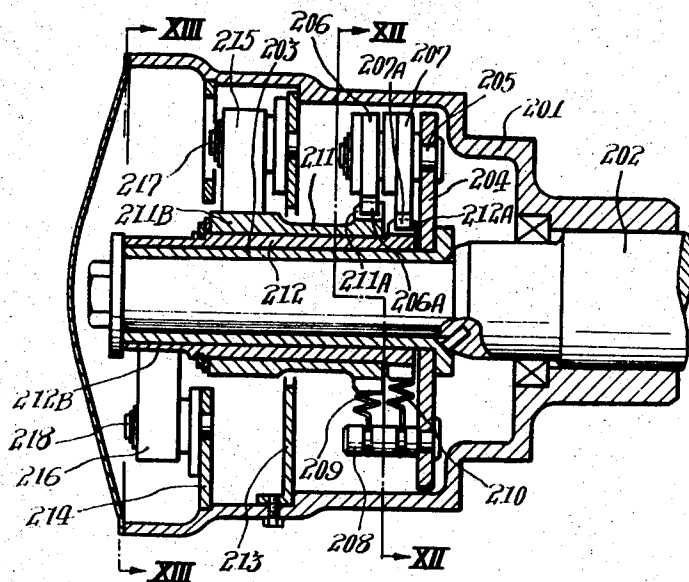


Fig. 12.

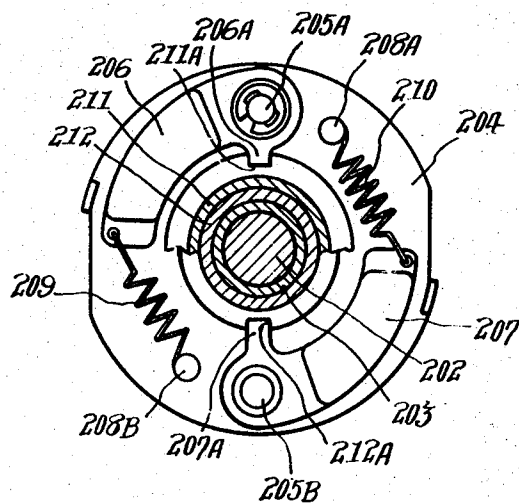


FIG. 13.

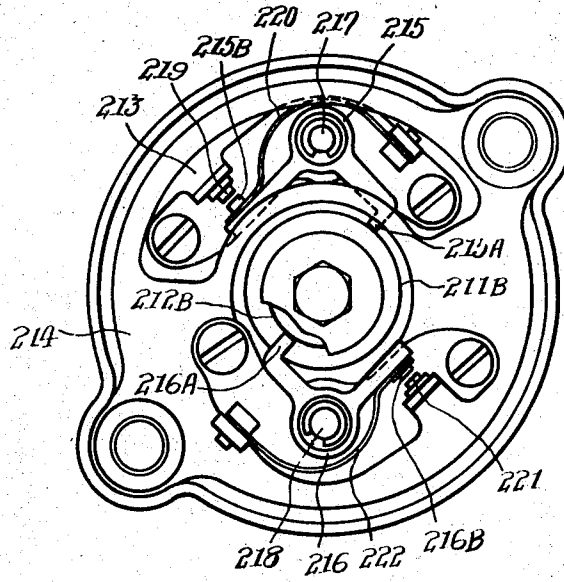
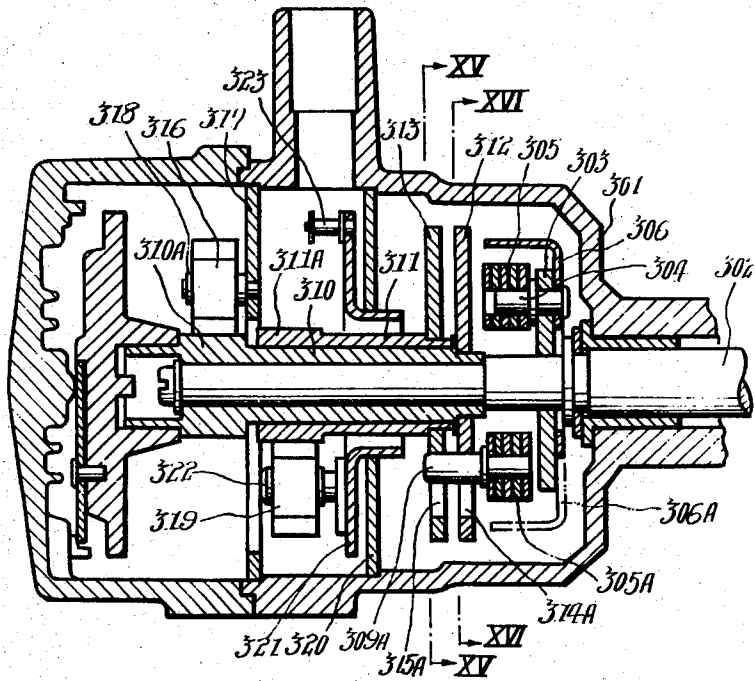


FIG. 14.



ENGINE-BRAKE INTENSIFYING DEVICE FOR SPARK-IGNITION TYPE INTERNAL-COMBUSTION ENGINES WITH AN AIR-POLLUTION PREVENTIVE SYSTEM

The present invention relates generally to spark-ignition-type internal-combustion engines and more particularly to air-pollution preventive devices therefor.

With spark-ignition-type internal-combustion engines it has been known that closing the throttle valve as for rapid deceleration of the engine decreases the amount of air intake per engine cycle and thus causes incomplete fuel combustion and hence discharge of large quantities of unburned gases into the atmosphere, which contributes to air pollution. To overcome this situation, it has already been a practice to employ an air pollution preventive device principally designed to prevent excessive decrease in engine intake as occurring when the engine is rapidly decelerated. This practice, however, has involved a deficiency that no satisfactory reduction in engine power output cannot be obtained and this results in marked impairment of the engine brake effect, rendering the engine unable to stop quickly.

The present invention has for its object to provide an engine-brake intensifying device for spark-ignition-type internal-combustion engines incorporating an air pollution preventive system of the character described, which device makes possible rapid deceleration of the driven parts of the engine without impairing the function of the air pollution preventive system, and is particularly suitable for automotive engines.

According to the device of the invention, discharge of any large quantities of unburned gases can be effectively prevented while obtaining a satisfactory engine brake effect at least in the lower range of engine speeds, but, in the higher speed range where the amount of intake per engine cycle is extremely reduced, it has been shown by experiments that, when the volumetric efficiency is reduced to the order of 15 percent or less, abnormal combustion phenomena such as backfiring and afterfiring may take place rendering the engine operation clumsy, depending upon the particular kind of the engine. On the other hand, if the device for moderating the reduction in amount of intake be set for a relatively wide range of throttle, the amount of intake and hence the power output of the engine when the engine brake is applied will be correspondingly increased disadvantageously reducing the engine brake effect.

In view of this, another object of the present invention is to provide an engine-brake intensifying device of the character described which effectively overcomes the above-described difficulty met in the higher range of engine speeds.

A further object of the present invention is to provide an engine-brake intensifying device of the character described which includes a plurality of contact breaker each including a breaker cam controllable by simple centrifugal means.

These and other objects, features and advantages of the present invention will become apparent from the following description when taken in conjunction with the accompanying drawings, which illustrate a few preferred embodiments of the invention and in which:

FIG. 1 is a partly cross-sectional partly schematic illustration of one example of air pollution preventive system embodying the present invention, showing an intake duct with a throttle valve operable both by accelerator pedal means and by intake vacuum and adapted to prevent excessive reduction in air intake, and also showing a vacuum-operated switching device forming part of the present invention;

FIG. 2 is an axial cross section of one form of contact breaker unit embodying the present invention and usable in association with the switching device shown in FIG. 1;

FIG. 3 is a cross section taken along the line III-III in FIG. 2;

FIG. 4 is a cross section taken along the line IV-IV in FIG. 2;

FIG. 5 is a schematic diagram illustrating the wiring connection of the entire ignition system embodying the present invention;

FIG. 6 is a characteristic chart diagram showing the manner in which the ignition timing is retarded by the device of the present invention;

FIGS. 7 to 10 illustrate a modification of the breaker unit shown in FIGS. 2 to 6, adapted to improve the performance in the higher speed range; FIG. 7 being an axial cross section of the contact breaker unit; FIGS. 8 and 9 being cross sections taken along the respective lines VIII-VIII and IX-IX in FIG. 7; and FIG. 10 being a characteristic diagram of the modified device, similar to FIG. 6.

FIG. 11 is an axial cross section of a further form of contact breaker unit of simplified structure including a single disc firmly secured to the cam shaft and carrying two spark advancing weights for actuating two respective breaker cam sleeves;

FIG. 12 is a cross section taken along the line XII-XII in FIG. 11;

FIG. 13 is a cross section taken along the line XIII-XIII in FIG. 11;

FIG. 14 is an axial cross section showing another form of contact breaker unit of simplified structure in which two breaker cam sleeves are operable by a single kind of centrifugal advancing weights;

FIG. 15 is a cross section taken along the line XV-XV in FIG. 14; and

FIG. 16 is a cross section along the line XVI-XVI in FIG. 14.

Description will now be made with reference to the drawings and first to FIGS. 1 to 6.

Referring to FIG. 1, reference numeral 1 indicates an intake duct in which a throttle valve 2 is pivotally mounted at 3. The duct is connected at one end, left in FIG. 1, to a spark-ignition-type internal-combustion engine E (see FIG. 5). Reference numeral 4 indicates a junction plate pivoted at 5 to the engine frame and a connecting rod 7 pivot at 6 to the junction plate 4 is pivoted at 9 to a lever arm 8, which is formed integral with the shaft 3 of the throttle valve. Also connected to the junction plate 4 are a throttle wire 10, which is connected to an accelerator pedal (not shown), and an adjusting screw 11 for determining the minimum opening of the throttle valve 2. With this arrangement, the throttle valve 2 is opened by operation of the accelerator pedal and closed under the action of an appropriate restoring spring (not shown), in a conventional manner.

Numeral 12 indicates a vacuum outlet or takeout port provided in the intake duct 1 on the side of the throttle valve 2 toward the engine and connected to the vacuum inlet port 14 of a vacuum actuator 13, which includes a diaphragm 15 and a pusher rod 16 connected therewith. A cam plate 18 is pivoted at 17 to the extreme end of the pusher rod 16 and also pivoted to the engine frame at 19. A pivotal arm 20 is firmly secured to the junction plate 4 and carries a threaded adjusting rod 21 for abutting engagement with the cam plate 18. With this arrangement, when the amount of air intake is decreased suddenly by the closing of the throttle valve 2, the vacuum from port 12 is correspondingly increased to cause rotation of the cam 18 so as to place its high dwell portion in contacting engagement with the adjusting rod 21 and thus the extent of throttle closing is limited precluding any excessive decrease in amount of air intake. It will be noted here that substantially the same result can also be obtained without employing such arrangement including cam 18 by utilizing either the vacuum or negative pressure from the vacuum takeout 12 or the released position of the accelerator pedal in the conventional manner to feed an additional supply of air into the intake duct on the engine side of the throttle valve 2.

Reference numeral 22 indicates a vacuum-operated switching device connected through a vacuum inlet 23 to said vacuum takeout port 12. An insulating slide rod 25 is secured to the diaphragm 24 mounted in the switching device and carries a short-circuiting ring 26, which is at all times in connection with an electrode strip 27 and placed alternately in connection with electrode strips 28 and 29. Respective conducting wires 30, 31 and 32 are connected to these electrode strips 27, 28 and 29, as shown.

Referring next to FIGS. 2 to 4, which illustrate a preferred form of contact breaker unit usable in the present invention, reference numeral 33 indicates the casing of the unit; 34 indicates the camshaft rotatable at a speed proportional to the speed of rotation of the internal-combustion engine E; and 35 indicates a first breaker cam mounted on the camshaft 34 for free rotation relative thereto. The first cam is shown formed as one for four-cylinder arrangement, but may apparently be formed to suit any other arrangement including a single-cylinder or an appropriate number of cylinders according to the case. As shown in FIG. 2, a supporting disc 36 is secured to the camshaft 34 and pivotally carries a pair of spark-advancing weights 38 at offcenter points 37 (see also FIG. 8). Each of the weights 38 is formed with an arm 139 which is in engagement with a respective slot 141 formed in the flange portion 140 of the first breaker cam 35. A relatively weak control spring 142 is connected to each of the weights 38 to bias it in one direction. As will be readily understood, the weight arrangement serves to impart to the cam 35 an angular displacement relative to the camshaft 34 according to the speed of rotation of the engine E.

Reference numeral 39 indicates a base plate fixed to the casing 33 and a ring plate 40 is rotatably supported in the central opening formed in the base plate 39 and pivotally carries a first breaker element or arm 41 as at 42. As shown in FIG. 3, the breaker element 41 carries at one end a slide finger 41A engageable with the cam 35 at high power ignition points. At the other end, the breaker element 41 carries a movable contact 41B, which is cooperable with a fixed contact 43. Numeral 44 indicates a leaf spring connected to the breaker element 41 normally to hold the movable contact 41B in pressure contact with fixed contact 43. Fixed contact 43 and leaf spring 44 are both mounted on the rotatable ring plate 40.

Reference numeral 45 generally indicates a vacuum actuator operatively connected with the breaker casing 33. A vacuum inlet 46 formed on the actuator 45 is connected to the vacuum takeout port 12 (FIG. 1) arranged in the vicinity of the throttle valve 2. The actuator 45 includes a diaphragm (not shown) to which is secured a pusher rod 47, which is pivotally connected with the movable plate 40. With the above arrangement, which is conventional per se, the ignition timing of the first contact breaker 41 is advanced according to the r.p.m. of the engine and also to the vacuum at the vacuum takeout port 12.

Referring next to FIGS. 2 and 4, reference numeral 49 indicates a second breaker cam firmly secured to the camshaft 34; and 39A indicates another base plate fixed to the breaker casing 33. The base plate 39A pivotally carries a second contact breaker element or arm 50 for low power ignition as at 51, where an ignition timing is obtainable which is retarded relative to that of the first breaker element 41. The second breaker element 50 carries at one end a slide finger 50A engageable with the camming surface of second breaker cam 49 and at the other end a movable contact 50B, which is cooperable with a fixed contact 52. A leaf spring 53 is provided to bias the breaker element 50 to normally hold its movable contact 50B in pressure contact with the fixed contact 52. As shown, the conducting wire 31 from the vacuum-operated switch 22 (FIG. 1) is connected to the movable contact 41B on the first breaker element 41 through the intermediary of leaf spring 44; conducting wire 32 is connected to the movable contact 50B on the second breaker element 50 through leaf spring 53; and conducting wire 30 is connected to an ignition distributor. Fixed contacts 43 and 52 are both grounded. FIG. 5 diagrammatically illustrates the wiring connection between the parts described and, is this FIG., numeral 54 indicates spark plugs for the respective cylinder of the engine E; 55 indicates an ignition distributor therefor; 56 indicates an ignition coil; and 57 generally indicates the ignition circuit conventionally formed of these elements.

Description will next be made of the operation of the device according to the present invention primarily with reference to FIG. 5.

It has previously been pointed out that, irrespective of how and in what engine state the throttle valve 2 is operated, there occurs no excessive decrease in suction or air intake per engine cycle and hence there is no danger that large quantities of unburned gases be discharged to pollute the atmosphere. In case the vacuum at the vacuum outlet 12 of the intake duct 1 is relatively limited and the electrode strips 27 and 28 of the vacuum-operated switch 22 are short circuited to render the first breaker element 41 effective to ignite spark plugs 54, the ignition timing is not only advanced or retarded through the intermediary of first breaker cam 35 in accordance with the speed of rotation of the engine E but also is varied through the ring plate 40 rotatable under the vacuum from the vacuum takeout port 12. On the other hand, in case the engine brake is applied for rapid deceleration of the engine and thus the vacuum at the vacuum takeout port 12 is increased, to interconnect the electrode strips 27 and 29 of vacuum-operated switch 22, the second breaker element 50 starts to serve the ignition purpose for spark plugs 54 with the ignition timing rapidly retarded to markedly reduce the engine power output and thus the engine brake effect is intensified. Incidentally, the vacuum actuator 45 may be omitted if desired and in this case the variation of the ignition timing of the first breaker element 41 will apparently depend solely on the engine speed.

In this manner, with the device of the present invention, if the engine brake is applied when the first breaker cam 35 is in operation for high power operation of the engine with the ignition timing advancing with increase in r.p.m. of the engine, the second breaker cam 49 starts to operate taking the place of the first cam 35 and the ignition timing is retarded to a definite point which is independent from the engine speed. In other words, if the engine brake is applied during high speed drive, the ignition timing is at once varied to the point for low power level ignition and the engine power output is reduced on the instant. This affords a remarkable industrial advantage that any reduction in the engine brake effect can be effectively avoided while precluding air pollution due to objectionable engine discharge.

As pointed out hereinbefore, if the engine brake is applied at high engine speeds the amount of intake per engine cycle will be extremely reduced and, if the ignition timing at the time is markedly retarded, the burning of the charge will also be retarded markedly and abnormal combustion phenomena such as after firing and backfiring may occur. According to the present invention, however, it has been confirmed by experiments that any reduction in engine brake effect can be effectively avoided without allowing occurrence of abnormal burnings such as described above even if the ignition timing with the second breaker cam 49 is set at a fixed retarded point in the vicinity of the top dead center as long as the throttle valve is controlled at all times to prevent the engine volumetric efficiency (the ratio of the volume of air actually admitted to the engine displacement volume) from descending below the order of 15 percent, depending upon the particular type of engine.

The manner in which the ignition timing is varied with the device of the present invention is graphically illustrated in FIG. 6, in which the abscissa represents the speed of rotation of the engine and the ordinate the time at which ignition occurs. Line A is a characteristic curve illustrating the ignition timing as controlled by first breaker cam 35 and rises with increase in engine speed. Line B represents a characteristic curve obtainable with an additional control by vacuum actuator 45. Line R represents the definite retarded ignition timing given by the second breaker cam 49. It is to be noted that, if the engine brake is applied when the ignition timing of the engine is being varied along characteristic curve A or B, the ignition timing is at once retarded or shifted to a definite point corresponding to the line R.

Description will next be made of another form of breaker device with reference to FIGS. 7 to 10, which is usable in association with the system of FIG. 1. In FIGS. 7 to 9, the same references have been used as in FIGS. 2 to 4 for similar parts

which have the same functions. The device shown in FIGS. 7 to 9 is principally the same as the one shown in FIGS. 2 to 4 with the difference that in the higher speed range of the engine the second breaker cam is advanced relative to the camshaft 34. Specifically, a support plate 152 is fixed to the cam shaft 34 and advancing weights 154 are pivoted to the support plate 152 at its offcenter positions 153 and each have an arm 155 engaged in a respective slot 157 formed in the flange portion 156 of the second breaker cam or sleeve 151. Reference numeral 158 indicates control springs connected to respective weights 154 and having a spring rate higher than that of weak control springs 142.

With this device, since the weak control springs 142 are connected to the respective weights 38 for the first breaker cam 35 as in the unit of FIGS. 2 to 4, and thus can be extended in the lower range of engine speed, the variation of ignition timing with engine speed by the first contact breaker element 41 is as illustrated by characteristic curve A in FIG. 10. That is, the ignition timing by the first breaker is advanced with increase in engine speed to reach a maximum advance at point A₁ corresponding to engine speed N₁ and thereafter remains substantially constant, as in the case of FIG. 6. On the other hand, the variation of ignition timing with engine speed by the second breaker 50 is represented by the characteristic curve C as the weights 154 for the second breaker cam sleeve ignition 151 are provided with stronger control springs 158, which are extended only in the higher range of engine speed. In this manner the ignition timing is advanced progressively with engine speed after point C₂ has been reached, which corresponds to engine speed N₂ (at which the volumetric efficiency of the engine is reduced to approximately 15 percent), though at lower engine speeds the ignition timing remains substantially fixed at a retarded point. In this connection, it is to be noted that according to the present invention there is no danger of giving rise to any abnormal fuel combustion even if at lower engine speeds the engine brake is employed and the ignition timing is retarded or shifted, from line A to line C since the range of operation of the throttle valve 2 is set in advance so as to prevent descent of the volumetric efficiency below 15 percent in the lower range of engine speed. In the higher range of engine speed exceeding N₂, for example, at the engine speed of N₃, the volumetric efficiency is reduced to 15 percent or less but again any abnormal fuel combustion is effectively prevented even when the engine brake is used and the ignition timing is retarded or shifted from point A₃ on line A to point C₃ on line C, since at C₃ the ignition timing of the second breaker is already advanced and correspondingly relatively early fuel combustion is obtained.

As apparent from the foregoing description, the present invention makes it possible to obtain a satisfactory engine brake effect over substantially the entire range of engine speed while avoiding abnormal fuel combustion and air pollution resulting therefrom.

Description will next be made of a further form of breaker device usable in the present invention with reference to FIGS. 11 to 13.

Reference numeral 201 indicates a breaker casing in which a cam shaft 202 is journaled which is rotatable at a speed proportional to the engine speed. Fixedly fitted over the cam shaft 202 is a bearing sleeve 203 to which a rotative disc 204 is fixed. A pivot stud 205 is firmly secured to the rotative disc 204 and pivotally carries at least two centrifugal advancing weights 206 and 207 of different characteristics. Control springs 209 and 210 differing in tension are arranged between the weights and a stud pin 208, which is secured to the disc 204, as shown in FIG. 11. If desired, the stud means 205 and 208 may each be provided in plurality as indicated by 205A₂—205B and 208A—208B in FIG. 12. Operatively fitted over the bearing sleeve 203 are breaker cam sleeves 211 and 212 corresponding in number to the weights 206 and 207, which weights are formed with respective arms 206A and 207A for engagement with respective slots 211A and 212A formed in the cam sleeves 211 and 212 at one end thereof. In the em-

bodiment shown, one of the two breaker cam sleeves 212 is fitted directly over the bearing sleeve 203 and the other cam sleeve 211 is fitted over the cam 212. It will be apparent that these cam sleeves 211 and 212 may both be fitted directly over the bearing sleeve 203, if desired.

Fixed in the breaker casing 207 are partition plates 213 and 214 which pivotally carry breaker elements 215 and 216, respectively, at 217 and 218. As shown in FIG. 13, one of the breaker elements 215 is formed at one end with a slide finger 215A for sliding engagement with the cam portion 211B of the cam sleeve 211 and carries at the other end a movable contact 215B. Numeral 219 indicates a fixed contact cooperable with movable contact 215B; and 220 indicates a leaf spring provided to normally hold the movable contact 215B in pressure contact with the fixed contact 219. Similarly, the other breaker element 216 is formed at one end with a slide finger 216A for sliding engagement with the cam portion 212B of the cam sleeve 212 and carries at the other end a movable contact 216B, which is cooperable with a fixed contact 221. Numeral 222 indicates a leaf spring provided to normally hold the movable contact 216B in pressure contact with the fixed contact 221. It will be understood that the pairs of movable and fixed contacts mentioned above may be arranged for selective insertion in a single ignition circuit, as described hereinbefore, for regulation of the ignition timing or may be connected to respective separate ignition circuits, according to the operating condition of the engine. It will be apparent that either one of the two breaker mechanisms can be employed for the first or low power level ignition by assigning a weaker control spring to the mechanism.

This form of breaker unit is advantageous in that it can be made compact and simple in structure, as apparent from the above description, including a single disc 204 rotatable with the camshaft 202 and carrying at least two centrifugal advancing weights 206 and 207, cam sleeves 211 and 212 being fitted over the cam shaft 202 for engagement with the respective weights.

Reference will next be made to FIGS. 14 to 16, which illustrates a further modified form of breaker assembly embodying the present invention and in which reference numeral 301 indicates a breaker casing. A camshaft 302 is journaled in the casing 301 for rotation at a speed proportional to the engine speed. Fixed to the camshaft 302 is a rotative disc 303 which carries pivot studs 304 and 304A (FIG. 15), on which centrifugal advancing weights 305 and 305A are pivotally mounted, respectively. Numeral 306 indicates a support plate secured to the rotative disc 303 and formed at opposite ends with lugs 307 and 307A. Control springs 308 and 308A are arranged under tension between the lug 307 and centrifugal weight 305 and between lug 307A and centrifugal weight 305A, respectively. Reference numerals 309 and 309A indicate pins secured to and extending axially from the respective centrifugal weights 305 and 305A.

Further, ignition cam sleeves 310 and 311 are rotatably fitted over cam shaft 302 and overlying each other in generally coaxial relation. These cam sleeves 310 and 311 carry at one end respective plates 312 and 313 and are formed at the other end with cams 310A and 311A, respectively. Plate 312 is formed with camming slots 315 and 315A while plate 313 is formed with camming slots 314 and 314A which differ in contour from camming slots 315 and 315A. Pin 309 on the centrifugal weight 305 is fitted through the camming slots 314 and 315 while pin 309A on the centrifugal weight 305A is fitted through the camming slots 314A and 315A. It is to be understood that one of the two centrifugal weights 305 and 305A may be omitted if desired as they are formed to exhibit the same centrifugal characteristics.

Reference numeral 316 indicates a contact breaker element pivoted at 318 to a partition plate 317 for sliding engagement with cam 310A; and 319 indicates another contact breaker element pivoted at 322 to a rotative plate 321, journaled in another partition plate 320. The breaker element 319 is operable in sliding engagement with cam 311A, as shown. For

regulation of ignition timing, these breaker elements are selectively connected in a single ignition circuit as described hereinbefore or respectively connected in separate ignition circuits, depending upon the operating condition of the particular internal-combustion engine. Rotative plate 321 is caused to rotate by intake vacuum through the intermediary of a pin 323 in the manner described hereinbefore.

As apparent from the foregoing, this breaker arrangement also has practical advantages of compactness and simplicity in structure, including only a single centrifugal weight means 305 and 305A mounted on a rotative disc 303 to act upon a plurality of cam sleeves 310 and 311 fitted over camshaft 302, instead of employing separate centrifugal means for respective cam sleeves 310 and 311.

Though, in this embodiment, pins 309 and 309A are shown mounted on a pair of the same centrifugal weights 305 and 305A, the pins may, if desired, be mounted on plates 312 and 313, respectively, and fitted each through camming slots formed in this case in the respective centrifugal weights in two different contours.

Although several embodiments of the present invention have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

We claim:

1. In a spark-ignition internal-combustion engine of the type designed to prevent excessive reduction in amount of air intake and the resulting discharge of any large quantities of unburned gases from the engine even when the engine throttle is rapidly closed, an engine-brake intensifying device comprising: first contact breaker means including a first breaker cam operable in association with the engine and adapted to vary the ignition timing according at least to the engine speed, and a first breaker arm arranged about said first breaker cam at a point for high power ignition and operable during normal engine operation;

second contact breaker means including a second breaker cam operable in association with the engine and affording an ignition timing at all times remaining practically unchanged, and a second breaker arm arranged about said second second breaker cam at a point for low power ignition retarded relative to the ignition timing of said

first breaker means; and

switching means operable upon application of the engine brake to render said second contact breaker means effective in place of said first contact breaker means.

2. In a spark-ignition internal combustion engine of the type designed to prevent excessive reduction in amount of air intake and the resulting discharge of any large quantities of unburned gases from the engine even when the engine throttle is rapidly closed, an engine-brake intensifying device comprising:

first contact breaker means including a first breaker cam operable in association with the engine, and a first breaker arm arranged about said first breaker cam at a point for high power ignition and operable during normal engine operation, said first breaker cam being adapted to advance the timing of operation, of said first breaker arm with increase in engine speed in the whole range of engine speed;

second contact breaker means including a second breaker cam operable in association with the engine, a second breaker arm arranged about said second breaker cam at a point for low power ignition retarded relative to the ignition timing of said first breaker means, said second breaker cam being adapted to advance the timing of operation of said second breaker arm with increase in engine speed in the higher range of engine speeds; and

switching means operable upon rapid throttle closing to render said second contact breaker means effective in place of said first contact breaker means.

3. An engine-brake intensifying device as claimed in claim 2, which comprises a single rotative disc rotatable with the camshaft, and at least two centrifugal advancing weights of different centrifugal characteristics pivotally mounted on said rotative disc and held in operative engagement with said first and second respective breaker cams rotatably mounted on the cam shaft.

4. An engine-brake intensifying device as claimed in claim 2, which comprises a rotative disc rotatable with the camshaft, centrifugal advancing weights of one and the same centrifugal characteristic pivotally mounted on said rotative disc, and a plurality of different cam mechanisms operably connecting said centrifugal advancing weights with said first and second respective breaker cams rotatably mounted on the cam shaft.

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