AN ALCOHOL-ACETYLENE MIXTURE FOR INTERNAL-COMBUSTION ENGINES.

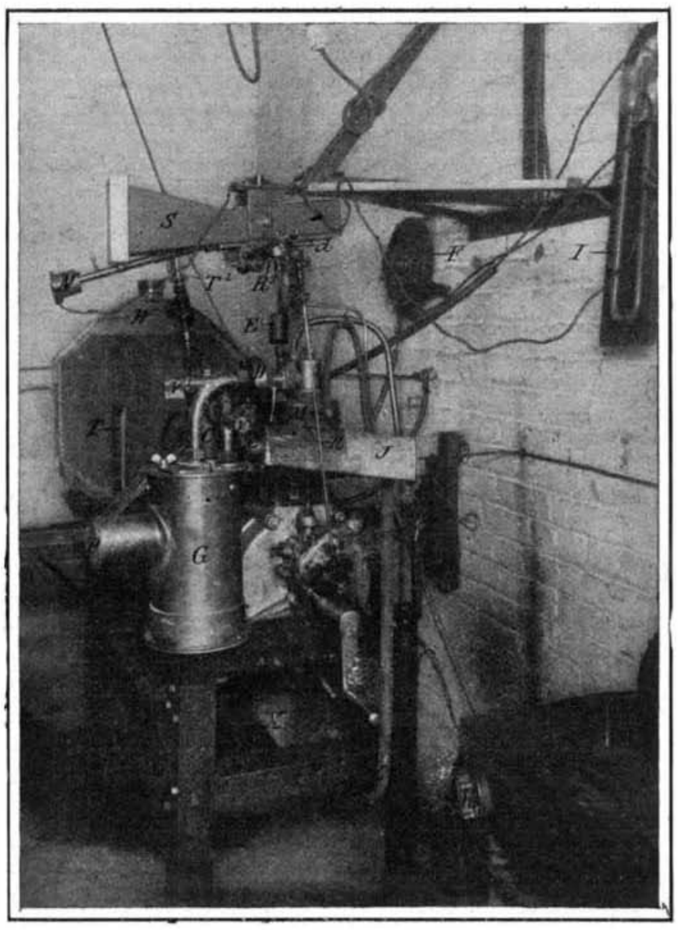
The photographs which we reproduce show an experimental testing plant for making all kinds of tests with a gasoline engine. The plant is that of Joseph Tracy, the well-known automobile driver. Mr. Tracy is also consulting engineer for several automobile companies, and in this capacity it is often necessary for him to make tests of various sorts.

As can be seen in the larger photograph, this testing plant is of the simplest possible type. It consists of a single-cylinder, 3½-horse-power de Dion motor, *M*, direct connected to a dynamo, *D*, to the other end of the shaft of which is connected a centrifugal water-circulating pump, *H*. The water pump forces the cooling water through the water jacket of the motor and also through the radiator, *W*. An electric fan is used to create a draft of air upon this radiator, if necessary, in making tests, while the temperature of the water when it enters the radiator at the bottom, and when it leaves it at the top, is shown upon two thermometers, *T* and *T'*. Attached to the outer field magnet casing of the dynamo is a circular ring having an arm, *O*, from the end of which is suspended a scale pan, *L*. The magnetic reaction of the armature upon the field magnets is counterbalanced by weights put in the scale pan, and thus the foot-pounds of energy per minute developed by the engine can be directly obtained at any moment provided the revolutions per minute are known. These are obtained from a suitable tachometer. This device does away with the inconveniences of the Prony brake, and also makes it possible to calculate the horse-power in two ways, one electrical, and the other mechanical. If the efficiency of the dynamo is known, by reading the volt and ammeters *A A'*, the electrical horse-power developed by the dynamo can quickly be figured.

The taking of indicator diagrams of a gas engine is found to be very valuable, and there are a number of different manographs on the market for this purpose. The one employed in the present instance is known as the Schultze manograph, and is shown at *S* in the two photographs. The diagram is traced by a beam of light reflected upon a ground glass by a mirror, which oscillates at the same time on both a vertical and horizontal axis. This diagram is shown in the larger photograph. A small Nernst lamp supplies the light to the manograph, and as this type of lamp requires alternating current, the latter is generated by means of a magneto, *m'*, driven by the small direct-current dynamo, *m*, and connected in circuit with the lamp, *N*, through a rheostat, *F'*. The movement of the mirror upon its vertical axis (which traces the horizontal line) is obtained from the 2-to-1 camshaft by means of the bevel-gear-driven rods, *R R'*. These rods make the same number of revolutions per minute as does the crankshaft, and they cause the mirror to oscillate by means of a suitable cam. The oscillation of the mirror upon its horizontal axis is obtained by means of the impulses of the gases upon a diaphragm in the box, *d*. The hot gases pass directly from the combustion chamber up through a small tube, which is fitted with a water jacket, *E*, for the purpose of cooling them somewhat. The impulses given the diaphragm cause the mirror to reflect the beam of light in a vertical direction, thus indicating the pressure obtained in the cylinder at any given part of the stroke. This instrument makes it possible to see indicated the variations in pressure from any cause whatever, and it is a most valuable appurtenance for the proper testing of any type of internal-combustion engine. A complete description of it will be found in the current SUPPLEMENT.

The apparatus shown in the upper photograph was constructed for the purpose of experimenting with a new system, whereby a mixture of acetylene gas and alcohol vapor is produced and used in the engine.

By the addition of a certain proportion of acetylene to the alcohol vapor, a quicker burning, more explosive mixture results. This would tend to make it possible to obtain from a given size of gasoline engine the same horse-power when operating with alcohol as when gasoline is used, without the greatly increased consumption (nearly double by volume) that ordinarily occurs when this is attempted. The apparatus illustrated was constructed in order to demonstrate for the inventors, Messrs. Frederick W. Barker and Thomas L. White, the feasibility of their patented process of gas generation, and to obtain interesting data as to the economy, if any, of the system. Quantitative experiments to find out the consumption per horse-power hour of alcohol, water, and carbide have not as yet been made: nor has the mixture of gases that enters the cylinder been analyzed; but the investigations carried on thus far have shown that as much as 20 per cent of the alcohol can be replaced by water with good effect. Probably not more than 50 or 60 per cent of the water in the alcohol acts on the carbide, which is detrimental, as the remainder, on account of its high latent heat of vaporization, deducts a considerable number of heat units from the mixture. The water that attacks the carbide, on the other hand, by generating acetylene increases the number of heat units quite materially. As this gas will develop twice as much power per unit of volume as will ordinary illuminating gas, one can readily see that this must be the case. The mixture of alcohol vapor and acetylene obtained in the engine cylinder should contain some 35 per cent more heat units than the alcohol and water vapor would otherwise have, this increase being based on the supposition than only half of the water in the alcohol acts on the carbide. The inventors believe, however, that the chief use of the acetylene is its action as a detonator. Being very explosive, it sets off the charge of alcohol vapor throughout almost instantaneously, and by thus hastening the combustion, causes the production of a higher mean effective pressure.



Testing Apparatus for Barker-White System, Showing Jacket Around Exhaust Pipe, Large Carbide Chamber, and Manograph With Engine Connections.

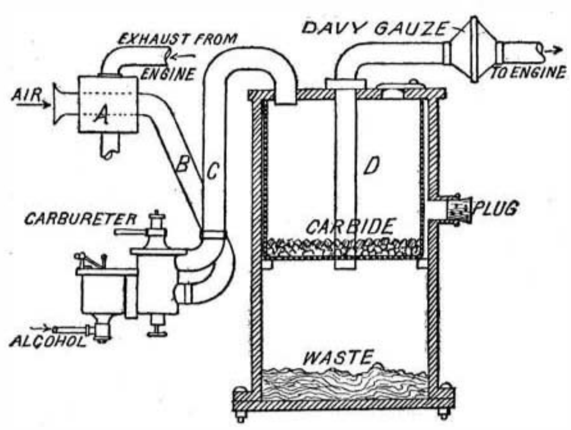


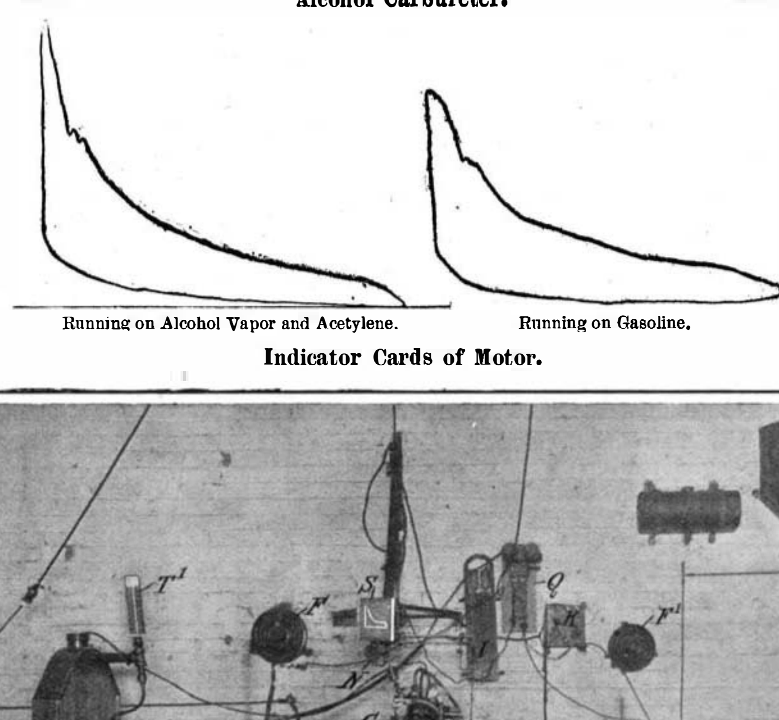
Diagram Showing Arrangement of Acetylene Gas-Producing Apparatus Used With an Alcohol Carbureter.

The arrangement of the apparatus, as well as its construction, can be seen from the photographs and diagram. The carbureter, *C*, is of the ordinary type; it is used in conjunction with an acetylene generator, *G*. The air intake pipe, *e*, of the carbureter starts from the inside of a hot-air jacket, *J*, which is built around the exhaust pipe, *c*. The suction pipe in the carbureter is connected with the top of the generator at one side, and contains a small auxiliary air valve, *V*, with which the richness of the gas can be varied. The inlet pipe to the motor comes up through the center of the generator and has in it a diaphragm, *D*, of wire gauze, for the purpose of checking any flame in case of a back-fire. This pipe also has a small auxiliary air valve, *D'*, that can be used in experimenting if necessary. The generator is fitted with a plug that will readily blow out in case of any back pressure from the motor, *M*. The following description with reference to the diagram will perhaps make the apparatus more clear to the reader.

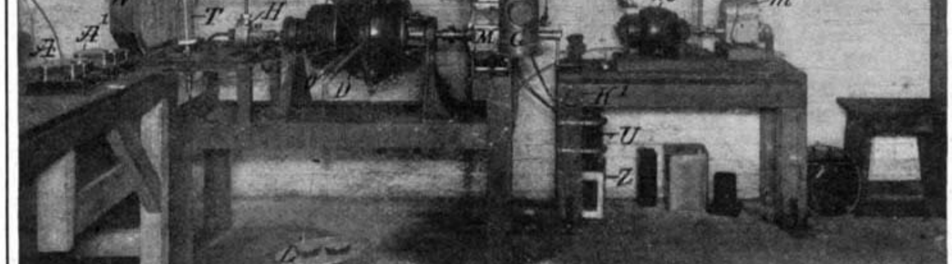
The air inlet pipe, *B*, starts from a hot-air jacket, *A*, placed around the exhaust pipe of the engine. The gas pipe, *C*, leads from the carbureter into the large mixing chamber, *D*, in which a layer of ¼-inch carbide an inch thick is spread on a wire gauze screen. The mixture of water and alcohol vapor passes down through the carbide and up and out through the central pipe, *D*, leading to the engine and in which a wire gauze screen is placed to prevent back-firing. Should a back-fire occur, the pressure would blow out the plug in the side of the generator. The lime from the carbide collects in a chamber at the bottom of the generator. A pool of alcohol about two inches in depth absorbs all the particles of waste material.

Fresh carbide can be inserted through the hole in the top cover without stopping the motor. In starting, a little of the alcohol is poured on the carbide, whereupon sufficient gas is generated to enable the motor to be started without much difficulty. The cards taken from the 3½-horse-power de Dion engine by means of a Schultze manograph showed a high initial pressure (about 240 pounds) and very good expansion.

After making the preliminary tests described, the inventors expect to construct a larger apparatus and to test the same in a practical manner upon an automobile.



Indicator Cards of Motor.



Experimental Testing Plant for Internal Combustion Engines.

AA', Voltmeter and ammeter. C, Alcohol carbureter. D, Dynamo mounted on ball bearings and direct connected to engine. FF', Rheostats for dynamo and magneto. G, Acetylene generator. H, Water circulating pump. I, Mercury vacuum gage. K, Cutout and rheostat for small electric motor, *m*. K', Switch. L, Scale pan. M, 3½ h. p. de Dion gasoline motor. *m*, *m'*, Small electric motor driving magneto to produce alternating current for Nernst lamp. N, Nernst lampof Schultze manograph. O, Lever arm attached to dynamo, D. Q, Switch and resistance for Nernst lamp. S, Ground glass screen of manograph. TT', Thermometers for testing water. U, Spark coil. W, Radiator. Y, Fuel tank. Z, Ignition battery.

The life of the mercury arc lamp in some cases amounts to 3,000 hours and more. The conducting material of the anode is either mercury alone, graphite and iron, or nickel.