

tank filled, weighs 1,050 pounds and is geared to 20 miles an hour with the engine running at 800 revolutions per minute.

The Toledo Four-Ton Steam Truck.

In view of the great importance of the problem of commercial self-propelled vehicles for heavy duty the data upon the steam truck of the American Bicycle Company can hardly fail to be of interest. This truck is said to be in daily operation at the company's factory at Toledo and to have covered a mileage of about 20,000 with good results.

Ordinary kerosene has been adopted as fuel and the burner in which it is utilized is of special construction. The kerosene is carried in two tanks in the extreme rear of the vehicle which have a combined capacity of 52 gallons on one barrel. An air pressure of 20 pounds per square inch is constantly maintained in these tanks by a crosshead pump upon the engine, which is provided with an automatic relief valve. For use in starting up an auxiliary hand air pump is used. From the tank a pipe leads to the driver's seat at the front, where is located a valve, and thence through the automatic fuel regulator to the burner under the boiler. Special provisions have to be made in this burner for the preliminary heating of the fuel to insure its gasification and complete combustion. Before entering the burner proper the kerosene passes through circular coils of tubing in the midst of the flame and thence into a disk which serves

not only as a heating chamber but as a baffling plate to properly spread the flame among the boiler tubes. From the hollow disk the fuel flows downward through channels in the burner body to the needle valve through which it is atomized. Just above the needle valve is a hollow cone so constructed as to insure a full mixture of air with the ascending vapor and secure complete combustion. Below the burner is a circular pan to hold alcohol for heating the burner preliminary to starting it into operation.

The boiler is of the water tube variety and consists of a mud drum at the base communicating by a multiplicity of spirally curved steel tubes with the steam drum above. These tubes are arranged in three concentric rows and the rows are "staggered" in such a manner as to give a circuitous path to the chimney gases for the maximum heating effect. The return pipes are two in number and centrally located. Above the steam drum and projecting upward into the stack is the steam dome, which is surrounded by the hot chimney gases and serves to thoroughly dry, if not to slightly superheat, the steam. The boiler tubes are 130 in number and of $\frac{5}{8}$ inch diameter, and the diameter of the boiler is 30 inches. Asbestos lagging is used to reduce the loss of heat.

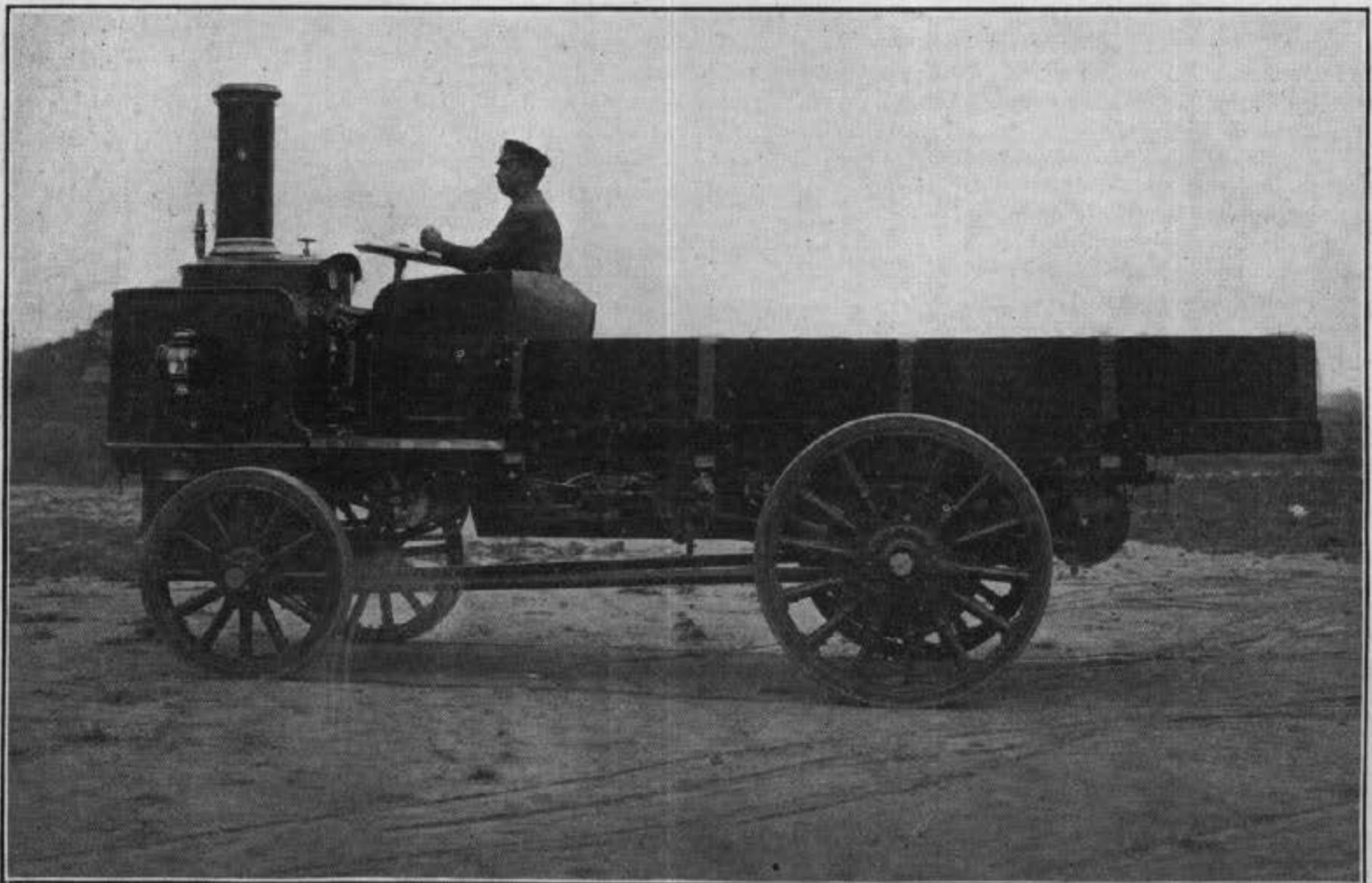
For the boiler water supply two pumps are provided—a crosshead pump on the engine, which is constantly in operation and provided with a by-pass within reach of the driver, and an auxiliary direct acting Worthington steam pump having its steam throttle in easy reach of the oper-

ator. The water tank, which is located under the driver's seat, has a capacity of 45 gallons and is supplied with an indicator. For filling this tank a lifting injector is provided.

Before entering the boiler the water passes through a combined coil feed water heater and condenser, which receives the exhaust from the engine and serves not only to heat the water but to extract much of the remaining heat from the exhaust.

The engine is a cross compound placed horizontally, parallel with the length of the vehicle. Its moving parts are fully inclosed by a phosphor bronze crank case, so that splash lubrication may be employed. Piston valves and Stephenson link motion are used. The cylinder dimensions are 3x5 inches for the high pressure and 6x5 inches for the low. The cylinders are of cast iron and the pistons cast iron with phosphor bronze rings. The crank shaft is machined out of a solid bar of nickel steel; the connecting rods are steel forgings bushed with phosphor bronze. Phosphor bronze is used for the crossheads and main bearings and steel for the guides. All bearings are adjustable for wear. The engine is rigidly attached to the carriage frame and develops 20 horse power under compound operation with the normal boiler pressure of 210 pounds, and the steam piping is so arranged that the operator may apply live steam to both cylinders and thus develop an "emergency" horse power of 35 or 40.

The engine shaft carries a bevel pinion which meshes directly with another bevel gear on a longitudinal flexible shaft, which



STEAM TRUCK OF THE AMERICAN BICYCLE COMPANY.

in turn communicates motion to the intermediate axle that carries the differential gear. A pinion on this intermediate shaft meshes with an internal gear on each of the rear wheels. All gearing is inclosed in dustproof cases and is self oiling.

The wheels are of wood with metal hubs, $2\frac{1}{2}$ -inch wood felloes and $\frac{3}{4}$ -inch steel tires or 4-inch tread, and are of 34 inches diameter in front and 44 inches in the rear; all are provided with steel bearings bushed with bronze. The rear axle is of forged steel and is of $2\frac{3}{4}$ inches diameter, while that in front is of 2 inches diameter and equipped with steering knuckles of the ordinary form. Lever steering will be used and there is a special device which automatically locks the steering gear in any desired position as well as suppressing the vibration which would otherwise be imparted to the hands of the operator. The truck is 18 feet long over all and the wheel base is 62 inches. A steel channel frame is employed and a steel tubular reach on each side. Semi-elliptic springs hinged at the rear end are used on the rear and regular elliptic springs in front. The weight of the truck unloaded is 6,000 to 6,500 pounds, including supplies, and a speed of 15 miles per hour can be attained.

Special precautions are adopted to obviate any visible exhaust. After going through the feed water heater the exhaust steam passes to a separator, where all the entrained water is removed, and thence is conducted to a coil of $1\frac{1}{4}$ -inch pipe in the stack just above the steam dome, where it is superheated and escapes invisibly with the chimney gases.

As no oil is used for cylinder lubrication the water condensed from the exhaust may be returned from the separator to the tank and this is accomplished on the intermittent siphon system.

The entire controlling and indicating mechanism of the truck is concentrated at the driver's seat in front. Little attention need be paid to the steam pressure, as it is automatically maintained by the fuel regulator. Means are provided so that this regulator may be cut out of service and the pressure raised to 300 or 350 pounds when needful. Powerful brakes, which act by shoes on the rear tires, are operated by a pedal, and a mechanism is provided which acts to lock the differential gear to obviate slewing.

The vehicle seems to be very well thought out and planned for real commercial service.
