The Powell Leverage Motor

A New Principle in the Construction of Internal Combustion Engines

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THE first difference between the Powell Leverage Motor and any orthodox engine, apparent to the eye on examination, is that the piston is not coupled directly to the crank shaft but has a compound lever between the piston and the crank shaft. There are other differences in construction which are revealed only on close examination.

In performance, the Powell Leverage Motor comes more nearly than any conventional engine to fulfilling the ideal conditions essential to the utilization of the greatest amount of heat and energy developed in an engine, as laid down by the French engineer, Beau de Rochas. These conditions as stated by de Rochas were:

First—There should be the largest cylinder volume with the smallest exposed surface.

Second—Maximum piston speed.

Third—Highest possible pressure at beginning of expansion.

Fourth—Great possible expansion.

The peculiar construction of the Powell Leverage Motor gives nine outstanding advantages.

A long piston stroke gives turbulence to the fuel mixture in the cylinder, moving the gases to the hottest portions of the cylinder and keeping the walls of the cylinder clean. It also gives increased flexibility.

In the Powell Leverage Motor the piston travel is exactly double the distance of the crank shaft stroke; a 4 inch crank shaft stroke giving a piston travel of 8 inches. This long piston stroke is beneficial in many respects, notably for the following reasons:

(a) Turbulence speeds up the combustion process, by mechanical distribution of the flame following ignition and seemingly gives the mixture more than one firing point. Turbulence also gives a scouring effect which results in cleaning the cylinder walls of the combustible mixture which may not be burned on account of its temperature never being raised high enough to bring about combustion. There is also a vaporizing or atomizing effect which may result from a high degree of turbulence.

There is also a tendency to move the gases over the three hottest portions of the cylinder (exhaust valve, piston center, sparkplug), so quickly that the gases do not cause preignition or increase the chances of detonation.

(b) Flexibility of an engine is usually dependent upon the length of stroke, valve timing, and size of valve ports. It has been found in testing conventional engines of various stroke-bore ratios, that the longer stroke engines are more flexible than the short-stroke engines.

The piston speed of a Powell Leverage Motor is double that of a conventional engine with the same sized crank shaft and making the same number of revolutions per minute, giving increased thermal efficiency, higher compression and hence increased horse power and torque and greater fuel economy.

Thermal efficiency is heat efficiency and the degree to which an engine possesses thermal efficiency depends on the extent to which it converts the degrees of heat of the combustible mixture into foot pounds of work.

In studying the movements of the Powell Leverage Motor on a plotted motion diagram, it is manifest that the piston on the compression stroke has an unusually fast speed on the last 90 degrees travel of the crank shaft. This rapid motion allows the use of a high compression which is conducive to increased horsepower, torque and fuel economy.

While high piston speed increases the flexibility of any engine, this feature in a conventional engine shortens its period of usefulness through strain which cannot be avoided because the rest of the engine must travel at a speed corresponding to that of the piston. In the Powell Leverage Motor, the effect of this piston speed is not more rapid motion of other parts but more power with the same amount of fuel.

The small diameter of the piston in the Powell Leverage Motor makes possible a light piston, tends toward high compression, shortens the nor-

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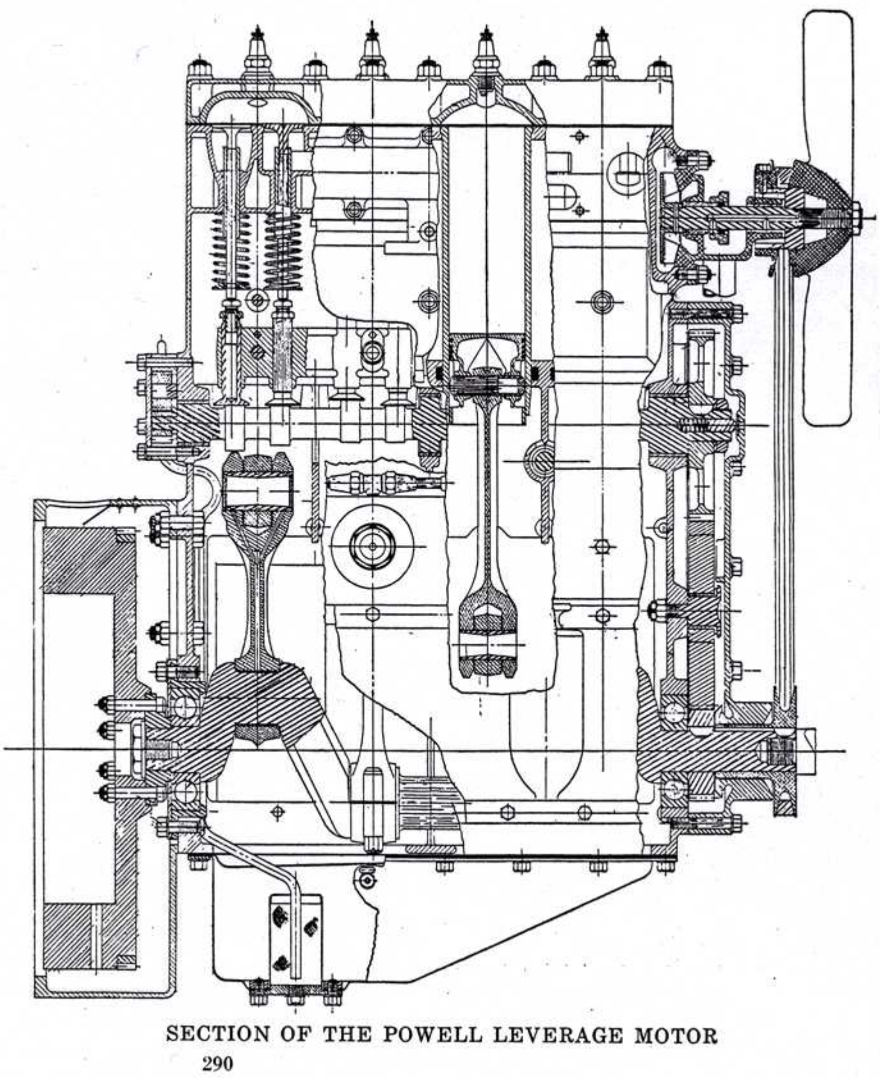

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mal flame travel, dissipates heat rapidly and has a small bearing surface.

A Powell Leverage Motor has a small diameter piston due to the fact that the total displacement of an engine is a function of the cylinder diameter and the length of piston stroke. If one is large the other is small, or, both may be equal, in which case we would have a so-called square-engine.

Now in order to obtain in a Powell Leverage Motor a certain displacement, the stroke being 8 inches, the cylinder diameter will usually be smaller than one-half of the piston stroke.

Among the advantages resultant from the utilization of a piston having a small diameter might be mentioned:

a. Light weight piston.
b. High compression.
c. Short distance of flame travel.
d. Rapid dissipation of heat.
e. High thermal efficiency.
f. Small bearing surface on cylinder walls.

(*a*) A light weight piston would reduce the total reciprocating mass thereby reducing the inertia which would result in a smoother running engine and would also reduce the size of the bearings.

(*b, d, e*) These items are so correlated as to make them dependent upon each other. A high compression is necessary to increase the thermal efficiency and can be obtained if the rate of heat dissipation of the piston is rapid.

(*c*) A short distance of flame travel through the mixture is obtained by using a small diameter piston in that a more compact combustion chamber can be employed.

(*f*) As the diameter of the piston employed is small, its length is correspondingly small, and the area producing friction by sliding on the cylinder wall is therefore low.

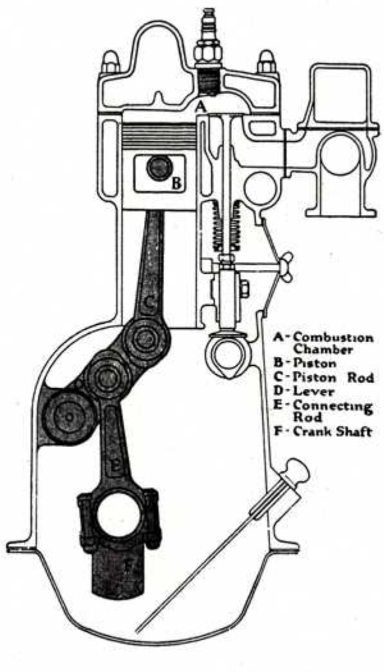
Reduction of the piston rod angularity in a Powell Leverage Motor reduces side thrust and lessens friction loss.

Fuel economy of an engine is dependent to a great extent upon the mechanical friction and as the piston friction is the greatest source of mechanical friction in an engine, it follows that to reduce it would increase the thermal efficiency. The piston rod's angularity is the greatest contributing factor causing piston friction, so that in reducing it a gain can be expected.

The angularity of the piston rod in a Powell Leverage Motor is reduced to about one-half of the angularity found in an orthodox engine.

Small crank shaft throw of Powell Leverage Motor reduces vibration and wear on main bearings.

As the crank shaft stroke in a Powell Leverage Motor usually equals 4 inches, it is readily understood that the following advantages are easily attained:



POWELL LEVERAGE MOTOR
The piston is not connected directly to the crank shaft but has a compound lever between the piston and the crank shaft.

a. Low centrifugal force.
b. Little wear and tear on main bearings.
c. Small crank shaft.
d. Light weight crank shaft.
e. Minimum torsional vibration.
f. Few main bearings required.

The above points should not need any further explanation, as a little thought will answer any question which might be raised.

Slow r.p.m. of crank shaft allows low gear ratio in transmission provided the required torque is delivered.

By increasing the load factor on an engine, through a reduction of the rear axle gear ratio, the number of miles per gallon is increased. It is a well known fact that the nearer an engine works to its maximum delivered output, the greater the thermal efficiency and hence the more useful work it will do.

Piston rods and connecting rods in a Powell Leverage Motor are placed slightly off center so that there is no possibility of the rods of a Powell Engine ever being on absolute dead center on the effective portion of the explosive stroke.

By referring to a plotted motion drawing of a Powell Leverage Motor, it will be seen that when the rods are at the limit of their upward movement the lower connecting rod is inclined at an angle of 1½ degrees to a vertical line. The lever is inclined at an angle of 45 degees to said line. The piston rod is inclined at an angle of about 2½ degrees to a vertical line. This would decrease the tendency to back fire.

Through the use of a lever having a 2-to-1 ratio in the Powell Leverage Motor the total pressure on the piston is doubled at the connecting rod, neglecting rod angularity.

The lever is similar to a reduction gear in that it reduces a high piston speed into a slow r.p.m. of crank shaft.

From the accompanying diagramatic sketch, it will be seen that the Powell Leverage Motor has a conventional combustion chamber, "A," into which combustible gases are admitted, exploded and expelled.

The cycle used is the familiar Otto cycle or more commonly called the 4-stroke cycle, as used in practically every automobile engine.

The piston "B" reciprocates in the cylinder exactly as in every engine, differing only in the length of travel thereof.

The piston rod "C" is connected to the piston "B" and also to the outer or free end of the lever "D." The crank case wall serves as the fulcrum of the lever. The upper end of the connecting rod "E" is operatively connected to the midpoint of the lever "D" which gives a leverage of 2 to 1, that is (neglecting rod angularity), a one-pound pressure on the piston will be multiplied by the leverage so that the pressure is two pounds at the connecting rod.

The lower end of the connecting rod "E" is secured to the crank shaft "F" in the usually accepted manner of a split bearing and standard S. A. E. connecting rod bolts.

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Due to the use of a lever giving a ratio of 2 to 1, the diameter of crank pin travel will be approximately one-half of the distance travelled by the piston in one stroke.

Now let us assume that the piston is at the limit of its upstroke and the spark has just passed. Due to the increased pressure of the expanding gases the piston will descend, forcing down the piston rod, which in turn forces the lever to move downwardly describing an arc of a circle about the fulcrum, the radius of which is equal to the length of the lever. As the lever moves downwardly on its fulcrum, the connecting rod will descend which in turn transmits motion to the crank shaft causing it to rotate about its center.

While the cross sectional view of the Powell Leverage Motor shows a four-cylinder engine, any conventional number of cylinders may be employed.

Mississippi River Delta

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of a plan for the improvement of Southwest Pass. This project contemplated a channel thirty-five feet deep and 1,000 feet wide. Jetties were constructed in 1905, but the discharge is about three times that of South Pass and the problem of maintenance is correspondingly large. The sediment deposits have caused the bar at the mouth to advance as rapidly as the jetties have extended seaward. Gulf currents are unfavorable, and unstable foundations have been met with where it was necessary to place great weight. The desired channel dimensions have never been approached and it seems that under the existing plan they will not be.

The discharge through South Pass has been metered to record as much as 250,000 cubic feet per second in high water. This water will run approximately one one-thousandth sediment by volume, which means that at times 250 cubic feet of sediment per second is being deposited by this pass alone. In the face of this it seems remarkable that a navigable depth of over twenty-six feet has been maintained for over forty years. This success is due principally to the jetties constructed by Eads, yet it cannot be entirely so due, for similar jetties have failed at Southwest Pass. It is likely that excess shoaling at the mouth of South Pass has been avoided, not alone by the jetties, but by the particular location of the jetties with respect to the gulf eddy currents across their mouth. At least the different effect of similar jetty construction would seem to indicate such a possibility.

At the time of the writer's leaving Port Eads an extensive investigation of the eddy currents, salinity, sediment, etc., of the waters at the mouths of the two passes was being started and it is not unlikely that in the past few years a solution of this unusual engineering problem has been indicated.

Most Powerful Electric Locomotive in World. There is now under construction at the Highland Park plant of the Ford Motor Co., an electric locomotive, larger and more powerful than any yet built. The engine is for freight service on the Detroit and Ironton Railway. It will weigh 340 tons and will be 117 feet long, 15 feet high and 10 feet wide. Its running speed will be 17 miles per hour and its maximum speed 35 miles per hour.

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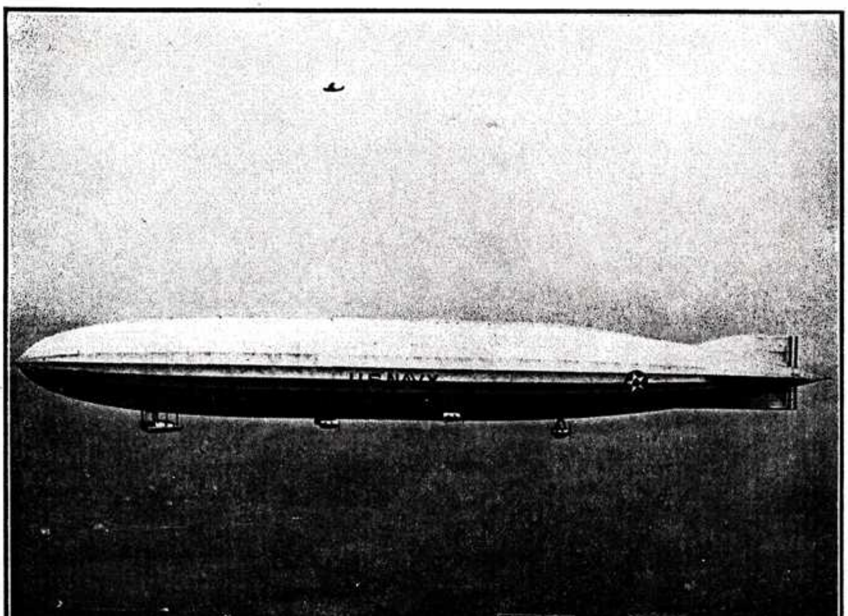

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