T. E. DAVIS.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED SEPT. 2, 1920.

1,393,670. **Patented Oct. 11, 1921.**

2 SHEETS—SHEET 1.

Fig. 1.

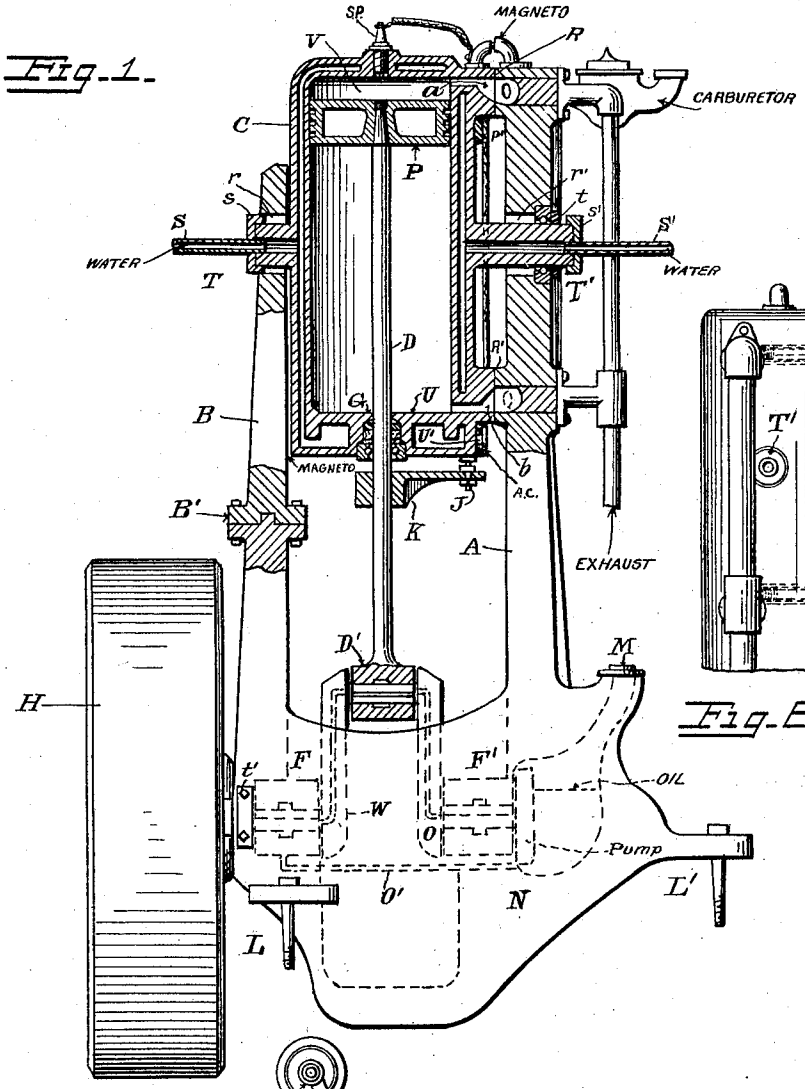

Fig. 6.

Fig. 5.

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2 SHEETS—SHEET 2.

Fig. 4.

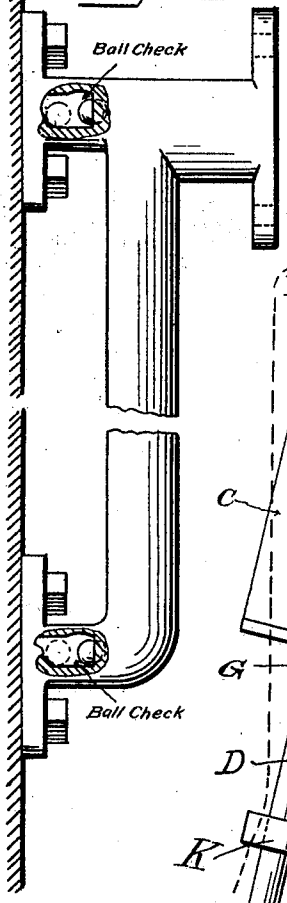


Fig. 3.

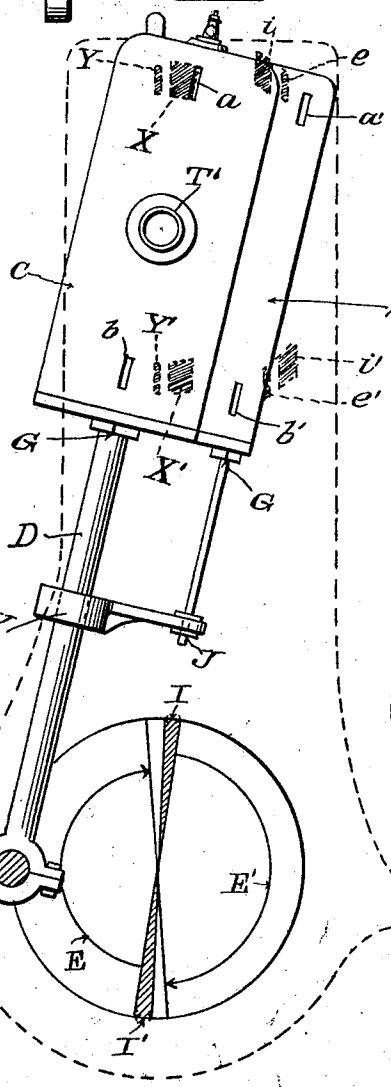
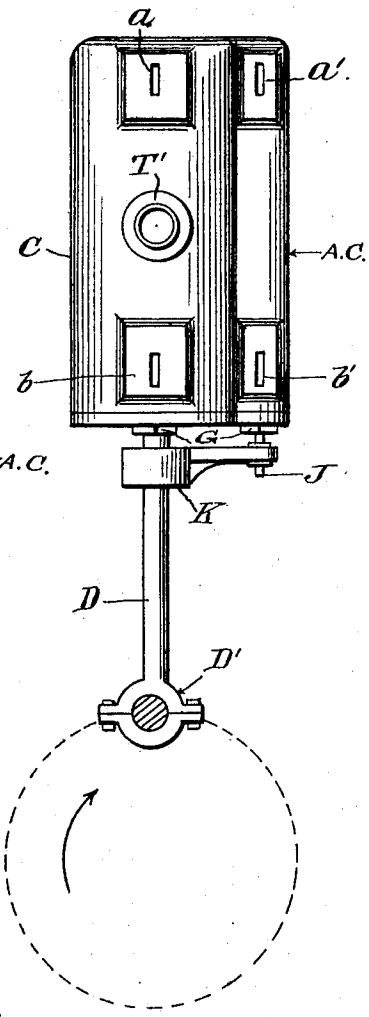


Fig. 2.



Inventor:
Theodore E. Davis
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Attorney.

UNITED STATES PATENT OFFICE.

THEODORE E. DAVIS, OF BRIGHAM, UTAH, ASSIGNOR TO DAVIS MOTOR CORPORATION, A CORPORATION OF UTAH.

INTERNAL-COMBUSTION ENGINE.

1,393,670. Specification of Letters Patent. Patented Oct. 11, 1921.

Application filed September 2, 1920. Serial No. 407,602.

To all whom it may concern:

Be it known that I, THEODORE E. DAVIS, a citizen of the United States, residing at Brigham city, in the county of Boxelder and State of Utah, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to improvements in internal combustion engines and refers particularly to engines used in automobiles, trucks, tractors, airplanes, motor boats, stationary and portable power plants, motorcycles, and all places and appliances where an internal combustion engine may be used.

The main object of my invention is the elimination of all intake and exhaust valves, all gears, chains and sprockets, all cam shafts, the resulting engine being absolutely noiseless and capable of enormous speed, and being of extremely simple, durable and inexpensive construction.

Another object of my invention is to utilize each stroke as a power-stroke, making this engine two-cycle, double-acting.

Another object of my invention is the utilizing of a pivoted cylinder, supported to the frame of the engine with two trunnions or pivot bearings,—the piston and connecting rod being composite, that is, the piston and the connecting rod are fixed, each to the other in a solid manner.

Another object of my invention is the employment of ports in the cylinder instead of sliding, sleeve, or puppet valves for intake and exhaust.

Another object of my invention is the employment of a smaller auxiliary cylinder for the purpose of drawing the fuel from the carbureter, compressing it under high pressure and injecting the resulting vaporized fuel into the main cylinder for exploding.

Another object of my invention is the creation of an engine capable of burning gasolene, illuminating gas, kerosene, and the cheaper grades of fuel, such as distillate and crude oil.

With these objects in view, my invention consists in certain details of construction and combination of parts for service, substantially as shown, described and claimed, it being understood that any changes may be made in the construction that come within the scope of my claims.

In order that the details of construction may be understood and the advantages which accrue from the use of my invention, I have shown in the accompanying drawings a structure embodying my invention.

Figure 1 represents a central sectional view of my invention with the integral parts shown in side elevation.

Fig. 2 represents an integral view of the main power cylinder, the auxiliary fuel-injecting cylinder and the connecting rods and connecting rod bearing, showing the ports for taking in the vapor and exhausting the exploded gases from the main power cylinder and the ports in the auxiliary injecting cylinder for drawing the fuel from the carbureter and injecting the compressed vapor into the main cylinder through the main cylinder ports, shown in front elevation.

Fig. 3 represents the timing diagram, showing the position of the ports in the engine housing in phantom view, front elevation, the positions of the center of the connecting rod bearing in the positions of intake, explosions and exhaust in both the upper and lower chambers.

Fig. 4 represents the intake manifold with carbureter support and with cutaway portions showing ball-checks to prevent back pressure to the carbureter.

Fig. 5 represents a top elevation of the ignition device.

Fig. 6 represents the front portion of the engine housing showing intake ducts in phantom, intake and exhaust manifolds and trunnion bearing for the front trunnion of the main power cylinder, shown in front elevation.

Referring by letter to the drawings, similar letters being used where advisable to denote the same parts in the six views:

The letter A designates the front portion of the engine housing, containing the trunnion bearings r' and t, the intake ducts, the intake and exhaust ports designated by the letters I, I′, and E, E′, respectively, in Fig. 3. R and R′ designates machined surfaces on projections of A through which the intake and exhaust ports pass, and which are in close contact with similar surfaces on C, the main power cylinder and on A. C. the auxiliary cylinder. These surfaces are kept in close contact with each other by the adjustable thrust bearing t, Fig. 1.

Main power cylinder C is constructed with top and side-walls in one casting together

with the trunnions T and T'. A water jacket extends entirely around the inner wall of C to provide for passage of the water from a radiator or other cooling device to insure proper cooling of the cylinder. The lower end of C is provided with a cylinder head U. An opening is provided on the top and one on the left rear wall of C to accommodate spark plugs for ignition. Cylinder C is also provided with machined surfaces similar to those on A, bearing closely to the like surfaces on A, and kept in constant close contact with the surfaces on A by the adjustable thrust bearing *t*. Through these surfaces, R and R' extend ports *a* and *b* through which the exhaust and intake gases pass. The head I is provided with a gland G consisting of three beveled metal rings, which, when pressure is brought against them from the bottom, have a tendency to contract and thereby lessen the size of the opening through G. Pressure is provided in the shape of a nut containing a ball thrust bearing which rides along the surfaces of the connecting rod D. D is a round metal rod having an enlarged base D' shaped to function as a connecting rod bearing on the lower end, and a tapered threaded upper end to which the hollow piston P is securely fastened. Piston P is designed to receive the force of the explosion from both top and bottom of the stroke, and is kept leak proof by three piston rings extending around the outer round surface and having a tendency to spread out against the inner cylinder wall, thereby preventing the passage of the gases past the piston.

Bearing D' works upon the complement bearing on the crank shaft W which is hollowed to permit of a passage of lubricating oil from the pump N at one end of the main bearing F' to the bearing D' and through the other main bearing F to a return duct O' back to the oil reservoir at the bearing F'. This passage through the crank is designated by the letter O in the drawings.

Bearings F and F' are constructed in two portions, the lower portion being integral with the engine housing A, and the upper portion being provided with bolts by which the two portions are fastened together.

A prolongation of the crank shaft W provides for the securing of a fly wheel H at its extreme end. This fly wheel is merely a simply constructed metal pulley of such weight and size as to compensate for the vibration set up by the revolving crank W. Between the fly wheel H and the main bearing F is provided a ball bearing thrust *t'* to prevent a misalinement of the connecting rod D and the cylinder C on the machined surfaces R and R'.

The letter B designates the remaining portion of the engine housing and consists of a metal casting providing for a roller bearing *r* through which passes trunnion T. B is fastened to the housing A at B' by bolts in the manner shown to simplify the process of assembling.

Trunnions T and T' are constructed with hollow centers to permit of the passage of the water from the water jacket of C through connections S and S' to the radiator or cooling device.

To the front and one side of C is provided the auxiliary cylinder A. C. being of similar construction to C. Auxiliary cylinder A. C. is cast integrally with cylinder C, having a perfectly round inner surface to permit of the passage of the piston P' up and down the length of the cylinder. Piston P' is constructed in a manner similar to P and is fastened to rod J which extends through a gland of similar construction to gland G., in the head U' which is screwed into the base of cylinder A. C. Rod J is threaded at the lower end unlike connecting rod D and is secured by lock nuts to the bracket K which is securely fixed to connecting rod D. Auxiliary cylinder A. C. is provided with machined surfaces as shown in Fig. 2 through which pass ports *a'* and *b'* and which are in close bearing contact with opposite surfaces on A and through which pass the intake and exhaust ports designated by *i*, *i'* and *e*, *e'* in Fig. 3.

In Fig. 3 is represented the timing diagram, showing the positions, on the imaginary circle which the center of bearing D' would produce in making a revolution of the crank, at which the intake and exhaust ports open and close at both the upward stroke and the downward stroke of the pistons P and P'. The upper shaded portion of the circle, marked Y in Fig. 3, represents the relative time the intake port I in housing A is opposite the port *a* in main cylinder C, and the exhaust port *e* in the housing A is opposite the port *a'* of the auxiliary cylinder A. C.; while the lower shaded portion of the circle represents the relative time the intake port I' in the housing A is opposite the port *b* in the main cylinder C, and the exhaust port *e'* in the housing A is opposite the port *b'* in the auxiliary cylinder A. C. The portion of the circle designated by the arc X, Fig. 3, represents the relative time the exhaust port E of the housing A is opposite the port *a* of the main cylinder C., and the time the intake port *i* of the housing A is opposite the port *a'* of the auxiliary cylinder A. C. The portion of the circle designated by the arc E', Fig. 3, represents the relative time the exhaust port X' of the housing A is opposite the port *b* in the main cylinder C, and the relative time the intake port *i'* of the housing A is opposite the port *b'* of the auxiliary cylinder A. C. The explosion in the upper compression chamber formed when the piston P has finished the

upward stroke, takes place at the point designated by the letter Y in the timing diagram circle, Fig. 3. The explosion in the lower compression chamber formed when the piston P has completed the downward stroke, takes place at the point designated by the letter Y′ in the timing diagram circle, Fig. 3.

The operation of the engine is as follows: Assuming piston P at the top of the stroke:

Revolving the crank shaft in a clock-wise direction, the piston P′ has just completed its upper compression stroke, the intake port I of the housing A is directly opposite the port *a* of the main cylinder C, and the exhaust port *e* of the housing A is directly opposite the port *a′* of the auxiliary cylinder A. C. The compressed vapor in A. C. is then forced into the main cylinder upper compression chamber through these coördinated ports by way of the duct in the housing A shown in Fig. 6. At this precise point the magneto coils as shown in Fig. 5, are directly opposite and the electric spark is sent through the spark plug at the top of, and penetrating into, cylinder C, igniting the compressed gas, or vapor. At this point, also, the exhaust port E′ of the housing A is opposite the port *b* in cylinder C, and the intake port *i′* of housing A is opposite port *b′* in auxiliary cylinder A. C. The lower portion of the auxiliary cylinder is now filled with vapor drawn from the carbureter. The explosion takes place and the piston P and the piston P′ travel downward through their respective cylinders, piston P expelling the exploded gases from the lower chamber of cylinder C, and piston P′ compressing the vapor which it drew from the carbureter in the upward stroke. When pistons P and P′ have reached the bottom of the stroke and have just passed lower center, the intake port I′ in the housing A is opposite the port *b* in the cylinder C, and the exhaust port *e′* in the housing A is opposite the port *b′* in auxiliary cylinder A. C., the compressed gas or vapor in A. C. is then forced through the ports so coördinated, by way of the duct in the housing A shown in Fig. 6, into the lower compression chamber of C formed by the downward stroke of piston P. At this precise point the magneto coils as shown in Fig. 5, are directly opposite each other and the electric spark is forced through a spark plug penetrating through head U of cylinder C into the lower compression chamber, and ignites the compressed vapor. At this point the exhaust port E of the housing A is opposite the port *a* in cylinder C, and the intake port *i′* in housing A is just moving opposite port *b′* in auxiliary cylinder A. C. The explosion occurs, forcing pistons P and P′ toward the top of their respective cylinders, exhausting the gases above P and compressing the vapor in A. C. above piston P′. So on *ad infinitum* or until the ignition is turned off, stopping the spark through the spark plug.

Fig. 5 represents the ignition device. Two coils, a primary coil fixed to the housing of the engine, and a secondary coil fixed to the cylinder C. The primary coil is supplied with electricity through a vibrator and condenser supplied from a storage battery. One terminal from the battery and one from the coil are grounded through the housing, on the primary side, and one wire from the secondary coil is grounded on the cylinder C. the other terminal leading to the spark plug. As the two coils pass opposite each other the induction set up in the primary coil by reason of the vibrator and condenser is stepped up by the secondary coil causing the spark to pass across the points on the spark plug. The vibrator is constantly operating while the engine is operating.

From the foregoing description taken in connection with the drawings it will be understood that the cylinders pivot back and forth instead of the connecting rod being pivoted at the piston; that the engine is two-cycle, double-acting, that is, every stroke is a power-stroke. It will also be noted that an engine of more than one set of cylinder and connecting rod may be constructed by a further prolongation and duplication of the crank shaft, housing and cylinder construction, and that the engine may be run in any position.

It will be apparent that I provide means which will accomplish the objects of this invention in a simple, practical and efficient manner.

I claim:

1. A valveless, two-cycle, double-acting, oscillating, internal combustion engine consisting of a power cylinder revolubly suspended on central, oppositely disposed bearings, a piston operating within the cylinder, forming a combustion chamber at each end of the cylinder, a piston rod connecting the piston with a crankshaft terminally connected to a fly wheel, there being ports, laterally and terminally disposed in the cylinder, and penetrating into each combustion chamber of the cylinder; a housing member having oppositely disposed ports coördinating with the ports of the cylinder and operated by the movement of the cylinder; an auxiliary cylinder mounted upon the power cylinder, a piston within the auxiliary cylinder operated by the piston of the power cylinder, there being ports laterally and terminally disposed in the auxiliary cylinder, penetrating into the auxiliary cylinder; the housing member having oppositely disposed ports coördinating with the ports of the auxiliary cylinder, and operated by the movement of the auxiliary cylinder.

2. In a valveless, two-cycle, double-acting, oscillating, internal combustion engine consisting of a housing, a power cylinder, oscillating within the housing, an auxiliary cylinder mounted upon the power cylinder, pistons in the cylinders, a crankshaft connecting with the pistons, and a fly wheel connecting terminally with the crankshaft, the combination of the housing and the power cylinder and ports in the housing coördinating with oppositely disposed ports of the cylinder.

3. In a valveless, two-cycle, double-acting, oscillating, internal combustion engine consisting of a housing, a power cylinder, oscillating within the housing, an auxiliary cylinder mounted upon the power cylinder, pistons in the cylinders, a crankshaft connecting with the pistons, and a fly wheel connecting terminally with the crankshaft, the combination of the housing and the auxiliary cylinder and ports in the housing coördinating with oppositely disposed ports of the auxiliary cylinder.

4. In a valveless, two-cycle, double-acting, oscillating, internal combustion engine consisting of a housing, a power cylinder, oscillating within the housing, an auxiliary cylinder mounted upon the power cylinder, pistons in the cylinders, a crankshaft connecting with the pistons, and a fly wheel connecting terminally with the crankshaft, the combination of ports in the cylinders and coördinating oppositely disposed ports of the housing and channels in the housing connecting the coördinating ports in the housing.

5. In a valveless, two-cycle, double-acting, oscillating, internal combustion engine consisting of a housing, a power cylinder, oscillating within the housing, an auxiliary cylinder mounted upon the power cylinder, pistons in the cylinders, a crankshaft connecting with the pistons, and a fly wheel connecting terminally with the crankshaft, the combination of ports in the auxiliary cylinder and coördinating oppositely disposed ports of the housing, and channels in the housing connecting the coördinating ports in the housing with a fuel supply.

6. In a valveless, two-cycle, double-acting, oscillating, internal combustion engine consisting of a housing, a power cylinder, oscillating within the housing, an auxiliary cylinder mounted upon the power cylinder, pistons in the cylinders, a crankshaft connecting with the pistons, and a fly wheel connecting terminally with the crankshaft, the combination of ports in the power cylinder and coördinating oppositely disposed ports of the housing, and channels in the housing connecting the coördinating ports in the housing with an exhaust manifold.

In testimony whereof I affix my signature in the presence of two witnesses.

THEODORE E. DAVIS.

Witnesses:
JEANIE DAVIS,
MARIE D. WIGHT.