STEAM POWER STATIONS

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Langerbrugge station of the Centrales Électriques de Flandres has one 300,000 lb. per hour boiler of this type installed.

The Velox Steam Generator.—The Velox steam generator is also a forced-circulation boiler embodying several new features and seems to be one of the most successful applications of a gas turbine. The general arrangement of the parts can readily be seen with reference to Fig. 172. A gas-turbine-driven compressor raises the pressure of the combustion air to 22 lb. per square inch gage. On the same shaft

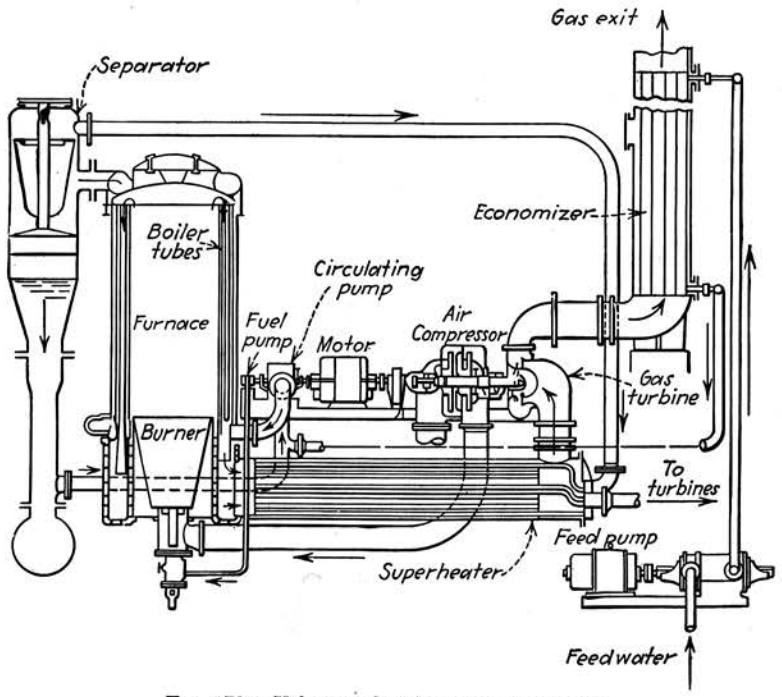

FIG. 172.—Velox combustion steam generator.

as the gas and air turbines a circulating pump, fuel pump, and motor are mounted. The combustion chamber is lined with vertical tubes, about 4 in. in diameter, which contain water. Each of these tubes contains three small tubes 1 in. in diameter through which the flue gas passes at velocities of 660 to 850 ft. per second; these inner tubes are the portion of the heat-releasing surface where enormous heat-absorption rates obtain. The radiant heat of the furnace is also effective on one side of the large tubes lining the furnace. Gases leave the combustion chamber at 3200°F. and are reduced in temperature to 1400 to 1500°F. in passing through the small inner tubes; and since the tubes

are followed by diffusers, there is little loss in pressure. The gases then pass to the superheating elements and are reduced to 900°F. approximately before they reach the gas turbine. In the gas turbine the temperature drops to about 700°F., and the turbine then forces the gases through the economizer at a velocity of 400 ft. per second, discharging the gas at some 200°F.

The heating surface surrounding the combustion chamber is completely filled with water, and ten to twenty times the quantity of steam delivered is circulating through this surface. The mixture of steam and water is separated by a mechanism similar to a cyclone separator, the steam being led off and the water falling to a lower chamber which acts as a hot-well storage. Also, sludge may be blown down from the bottom of this drum. It is claimed that the moisture content of the steam leaving the separator will not exceed 2 per cent.

This boiler is claimed to be impervious to poor feed water, the scale-forming substances remaining in solution. Since the air compressor, gas turbine, feed pump, and circulating pump are on one shaft, regulation is accomplished by varying the speed of the motor. For normal operation, the capacity of the air compressor is adjusted to give about 10 per cent excess air. The pressure drop through the gas turbine is proportioned so that the turbine does not have quite enough energy for driving the load, the difference being supplied by the motor. Heat-transfer rates are of the order of ten times those obtaining in ordinary steam-generating practice.

The field of application of this boiler is enhanced because it occupies so small a space and is self-contained. An experimental plant of 22,000 lb. per hour capacity was installed at an early date in the period of development of the boiler at the Brown-Boveri works in Switzerland. A 165,000 lb. per hour Velox boiler was ordered in 1935 for the municipal plant at Oslo, Norway, to operate at 400 lb. and 800°F. At the present writing the generation pressure has not exceeded 710 lb. per square inch, but designs have been worked out for 800 lb. and 900°F. There seems to be no reason why this pressure should not be raised considerably in the near future. Recent tests have shown that, with a feed-water entrance temperature of 180°F., the boiler, the auxiliaries, and the feed pump attain at full load an over-all efficiency of 90 per cent and that this figure remains practically constant down to half-normal boiler load.

The Steamotive Boiler.—Although this unit was developed primarily for use as a boiler on steam locomotives, there are indications that it has an application in the small stationary-boiler field where space is of considerable importance. The flow diagrams of the boiler

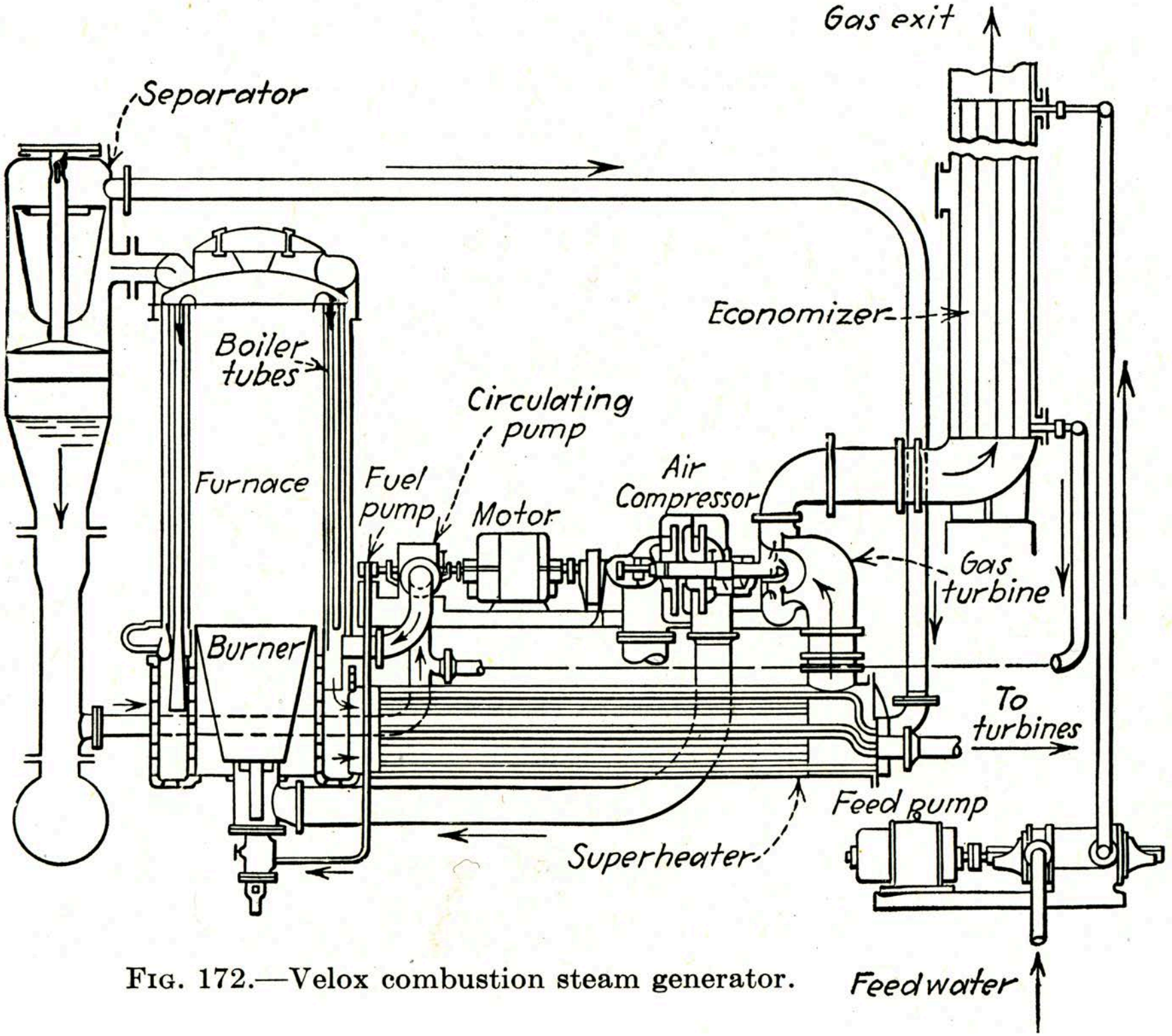

FIG. 172.—Velox combustion steam generator.