

Feb. 14, 1939.

M. KADENACY

2,147,200

INTERNAL COMBUSTION ENGINE

Original Filed Jan. 23, 1936

2 Sheets-Sheet 1

Fig. 1.

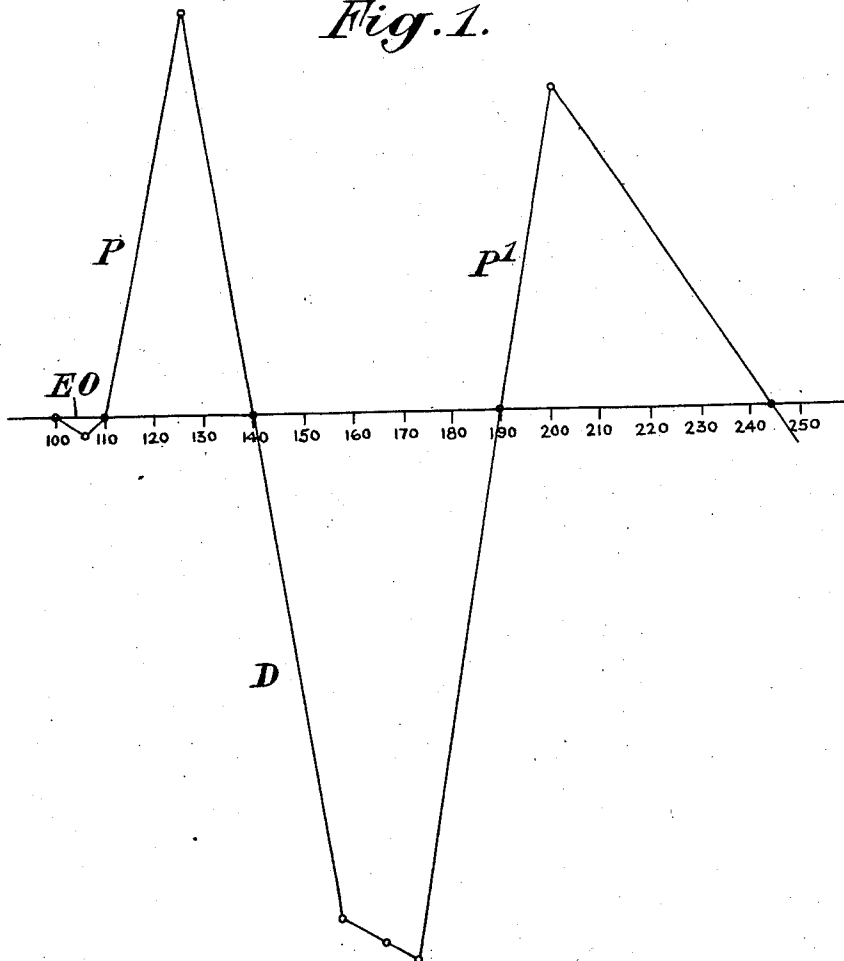
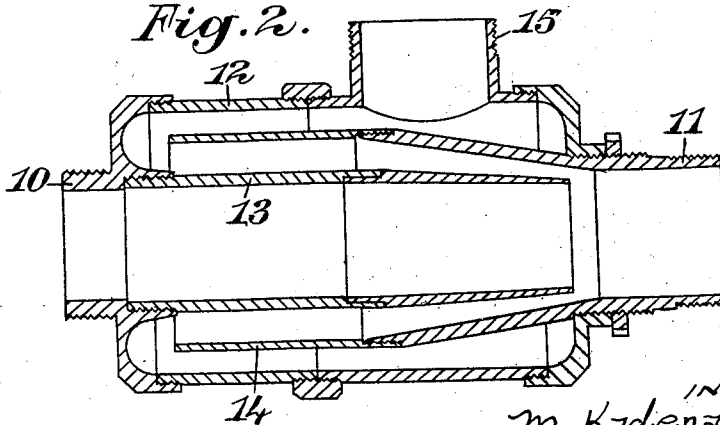


Fig. 2.



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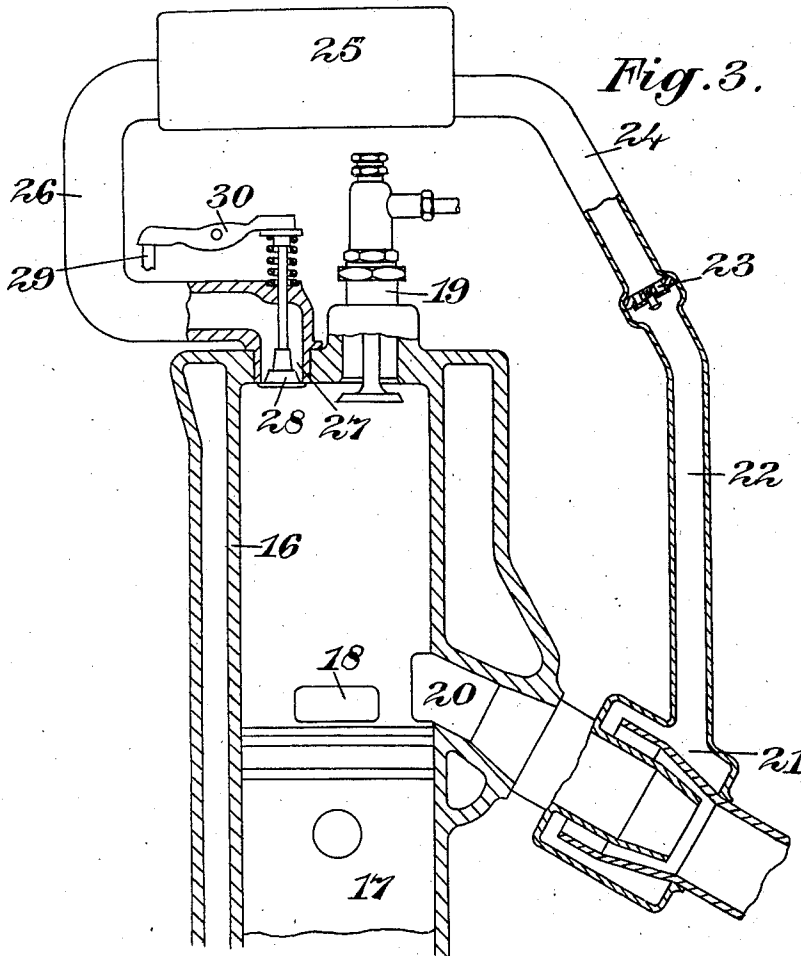
By: *Clascock Downing & Asbell*
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UNITED STATES PATENT OFFICE

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INTERNAL COMBUSTION ENGINE

Michel Kadenacy, Paris, France

Original application January 23, 1936, Serial No. 60,529, now Patent No. 2,134,920, dated November 1, 1938. Divided and this application June 3, 1937, Serial No. 146,297. In Great Britain August 13, 1935

2 Claims. (Cl. 60—32)

This invention relates to two-stroke cycle internal combustion engines of the kind wherein at least a substantial portion of the burnt gases leaves the cylinder at a speed much higher than that obtaining when an adiabatic flow only is involved, and in such a short interval of time that it is discharged as a mass leaving a depression behind it which is utilized in introducing a fresh charge into the cylinder by opening the inlet orifice with the required delay after the opening of the exhaust orifice to ensure that the burnt gases are then moving outwardly through the exhaust orifice or duct and that a suction effect is exerted at the inlet orifice as a consequence of the exit of the said mass, and is divided from my co-pending application, Serial No. 60,529 filed 23rd January, 1936, which has issued as Patent No. 2,134,920 on November 1, 1938.

According to the present invention that portion of the depression created by the mass exit of the burnt gases which is not utilized for the purpose of introducing fresh charge into the cylinder is employed for exerting a suction in the engine cylinder or for accumulating a depression in a container which depression may be utilized for example, for exerting a suction in the engine cylinder.

An embodiment of the invention will now be described, simply by way of example, and with reference to the accompanying drawings, in which:

Figure 1 is a curve of pressures and depressions taken in the exhaust duct of an engine of the kind to which the invention relates, during the exhaust period.

Figure 2 shows an example of a suitable arrangement of the communication between the exhaust duct and the pipe to be provided thereon.

Figure 3 shows an arrangement in which the invention is employed for exerting a suction through the cylinder of the engine to which it is applied.

If a record is taken of the pressure variations in the exhaust pipe of an internal combustion engine of the kind to which the invention relates during the exhaust period, a curve similar to that shown in Figure 1 may be obtained, in which EO represents the opening of exhaust, the ordinates represent pressures above and below atmospheric pressure and the abscissae crank angles in degrees.

It should be mentioned that the figure is a formal representation showing the chief characteristics of the curve and that the pressures above

and below atmospheric pressure are not shown in scale relationship.

Such a curve may be obtained for example by utilizing a stroboscopic device formed by a ported tube mounted in or on the exhaust duct and rotating with the engine and a stationary but angularly adjustable ported sleeve on this tube having its port connected to a manometer, a pressure or depression impulse being obtained each time the port in the tube and sleeve coincide and a record being taken when a steady reading is given on the manometer, the crank angle at which each reading is taken being determined by the angular adjustment of the sleeve.

The curve shows clearly the two phases of pressure or impulse P, P' that occur during the outflow and return of the gases and the intervening phase of depression D. This curve is characteristic for all internal combustion engines of the kind to which the invention relates but the moments at which the outflow and return of the gases occur will vary.

The period during the operation of the engine at which the aspiration of fluid may be produced in accordance with the invention, will be seen from Figure 1.

In the first place a pressure is registered shortly after the opening of exhaust, as shown by the part P of the curve.

A depression is then formed in the cylinder and a little later a depression D is formed in the exhaust duct and the intensity and magnitude of the volume in which it exists will be proportionate to the kinetic energy contained in the exhaust gases.

At this moment the aspiration of external fluid through the medium of a communication with the interior of the exhaust duct may be obtained.

The return shock P' then follows and destroys this depression phase.

In an engine of the kind to which the invention relates, the fresh charge admitted to the cylinder cannot fill the complete void left in the cylinder and in the exhaust duct by the issuing gases for practical reasons depending upon the position, shape and surface of the admission orifices.

In fact, the applicant has found that if an orifice is provided in the exhaust duct close to the cylinder and is opened to a source of gaseous fluid external to the exhaust duct, the volume of gaseous fluid drawn directly into the exhaust duct through this orifice during the depression phase described above does not in any way impede or reduce the charge admitted directly into the

cylinder through the usual admission orifices, although the volume of gaseous fluid drawn into the exhaust duct may be equal to this charge.

Consequently, by providing a pipe communicating with the interior of the exhaust duct of the internal combustion engine at a point nearer the cylinder than the point from which the burnt gases return, and with a source of fluid external to the exhaust duct, this fluid can be aspirated into the said chamber and thereafter discharged into the exhaust duct, without detriment to the utilization of the depression left in the cylinder by the issuing exhaust gases for the introduction of a fresh charge through the main admission ports.

Suitable distribution means must be provided so that the aspirated air or other gaseous fluid will follow the required direction during the suction and so that it cannot return from the paths it is required to follow.

These means may for example consist of non-return valves or of controlled valves or of means such as those described in British patent specification No. 431,857.

The communication with the interior of the exhaust duct must be suitably arranged to permit a utilization of the depression phase in accordance with the invention.

Figure 2 illustrates one example of an arrangement of the communication with the interior of the exhaust duct.

In this figure the exhaust duct is formed by two portions 10 and 11 connected together by a chamber 12.

The portion 10 of the duct is extended into the said chamber by means of a tubular element 13 opening into the portion 11 and situated in the interior of a tubular element 14 which extends the portion 11 of the duct and stops short of the inner wall of the said chamber 12. The annular space left between the elements 13 and 14 establishes a communication between the interior of the exhaust duct and the chamber 12.

The portion 11 of the duct is adjustably connected with the chamber 12 in order to permit a regulation of the distance between the free end of the element 14 and the internal wall of the chamber situated towards the cylinder.

The diameter of the free end of the element 13 is slightly smaller than that of the duct 11 and the element 14 at this point is slightly flared so as to provide a passage of increasing section between the elements 13 and 14 from the free end of the element 13.

The length of the element 13 may also be regulated by means of the screw connection provided between this element and the duct 10. These adjustments enable the action of the device to be varied so as to vary the intensity of the suction which will be exerted through the outlet 15 of the chamber 12.

In carrying the invention into effect the depression may be employed in order to exert a suction on the cylinder, through an additional outlet other than the main exhaust port, with the object of prolonging the suction in the cylinder, or of intensifying the suction therein, or of sucking residual gases from the cylinder, if desired through the intermediary of a reservoir and suitable distribution means, whereby the depression can be accumulated and employed at chosen moments. An example of such an application is illustrated in Figure 3.

This figure shows an engine cylinder 16 in which moves a piston 17. Air is admitted by

atmospheric pressure through the inlet 18 and fuel is introduced by the injector 19. Exhaust takes place through the duct 20.

Upon the exhaust duct close to the cylinder is provided an intake 21, which by way of example is shown similar to that illustrated in Figure 2, communicating with a first chamber 22.

This chamber 22 is provided at its other end with a suction valve 23 or the like, which may be controlled or otherwise, and which allows the passage of fluid only in the direction towards the exhaust duct. This valve 23 is followed by a duct 24 leading to a reservoir 25 connected by a duct 26 to an additional outlet 27 provided on the cylinder and controlled by a valve 28 actuated by a push rod 29 and rocker arm 30.

With such an arrangement a depression will be detained in the reservoir 25 which may be utilized at a convenient time by a suitably timed operation of the valve 28, in order to draw residual gases from the cylinder or to assist the entry of the charge to the cylinder through the inlet port 18.

In this example the suction valve 23 opens automatically each time a depression is left in the exhaust duct but it is obvious that the valve 28 should not open before the exhaust gases have left the cylinder and that it should not remain open after the inlet port 18 has closed.

In the example described with reference to Figure 3, the charge is introduced into the cylinder by atmospheric pressure but this does not exclude the use of means for maintaining or augmenting the pressure of the supply.

Any suitable devices may be provided in the exhaust duct in order to prevent a return wave of the exhaust gases from re-entering the cylinder, such for example as the means described in the applicant's British patent specification No. 431,857.

The valves employed for the suction of the fluid in an arrangement according to the invention may be simple or multiple. These valves may be arranged so as to provide a passage of large area and they may have any shape provided they respond to rapid suctions.

I claim:—

1. A two-stroke cycle internal combustion engine having a cylinder, a piston moving in the cylinder, exhaust and inlet orifices in the cylinder, an exhaust conduit on the exhaust orifice, means for so controlling the exhaust orifice during the firing stroke as to ensure the issuance of the burnt gases as a mass, whereby the said mass moves outward and thereafter returns from a point which may be within the said conduit, means for so controlling the inlet orifice as to ensure that it will be opened while the exhaust orifice is still open and when the said issuance of the burnt gases is in full progress and produces a suction effect in the cylinder, the exhaust conduit providing a permanent free passage for the burnt gases to the limit of outward travel of said gases, and providing a passage for the gases during their outward motion as a mass having no cross section of substantially greater area than any cross section thereof further from the cylinder, an intake on the exhaust conduit at a point situated nearer the cylinder than the limit of outward travel of the burnt gases, a supplementary outlet on the cylinder, means for so controlling said outlet as to ensure that it will be opened after the said issuance of the burnt gases through the exhaust orifice, a duct connecting the said intake to the supplementary

outlet, controlling means in said duct, said controlling means opening towards said intake, whereby the depression left behind the mass of burnt gases when it has passed beyond said intake causes a suction effect to be exerted in said connecting duct whereby any residual gases may be drawn out of the cylinder upon the opening of the supplementary outlet or the suction in the cylinder during charging may be prolonged or intensified.

2. A two-stroke cycle internal combustion engine having a cylinder, a piston moving in the cylinder, exhaust and inlet orifices in the cylinder, an exhaust conduit on the exhaust orifice, means for so controlling the exhaust orifice during the firing stroke as to ensure the issuance of the burnt gases as a mass, whereby the said mass moves outward and thereafter returns from a point which may be within the said conduit, means for so controlling the inlet orifice as to ensure that it will be opened while the exhaust orifice is still open and when the said issuance of the burnt gases is in full progress and produces a suction effect in the cylinder, the exhaust con-

duit providing a permanent free passage for the burnt gases to the limit of outward travel of said gases, and providing a passage for the gases during their outward motion as a mass having no cross section of substantially greater area than any cross section thereof further from the cylinder, an intake on the exhaust conduit at a point situated nearer the cylinder than the limit of outward travel of the burnt gases, a supplementary outlet on the cylinder, means for so controlling this outlet as to ensure that it will be opened after the said issuance of the burnt gases through the exhaust orifice, a duct connecting the said intake to the supplementary outlet, a reservoir in the said connecting duct, controlling means in the conduit between the reservoir and the said intake, the said controlling means opening towards the said intake whereby a depression may be stored in said reservoir for utilization in prolonging or intensifying the suction in the cylinder during charging or in sucking residual gases from the cylinder through the supplementary outlet.

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