ing the structures. Two 42-inch sluice gates are provided in the front wall of the intake crib and cast iron guides are used for screens and grilles.

The turbo-generator installation consists of two units of 2,000 kilowatts each and one 4,000 kilowatt turbo-generator, all of which supply a three-phase current of 2,300 volts pressure and a frequency of 60 cycles per second.

For the 2,000-kilowatt steam turbine two boilers each are provided with a 6-inch outlet feeding into an 8-inch header passing to the turbine throttle through the division wall, while the steam is supplied to the 4,000 kilowatt unit by a 10-inch header.

The steam headers are connected with loops, the latter being of 6-inch pipe between the first and second units and of 8-inch pipe between the second and third units, each header being fitted with a valve.

From the 4,000 kilowatt unit there is a 34-inch free exhaust while from the two 2,000-kilowatt steam turbines a 16-inch free exhaust is connected to the condenser. From the 4,000-kilowatt unit there is an 18-inch outlet and a 16-inch outlet from the second stage of each of the 2,000-kilowatt turbines, while a 14-inch connection has been installed running from each outlet to the 14-inch exhaust header.

The second stage connection from each turbine has an 8-inch back pressure valve serving as a relief together with a 14-inch gate and a 14-inch automatic reverse current valve.

For the hot water supply system the connections to the headers include 14-inch gate valves and 14-inch oil separators. A surface having 6,000 square feet of condensing area is included in the auxiliary equipment of the 2,000-kilowatt turbine, together with a priming pump and a 3-inch turbine-driven hot well pump, a dry vacuum pump and a 16-inch volute circulating pump.

The 4,000-kilowatt steam turbine has a surface condenser of 10,000 square feet condensing surface and a similar pumping equipment, which however includes a 20-inch circulating pump and a 4-inch turbine-driven hot well pump.

All of the auxiliary equipment is located in the basement including the feed water heater, hot water circulating pump, stoker and fan engine and other apparatus together with the 100-kilowatt engine-driven exciter set, the oil compressor, oil pumps and filters.

The stack at this station measures 216 feet in height with an inside diameter of 13 feet and is constructed of brick and concrete, the former being used in the base. These steam turbines are so installed that steam may be

taken from the second and third stages and an 18-inch opening is therefore provided in each of these stages while the second stage has hand operated valves by means of which the nozzle opening may be controlled to the third stage.

Between each turbine and the control board there is a signal system provided. An annunciator drop signal equipment is also employed for indicating when the relays on the oil switches and circuit breakers are open. This is undoubtedly one of the most complete stations in the United States for the class of service for which it is intended.

The hot water heating system covers an area of about one and a half miles extending from New Jersey Avenue to Arkansas Avenue and from the board walk to Baltic Avenue. For taking care of this hot water heating load there is a 14-inch main passing underground from the new steam turbine electric station. This new plant is one of the attractions of Atlantic City, and supplies current for incandescent lighting from the three-phase alternating current generator, while arc machines and direct current dynamos are driven by synchronous motors at the same power station. As will be seen, the plant presents some features of special interest, which render it well worthy of note.

A Gasoline Engine With Auto-Ignition*

A Remarkable Lightweight Internal Combustion Motor for Automobiles and Aeroplanes

By A. M. Low

It is not a very easy thing to describe any really new engine, for everyone at once pictures some slight alteration in valve gear, an extra net construction, or other detail alteration.

This engine is absolutely different from any other, though its method of working is not unlike the Diesel. In this comparison, however, there are two vital exceptions, namely, waste heat is utilized, and no pumping gear has to be worked by the engine itself. The principle upon which the "Low" engine is based is the utilization of waste heat, and is identical with that of the coal engine, which was described in the technical press about a year ago, and which further tests have shown successful.

The best way to understand this engine is to imagine an ordinary car engine with a very high compression, and with the water-jacket full of gasoline. The engine is first run in the ordinary manner, the liquid gasoline being sucked through a valve in the head. As soon as the engine gets hot, the compression is increased to its full amount by fully dropping the exhaust valve, and the jacket has by this time become full of gasoline vapor under a high pressure.

On the suction stroke the piston draws pure air into the cylinder, which is compressed to above 500 pounds per square inch. At the top of the stroke the gasoline vapor is admitted, thus causing the "explosion." The burnt gas is exhausted in the ordinary way.

Having once indicated the method of working, it will be obvious that there are several ways of carrying it into effect. The engine which has been successfully run was fitted, for the sake of simplicity, to a small Duocar. Its bore and stroke were 2 inches and 4 inches, respectively, the engine being built after the manner of an ordinary 60-degree twin. Each cylinder is jacketed throughout its length and cooling fins are fitted on the outside. This arrangement was adopted, as it was thought necessary to have a considerable volume of gasoline vapor available. In the top of the head is a trip valve held down by a spring; this valve can be altered as regards the periods of its opening by varying the stiffness of the spring from the outside. It is fed by a coil of steel tubing, which is screwed to its seating after the manner of an automatic inlet-valve pipe. The other end of the steel coil is connected to the exhaust of a pump that is worked by the pressure of evaporated gasoline. The pump is used to deliver liquid gasoline from the tank to the jacket, where it is vaporized, and then passes via the pump through the steel tubing into the cylinder, by the trip valve as indicated.

It needs no knowledge to see that this arrangement is a bad one, but it was done in the first engine, as it was thought necessary that the gasoline should enter the cylinder quickly and also because of the extreme difficulty of making any gland to stand gasoline vapor under high compression. Gasoline vapor will even leak through ordinary cast iron unless the grain is particularly close.

Once the engine warms up no ignition is necessary, but it has been found that if proper combustion is to be obtained without the use of a spark, the gasoline must enter the cylinder quickly. Now, the great ob-

ject is to get an engine which runs smoothly, and this can only be accomplished by admitting the gasoline gradually so as to maintain the pressure during most of the stroke. To allow for this an ordinary sparking plug is used close to the point where the gasoline vapor enters, and the spark is allowed to take place during the whole of the firing stroke.

It is interesting to note that, whereas at ordinary pressures the old theory of stratification has been found to be mainly false—where the pressures are in the neighborhood of 300 pounds per square inch and over the effect is very noticeable, and it is this that causes the gasoline to burn more or less locally in the com-

pressed air as it is injected, giving a slow, steady rise of "explosion" pressure.

On this experimental engine timing is obtained by varying the depth of the trip-valve plunger. This has been found a quite unnecessary arrangement, but for an engine that has to run at one speed it is satisfactory, as is proved by the fact that while it renders an engine very untractable it has been possible to obtain 18 horse-power at 3,400 revolutions per minute from this little engine, with a cubic capacity of less than 400 cubic centimeters.

Naturally, it is not possible to give very complete details of the valve and its arrangement, or of the special gasoline pump used, as these will form the matter of separate patents. The future design of this engine is not without interest. It is not desirable to jacket the whole of the cylinder; we are, of course, speaking of air-cooled engines, though the principle applies exactly the same to water cooling; and in future engines, which are to be built for the purpose of developing this system, the head only will be jacketed, keeping it cool, and providing ample evaporating service. The gasoline vapor will be admitted to the cylinder by means of an oscillating inlet valve, and the moment of ignition will be variable, just as the spark in an ordinary engine, the place of the throttle being taken by controlling the exhaust of the vapor pump.

It must be emphasized that this pump is only being used as a convenient control, and for getting the liquid gasoline into the jacket. In the present engine the trip valve has been found to be quite reliable, but it makes the engine difficult to control except by lifting the exhaust, as the engine, of course, runs synchronously with the gasoline pump, which vibrates up and down very much in the manner of a Worthington pump.

There is no need to go into a longer description of the present engine, but it is interesting to see what are its possibilities. This little engine of the cubic centimeter ordinarily fitted to a light-weight motor bicycle has been reduced to a fuel consumption of 0.46 pints per brake horse-power hour, and this with a valve gear which is extremely inefficient. It develops 18 horse-power as nearly as possible at 3,400 revolutions, it does not run with great vibration, and no special precautions were taken with its construction. It must be admitted that several slight accidents took place, as was only to be expected during any experimental work. The great point which has to be remembered is that the engine works well, and that it is not merely a much talked of design on paper.

For motor cycles a small twin with a bore and stroke of, perhaps, one or two inches respectively, should be sufficiently powerful for ordinary purposes. Cars could be built with enormously powerful engines using no more gasoline than the ordinary car of to-day, while for commercial work the value of such fuel economy can hardly be over estimated. Owing to the method of causing the explosion, the average pressure can be maintained during the greater part of the stroke, as the gasoline is injected for about 50 per cent of the power stroke, which makes the engine develop its power at very low speeds.

The Duocar to which it is at present fitted has taken two heavy passengers up a gradient of about 1 in 18 at 40 miles per hour with the engine turning at between 1,500 and 1,600 revolutions per minute, which will give an idea of the great possibilities of the engine, as with a properly constructed valve gear and a properly controlled and timed admission the car can be driven almost like a steam car, and it can be started up by merely warming the jacket with a small spirit lamp.

The revolutionary advantages of this system need no exaggeration, but it has been a little amusing to receive so many orders from people who do not seem to realize that new inventions are not developed in a day, and it will probably be quite a year before this system can be entrusted to the general public.

One of the applications which brings out this system more than any other has already been noticed by the war office authorities, who foresee possibilities of its adaptation to aeroplanes. Engines built in this way would be very light for the power developed, the evaporation of gasoline helps to keep them cool, their fuel consumption is low, and owing to the expansive nature that it is possible to give to the explosion they should prove effective in reducing propeller flutter. It would enable aeroplanes to be constructed very substantially without reducing their lifting power, and once that is understood there is but little more to say.

There seems to be every reason for looking forward hopefully for further developments.

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