## Gas Tractor Engine Capacity and Design

By C. E. SARGENT

THE size of the engine compared to the weight or capacity of its tractors is so variable for not only different designs of tractors but often for different sizes of the same design, that a discussion of the proper size of engine for a given tractor seems desirable both for the purchaser as well as for the manufacturer.

It was not many years ago that when a larger electric generator was required, it would be built, tested and its rating obtained from the test output before its capacity was filled in on name plate. and the tractor engine situation seems almost in the same cate-

There has been recently an inclination to furnish larger engines than formerly and the reasons given, which would seem logical if not thoroughly analyzed, are that more belt and draw bar horse power can be developed. In buying a tractor, the purchaser is inclined to prefer the tractor with the larger engine, other things such as weight, draw bar pull, etc., being equal, little realizing that from the standpoint of efficiency too large an engine is worse than one too small.

As the steam engine was the prime mover in the first commercial tractors (in those days they were called traction engines) there has been a tendency of manufacturers to rate the internal combustion or gas engine in the same way and the operator to expect an overload capacity.

In order to thoroughly comprehend the difference between the two types of prime movers, the steam and gas engine, or the external and internal combustion engine, let us consider the cycle or operation of each. A steam engine is rated at its most economical load, which is one-fourth cut off at say 100 pound boiler press-Running at this rating,

steam at say 100 pounds pressure is admitted to the cylinder until the piston has reached one-fourth of its travel, when the steam is cut off and, on account of the admitted volume of steam expanding as the piston continues the stroke, there will be an average or mean pressure of 50 pounds.

Now if, instead of cutting off the steam at one-fourth stroke, it is admitted full stroke of the piston, the average pressure will be 100 pounds, the horse power will be doubled and the steam consumption, will be four times as much as at rated load.

Then again, if the boiler pressure is raised to 150 pounds, the horse power output is raised fifty per cent so that a steam enwhose economical rating is say 10-horse power will have a possible output of 30-horse power when desired, but with a greater consumption of fuel per horse power output than at rated load.

A gas engine when rated at its most economical load is rated at all the load it will develop at which a full cylinder of gas and air is taken in during the suction or induction stroke. As we cannot increase atmospheric pressure, which corresponds to the boiler pressure used in a steam engine, we cannot get more heat units in the gas engine cylindertherefore we cannot get an overload from a gas engine and the fuel consumption per unit of output increases rapidly as the load gets lighter, as hereafter explained.

In order to thoroughly diagnose the relation of engine capacity to load, let us consider the operation of the ordinary internal combustion engine-a type used on ninety-nine per cent of the commercial tractors.

When a cylinder full of combustible mixture or gas is compressed, fired, expanded and released, full power of the engine will be developed-and a characteristic of this type of engine is that under such conditions more heat is turned into work than at any other load.

Of course, more than full load cannot be obtained, because if the cylinder is full of gas before compression no more can be drawn in, so the average pressure after ignition within a cylinder cannot be increased.

There are several reasons why a gas engine at full load will furnish more power per pint of fuel consumed than at lesser loads, the most important of which is that the higher the compression the greater the amount of heat turned into work. Diesel engines compressing to 500 pounds deliver a horse power with about one-half the fuel used by a tractor engine.

In order to prevent standard truck or tractor engines from running too fast with a reduced load, the amount of gas drawn in during the suction stroke is limited by a hand or a governor controlled butterfly or throttling valve, reducing the compression pressure and the efficiency, and at the same time putting a back pressure on every piston by

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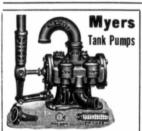
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