completed long before the end of the power stroke is reached, and during the last 30 to 40 degrees crank travel on the power stroke comparatively little expansive power is left in the expanding gases. For this reason the exhaust valve is opened before the stroke is completed as the extra time thus allowed for exhausting the burnt gases is of more importance than the little power that might be left in the gases.

A simple problem will serve to illustrate the method of finding the valve setting of an engine. Assume the engine to have a 70-in. flywheel, then the circumference equals 70x3.1416, or 219.9 in. To determine the time at which the intake valve opens place the engine on inner dead center at the beginning of the suction stroke. Having marked the dead center on the flywheel, turn the engine in the proper direction until the valve starts to open, mark this position on the flywheel and measure the distance to dead-center mark on the flywheel. We will assume this distance to be 5.75 in. This in terms of the crank angle equals $5.75 \div 219.9 \times 360$, or very nearly 9.4 degrees. Or by dividing 360 by 219.9 gives the degrees per inch or approximately 1.63 degrees. Now all that is necessary to get the crank angle for the valve setting is to multiply the distance on the flywheel between dead center and time of opening or closing of the valve by 1.63, which would be $5.75 \times 1.63 = 9.37$ degrees.—*Power*.

A DEPARTMENT FOR THE AMATEUR.

Perhaps the most essential detail of the gasoline engine is the vaporizer, or carbureter. It is also the least understood and most tampered with part of an engine. The first engines, and indeed some small ones today, were equipped with a mixing valve, a very uneconomical device for vaporizing the gasoline and mixing this vapor with air in the proper proportions to form an explosive mixture.

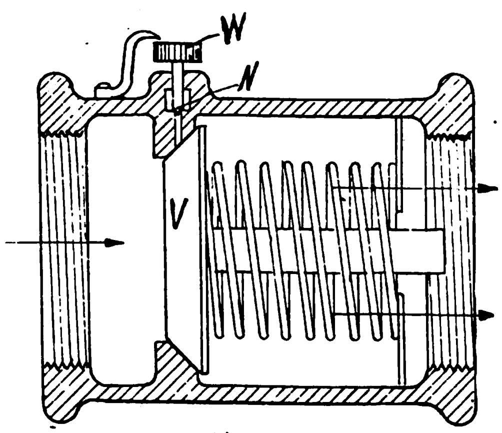

FIG. 1.

The simplest of these mixing valves are nothing more than a spring check valves placed in the intake pipe with a connection, through a small hole drilled in the valve seat, to a source of fuel supply. The flow of the gasoline is regulated by a needle valve, controlled by a marked wheel with a pointer to show the valve opening. Such a valve is shown diagrammatically in Fig. 1. V is the check valve held to its seat by a coil spring. The gasoline is brought to the valve through a small pipe connected to the boss and is regulated by the needle valve N through the medium of the hand wheel W. The flow is in the direction of the arrows. Some of the mixing valves are of course more complicated, with various attachments, but all operate on the same principle.

Most engines now are equipped with carbureters. The requirements of an efficient carbureter are many: It must vaporize the fuel, mix the gas and air in proper proportions at all speeds and loads and mix them thoroughly. It consists of a float chamber, in which the gasoline is kept at a constant level by the action of a float on a needle valve in the supply pipe, an air inlet, through which is taken the air to vaporize the gasoline, and, in some, an auxiliary air inlet to supply such further air as is needed to dilute the mixture to proper proportions of gas and air for economical combustion in the cylinder at high speeds.

Suppose a pipe is introduced into the air intake and connected to a supply of gasoline maintained at a constant level. When air is sucked through the intake, the pressure therein falls below atmospheric, and as the pressure on the gasoline supply is that of the atmosphere, a small quantity of gasoline will be forced into the intake and there vaporized and mixed with the air flowing through. This is the principle of the carbureter. As the speed of the engine increases the amount of air rushing through the intake will increase and the pressure inside will be reduced, or to employ the familiar term, the vacuum will be increased. However, this change of pressure is not proportional to the velocity of the air, but decreases in greater proportion than the velocity increases. Therefore, if the carbureter be adjusted at low or medium speed, too much gasoline will be forced in at high speed and the mixture will be too rich. For this reason some compensating device must be used to maintain the mixture at as near a constant proportion of gas and air as possible.

In some carbureters all the air enters through one port which is closed by a valve held to its seat by a spring. In this valve there must be an initial opening through which the air for starting is drawn. As the speed increases the valve lift is increased and more air admitted thus maintaining the vacuum, and consequently the amount of gasoline, very nearly constant. This might be termed the choking type of compensator.

Another type takes the main air supply through an opening near the bottom, the air passing up through a nozzle, in the center of which is placed the spray nozzle. As the speed increases and the demand for more air is felt, a check valve is pulled open and the air drawn through this valve is mixed with the mixture of gas and air above the nozzle. This type may be termed the auxiliary air port carbureter. In some of these the spring-controlled auxiliary valve is replaced by several ball valves, each ball of the same size, but placed on seats of increasing diameter. As the speed increases, the ball offering the smallest area is lifted first and with a further increase the others are lifted in turn, until the capacity of the port is reached. In either of these two types of carbureter, the admission of the auxiliary air may be manually or automatically controlled. In the case of manual control the usual procedure is to connect the valves with the throttle so that they are both opened at the same time. Automatic control is obtained through springs or the weight of the valve itself.

In still other carbureters the flow of the fuel is controlled, instead of the air supply. In this case the needle valve controlling the gasoline supply is closed as the motor speeds up. This operation is almost always performed manually, by a connection through levers with the throttle valve. Some carbureters make this automatic by changing the level

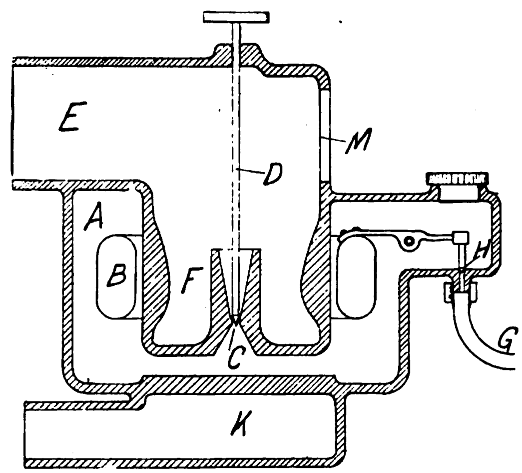

FIG. 2.

of the gasoline in the float chamber—that is, lowering the level as the speed increases, so as to allow less gasoline to flow through the spray nozzle. One carbureter recently developed uses several nozzles in series and great economy of operation is claimed for this system of operation. Then also, both the air supply and the gasoline may be controlled simultaneously by combining two or more of the foregoing methods.

Since the introduction of low grade gasoline and kerosene, some means of heating the air must frequently be supplied, particularly in cold climates. The air may either be heated before entering the carbureter or after it has passed through and is carrying the partially vaporized gasoline to the cylinder. Some employ an intake box on the exhaust pipe from which the heated air is led through a flexible tube to the carbureter. This heats the incoming air and tends to increase the actual vaporization in the carbureter. Also the intake pipe from the carbureter to the cylinder or cylinders may be jacketed and warmed by the passage of the cooling water after it has passed through the jackets or by deflecting part of the hot exhaust gases through this jacket.

So many carbureters are on the market differing in slight constructional details but embodying the same principles that only a rough sketch showing the salient features of the device is here presented. In Fig. 2-A is the float chamber with the float B connected through a system of levers to the needle valve H, which controls the gasoline supply coming from the tank through the pipe G. The gasoline is drawn or forced from the float chamber through the orifice, or spray nozzle, C where the amount of gasoline to be supplied is regulated by the adjusting needle D. The main air supply is taken through the main air inlet K, which is sometimes nothing more than a series of ports in the bottom of the carbureter. The ports leading from K through the gasoline chamber into the passage F are not shown in the drawing. The air is drawn through this passage F, which is given in many carbureters the form of a venturi tube to increase the velocity of the air and consequently the vacuum induced, which draws the gasoline through the spray nozzle C. The carbureter is connected to the intake pipe of the engine at E and the auxiliary air port is fitted at M.

It will be noticed that the float is shown surrounding the spray nozzle C instead of being to one side as was the case with some of the earlier forms of carbureter. This is done so that the relative levels of the gasoline in the float chamber and the spray nozzle will not change to any great extent with a slight tilting of the carbureter.

BOOK REVIEWS.

JOHN T. FAIG.

The Gas Turbine *by Norman Davey, of Ewell, Surrey, England, 6" by 9", published by D. Van Nostrand Co., New York,* $4.00.

The old adage, that of making books there is no end, cannot be applied to books upon the gas turbine, since up to this time there have been only two books in the English language devoted exclusively to this subject, that of Mr. Suplee, published in 1910, and that of Mr. Hans Holzwarth, which was translated into English in 1912. The former was largely a compilation of technical papers and results of experiments that had been published up to the time of its appearance. It covered the ground remarkably well. Many parts of it were quoted verbatim from discussions and reports by the experimenters themselves, thus giving the reader the various points of view of different investigators. The volume by Mr. Holzwarth dealt exclusively with several larger experimental turbines designed by him, and was exhaustive in its theoretic treatment of the cycle employed by him and of the details of his machines. His experiments are the only ones ever carried out on so large a scale and have done much to stimulate interest in a form of prime mover that is fascinating because of its great possibilities and because of the tremendous practical difficulties that must be overcome for successful commercial operation.

Mr. Davey's book is intended to cover the entire field and to epitomize the body of theoretic and practical investigation on the gas turbine. This it does quite well. Mechanical engineers who are accustomed to temperatures in Fahrenheit and to British thermal units will be obliged, in reading this book, to accustom themselves to think in Centigrade degrees of temperature and in terms of the new heat unit used by some English writers, which is the amount of heat required to raise one pound of water through one degree Centigrade. This hybred unit is an indication of a tendency to permit the absorption of the old English units in the Centigrade-gram-centimeter system; a tendency which will probably result in the adoption of the latter system in its entirety.

In discussing the various cycles proposed, the author refers to the constant pressure cycle as the cycle of Diesel, instead of Brayton, whose name is usually associated with it in this country.