Hudson Super-Six

Highest Powered Stock Motor Per Cubic Inch Displacement The World Has Known

Save in One Respect the Super-Six Is Not Unlike Other Standard Motors

We use neither aluminum pistons nor other special parts of that nature such as are being featured by some other manufacturers. *There is nothing experimental about the HUDSON Super-Six motor.* It is in every respect except for our newly discovered system of balancing, on which we have obtained a *basic* patent, exactly like the standard practice of design and construction.

It has not been necessary to resort to abnormally light reciprocating parts, ball bearings, or to complicated valve mechanism.

In motors of every type, the application of our newly discovered and patented invention will obtain a gain in power for them.

Our patent is recognized by the United States Patent Office, therefore it must cover a new idea.

All World's Records Broken

Up to 100 Miles

Made at Sheepshead Bay under supervision of American Automobile Association, *with a 7-passenger fully equipped stock-car Super-Six.* Breaking all stock-car records for any size, or any price, or any number of cylinders. No changes were made in the motor. Compression was not raised. Valve turning was standard. Oiling system no different than used in all Super-Sixes.

100 miles in 80 min., 21.4 sec., averaging 74.67 miles per hour, with driver and passenger.

Previous best stock-car record was made with a multi-cylinder car carrying driver only.

75.69 miles in one hour with driver and passenger.

Laps were made at 76.75 miles per hour.

With top and windshield up, carrying five passengers, 70.74 miles in one hour.

Standing Start to 50 miles per hour in 16.2 sec.

Note that the Super-Six was not built to be a speed car. But speed requires power, and it also proves endurance.

What these tests demonstrate is greater endurance than any driver will ever require of his car.

Data From an Affidavit Submitted to the United States Patent Office With an Application Which Resulted in Our Obtaining Patent No. 1165861

It is well understood that the ordinary four-cylinder internal combustion engine is in balance, but the centre of gravity of the four pistons does not remain at the same point during the revolution of the motor. On the contrary, it changes position vertically up to about one-half inch. This change in position of the centre of gravity of the pistons of the four-cylinder engine produces a vibration which becomes periodically noticeable as the speed increases, there being certain critical speeds at which the vibration is maximum.

In the six-cylinder motor, the centre of gravity of the pistons is stationary throughout the entire revolution of the crank shaft, and the crank shaft is statically in balance—that is to say, the mass is distributed symmetrically about the axis rotation. Therefore *it has always been believed* that the six-cylinder motor should give the least vibration.

The Limits of the Six

It has been found in practice, however, that it is impossible to run a six-cylinder motor above a certain critical speed, varying according to the particular motor. At such a speed the vibration becomes so great and the loss of energy due to friction increases to such a degree that the motor will not give increased power in proportion to the increased speed beyond that point.

Designers then resorted to multiple cylinder engines in the hope of overcoming this difficulty. It will be understood, of course, that the ideal automobile engine is one which has maximum flexibility; that is to say, can be operated at the widest range of speeds and which will have the power to accelerate rapidly.

The small-bore, high-speed, six-cylinder engine is particularly flexible. Its limit of speed has ordinarily been about 2000 revolutions, at which point the vibration, due to the unbalanced centrifugal force in the crank shaft, has been so great as to preclude any increase in speed and power. Various attempts to overcome this difficulty have been made.

The Limits of the Eight and Twelve Cylinder Motors

The eight-cylinder engine with the cylinders set at an angle of 90 degrees has the same objections as found in the ordinary four-cylinder engine, except that there is a component of the vibration force in each bloc of four cylinders, which tends to reduce each other. This eliminates the trouble, to a small extent, but introduces additional complication, increased number of parts and expense without adding to the power of the motor or increasing its economy of operation.

The twelve-cylinder motor is another attempt to overcome this difficulty, but the same troubles are present in the twelve-cylinder engine as in the ordinary six-cylinder, only the critical speeds are higher because of the reduced weight of the moving parts and pressures. In the twelve-cylinder engine there is less counteracting effect of the vibration force in one bloc of cylinders against the corresponding vibration force in the other bloc of cylinders than there is in the eight-cylinder motor.

We Built Eights and Twelves

We have designed, built and tested in our laboratories, for the past two years, eight and twelve cylinder motors in the hope that by so doing we could get away from the excessive vibration of the ordinary six-cylinder motor. We were exceedingly disappointed on testing out the twelve to find that we had not accomplished this result.

Because it is impossible to reduce the vibration satisfactorily in the twelve and eight cylinder motors we went back to the six-cylinder motor.

Other attempts have been made to do away with this trouble in six-cylinder engines. For instance, attempts have been made to make the crank shaft very light, but this increased the flexibility of the crank shaft and therefore increased the trouble due to vibrations. Crank cases have been made exceedingly heavy in the hope of holding the shaft in place. It has also been attempted to make the crank shaft very large, to approach as nearly as possible perfect rigidity.

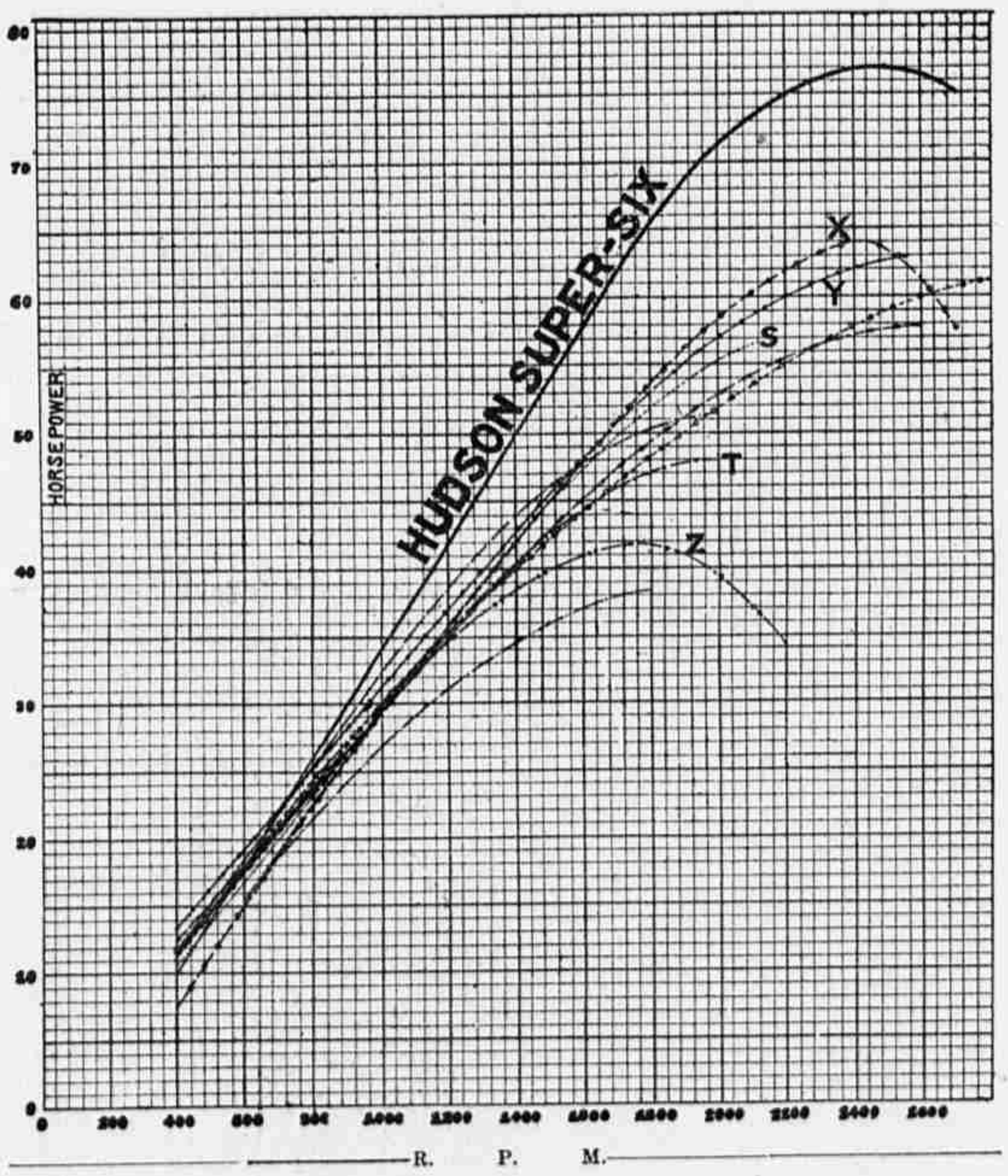
The best proof of this is found in the curves showing the power developed by various types of motors at different speeds, this power being determined by the ordinary brake test. For this purpose we have prepared a chart showing the horsepower developed by eight different motors. Of these motors, four are six-cylinder engines having the ordinary balanced crank shafts. Two are eight-cylinder engines, one of these being the well-known X* Eight and the other the Z* Eight, which is a considerably smaller engine.

The twelve-cylinder engine is the famous Y* twelve cylinder. In the case of the S* Six the curve is that published by the makers of the engine in the papers of the Society of Automobile Engineers. The curve of the first-mentioned twelve was obtained in the same way. The curves for the T* Six, X* Eight and Z* Eight were obtained in the same way, but in the case of these motors, we tested the motors themselves in the Laboratory of the Hudson Motor Car Company. We adopted the published curves as being the best result for these motors. The curves for the three Hudson models were obtained from our own Laboratory tests.

It will be noted that while the various motors tested had *different* piston displacements, the curves are plotted on the basis of a piston displacement of 288.7 cubic inches as unity for the purpose of comparison.

Greater Motor Speed, Greater Power

This chart shows that the engine having the *compensated* crank shaft (i. e. The Hudson *Super-Six*) and having a cylinder size and construction otherwise identical with previous models, not only gave a much *greater horsepower at every speed,* but was able to attain a much higher speed. The increased horsepower was particularly noticeable from 1500 revolutions to 2000, beyond which the previous model motors could not be forced with increase of power. The increase in power in the *Super-Six* over the best "eight" and "twelve" engine is almost equally noticeable, being about twelve horsepower between 2000 and 2200 revolutions.



FOR COMPARISON, ALL MOTORS HAVE BEEN REDUCED TO THE UNIT OF SIZE OF THE HUDSON SUPER-SIX—288.7 CUBIC INCHES.

X—Indicates the power curve of a well-known eight-cylinder motor.
Y—Is that of a famous Twelve.
Z—Is a smaller sized Eight, also well known.
S—Is that of a leading larger sized Six.

*As these are well-known makes of cars, we refrain from mentioning them by name.

Other Motors Self-Destructive

In making these tests, the increase in vibration of the crank case was carefully observed. In all other sixes the motors were fairly free from vibration up to 1500 R. P. M., at which point the vibration increased to about 1800. From 1800 R. P. M. the vibration increased rapidly and apparently had wide amplitude. It was impossible to run other sixes much beyond 2000 R. P. M. with increasing power without danger of collapse of the bearings.

On another occasion a high-grade six of ordinary balanced construction was spun idle by an electric motor. At 2200 R. P. M. one of the bearings burned out. Just prior to this time the vibration had become excessive and the motor had evidently approached a point of self-destruction.

Vibration Practically Nil in Super-Six

With the Hudson *Super-Six compensated* crank shaft there was almost total absence of vibration and the crank shaft speed was practically unlimited.

Tests have also been made by spinning bare crank shafts in the crank cases and bearings in which they are intended to be employed. These tests also showed in a very marked degree the lessening of vibration due to the compensating system described in our patent application. We have made tests in this manner on various crank shafts, which showed conclusively that the vibration is due to the unbalanced forces in the crank shaft itself.

We also recently saw a test of a six-cylinder crank shaft of a well-known car. It was a three-bearing shaft without connecting rods. It was supported in the rear and centre bearings, the shell of the front bearing was taken out, so that the front end of the crank shaft rotated freely and was unsupported. The shaft was spun up to 2900 R. P. M. by an electric motor. Upon examination it was found that the crank shaft had taken a permanent set, or bend out of line of about one-eighth inch. This shaft was made of a higher grade material than is ordinarily used. During the test it was noticeable that as this high speed was reached, the front end of the shaft appeared blurred, showing the distortion that was taking place.

Proved in Gruelling Tests

Before applying for the *Super-Six* patent we built three *Super-Six* engines with *compensated* crank shafts. These engines were put into cars and tested on the road. The engines were as smooth at 45 to 70 miles per hour as they were at 30 miles per hour, while in previous model Hudson Six 40's the engines which had the usual balanced crank shafts began to lose smoothness at about 35 miles per hour. This roughness increased as the speed increased.

One of the Hudson *Super-Sixes* was driven approximately 7000 miles, from Denver to the west coast and back to Las Vegas, N. M. During this trip the car was given the roughest possible road treatment. This sort of use increases very rapidly the wear on the engine over what would be apparent for ordinary use. When the car got back to Detroit, the engine was tested in the Laboratory, and there was no discoverable reduction in horsepower.

The engine was also taken down for the purpose of examining and taking up the bearings. The previous Hudson model Six-40's ordinarily required having the bearings taken up from 2 to 2½ thousandths of an inch after 7000 miles use. In the new *Super-Six* motor there was no perceptible wear on the bearings, and it was not necessary to take them up at all.

We regard this as the strongest possible proof that the chief strain on the bearings is due, not to the motor load, but to the vibration of the ordinarily balanced crank shaft, and that the system of compensating described in our application completely overcomes this difficulty.

Hudson Motor Car Co.

1350 Miles at Speed Exceeding 70 Miles an Hour Without Discoverable Wear to Any Part. That Means Super Endurance