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CHAPTER XIX

PERFORMANCE OF RECIPROCATING ENGINES

274. Engine Friction—Mechanical Efficiency.—An assumption which is frequently made is that the power consumed in overcoming the frictional resistances of a reciprocating steam engine is the same at all loads at constant speed. Making this assumption the horse-power required to overcome the frictional resistances, generally called the *friction horse-power*, for any load at a given speed is readily obtained by finding the indicated horse-power at no load at that speed. It would seem, however, from various tests, that the friction horse-power generally increases with the load, but not to any considerable extent.

It is now well established that if an engine is tested at various brake loads at approximately constant speed and if the indicated horse-power (I.H.P.) is plotted on a brake horse-power (B.H.P.) base, the points thus found practically lie on a straight line. It follows from this that since the friction horse-power (F.H.P.) at any given load is the difference between the I.H.P. and the B.H.P., the various points representing the F.H.P. on the same diagram will also lie on a straight line. Such a diagram is shown in Fig. 497.

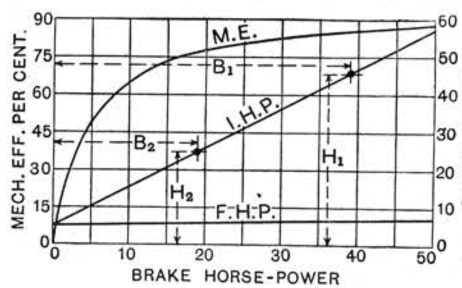

FIG. 497.

The equation to the I.H.P. line is $H = mB + F_0$, where H is the indicated horse-power corresponding to the brake horse-power B, F_0 is the friction horse-power at no load, and m is a coefficient which does not differ much from 1.

Since a straight line is fixed when two points in it are known, the I.H.P. line is determined when two trials are made at two different loads at the same, or nearly the same, speed. Let H_1 and H_2 be the I.H.P.'s corresponding to the B.H.P.'s B_1 and B_2.

Then, $H_1 = mB_1 + F_0$ and $H_2 = mB_2 + F_0$.

Hence, $m = \dfrac{H_1 - H_2}{B_1 - B_2}$ and $F_0 = H_1 - mB_1 = H_2 - mB_2$.

At a given load the ratio $\dfrac{\text{B.H.P.}}{\text{I.H.P.}}$ is called the *mechanical efficiency* of the engine at that load. If the mechanical efficiency be calculated and plotted for various loads the curve M.E., Fig. 497, is obtained. At full load the mechanical efficiency of reciprocating steam engines is generally between 80 and 90 per cent. In high-speed engines with forced lubrication the mechanical efficiency at full load may be as high as 96 per cent.

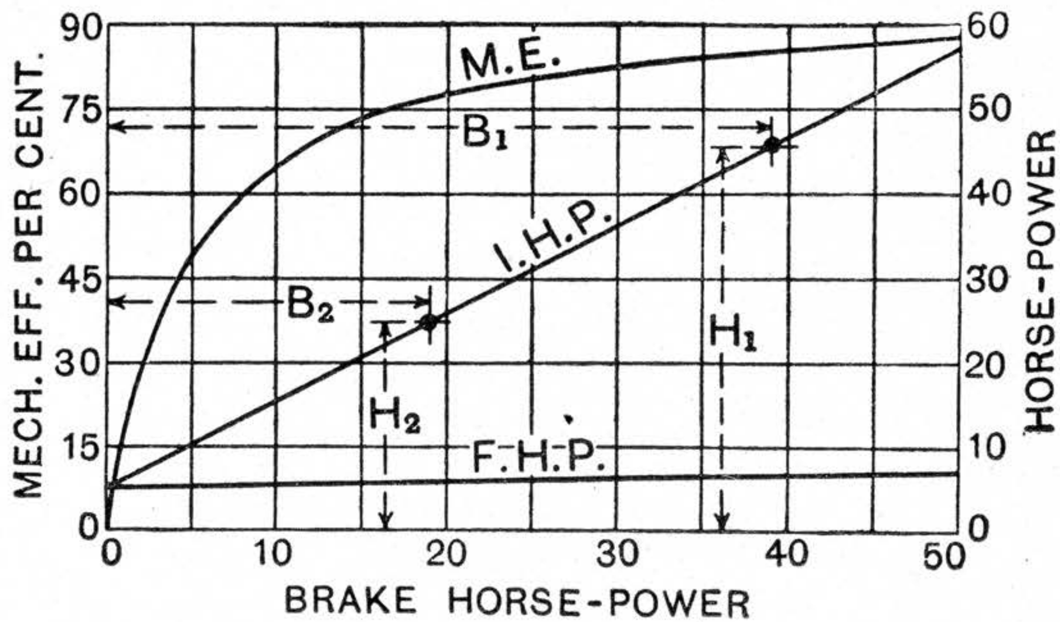

FIG. 497.