the bottom. The ejector discharges into the air separator and the steam from the ejector is condensed in the jet-condenser portion of the air separator. The surface portion of the separator condenses any remaining steam or vapor not taken care of by the jet condenser. There is an air vent at the top of the separator where a slight vapor is given off. The condensate then falls by gravity to the feed tank. To cool the water in the feed tank when the ship is "standing by," a connection is made to the top of the condenser. There is a water connection from the feed tank to the condensate pump so that when there is insufficient condensate from the condenser the pump may be supplied with water. As an air-removal apparatus the steam ejector is efficient due to the fact that the remaining heat in the steam from the ejector is used to heat the feed water. The principal reasons that it is used for marine work are that the weight is appreciably less than that of an air pump, and it has no moving parts.

For land installation the field for steam ejectors for air evacuation is large. The simplicity of the ejector compared with the high-vacuum air pump is a feature. As the ejector has no moving parts and the only replacements necessary consist of steam strainers and nozzles, it will require less attention. If a 28-in. vacuum or less is desired the steam consumption of the ejector is slightly less than that of the hydraulic air pump. However, if 28.5 or 29 in. of vacuum is desired, the capacity of the air ejector must necessarily be greater, and the steam consumption is nearly doubled, while the same hydraulic air pump can be used with the same steam consumption as for 28 in. of vacuum. From the standpoint of steam consumption only, the dividing line is 28 in. of vacuum.

Discussion of the Paper

In the discussion it was stated that the Government would confer a favor on the manufacturer of surface condensers, if, due to the shortage of copper, it enforced the use of steel tubes, tin-coated to eliminate pitting. By the use of steel, trouble from expansion would be reduced. The longevity of steel tubes was questioned and the percentage of nickel to make them durable. Other questions were the proper location and the size of zinc plates used to obviate the effect of electrolysis, the relative longevity of steel and Muntz-metal tubes and the possibilities of tin coating.

In the opinion of Mr. Morgan steel tubes would last as long as bronze tubes if proper precautions were taken to eliminate the action of the water. This was a question for the chemist to solve. Tin coating of steel tubes would be more beneficial than similar coating for Muntz-metal tubes. The difficulty was to obtain an even coating. Little spaces of the original metal would be left open to attack. His experience had been that the life of coated tubes was not appreciably longer than that of uncoated tubes. About 5½ per cent. of nickel would be required in the steel tubes. In heat transfer through steel tubes the time element would be an important factor, so that cooling-water velocities should be relatively low. With a steel tube perfectly clean the heat transfer might be 85 per cent. of that obtained with Muntz metal, but in actual operation with the tubes coated the heat transfer would probably drop to a figure ranging from 40 to 60 per cent. If steel tubes are used it is obvious that it will be necessary to eliminate brass tube plates and circulating-pump impellers, using steel or cast iron instead.

Admiralty-metal tubes with zinc plates were better than copper tubes. The proper location for the zinc was on the inner surface of the handhole covers and the proper ratio was 1 sq.ft. of zinc plate per 1000 sq.ft. of condensing surface.

Rather than go into the high costs involved in high pressures, it was Mr. Morgan's suggestion that efforts should be made to first use to full advantage the vacuums that are now available from the modern condenser. Designers need fuller information than they get from the average plant. Average yearly conditions are seldom taken and it is a usual thing to put in a condenser too small for the maximum work expected of it.

Another important item instigated by the thought of fuel conservation is that the manufacturers of condensers are not consulted to a sufficient degree when condensing apparatus gives trouble. Countless opportunities are given to correct defects and increase vacuum, but the worst of the situation is that when letters arrive, the complete information regarding the trouble, which the operating engineer could give, is lacking in a marked degree. Periodical inspection would be of great benefit, especially at this particular time when every concern in the country is taxed to full capacity. If repair parts could be anticipated in advance of needs a great deal of coal would be conserved.

Railroad Electrification and Water Supply

Mr. McAdoo's plan to electrify most of the United States railroad mileage, which is regarded by railroaders as feasible only in certain districts, calls attention anew to the great water-power resources of North America, says the *Boston News Bureau*. Canada's water-power is incalculable, much of it being in unsettled areas, but all over the Dominion available water-power is found in abundance where most needed or most likely to be needed. In the United States the maximum potential water-power is estimated at 60,713,200 hp., of which only 5,321,699, or 8.8 per cent., has been developed. The far West, especially the Pacific states, is very much in the lead in maximum potential water horsepower, the State of Washington being first on the list, with 9,990,000, followed by California with 8,865,000 and Oregon with 7,505,000. The percentages of development in those three states are 3.2, 8.2 and 2.1 respectively. Montana ranks fourth with 4,290,000, of which only 4.1 per cent. has been developed. Then comes the State of New York, with 4,242,000, of which 18.8 per cent. has been developed.

Other states exceeding the million mark are as follows: Idaho, 2,910,000; Arizona, 1,930,000; Colorado, 1,928,000; Utah, 1,490,000; Wyoming, 1,470,000; Alabama, 1,070,000. North Carolina has an even 1,000,000, and Maine falls below million mark by 84,000, but is 15,000 ahead of combined total for New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut.

Montana's water power is peculiarly adaptable to transportation purposes, and it was the St. Paul's successful electrification of 440 miles of its mountain divisions, with proposed extension of electrified system to the Pacific coast, and a similar project by the Great Northern which impressed the director general of railroads with the possible utilization of the country's latent water power for general electrification of all systems, more or less. Railroad operators say the water power is not distributed throughout the country in proportions suitable to complete electrification and that in many sections where it is the cost would be prohibitive. Oil burning locomotives of the Southern Pacific and Santa Fe, for illustration, they say, are more economical and, under the circumstances, more effective.

However that may be, there is running to waste 16,000,000 water horsepower in excess of the entire steam-engine horsepower, including locomotives.

Water-power development has been retarded by restrictive laws. An engineering report submitted to the Chamber of Commerce of the United States says: "Of the 55,000,000 undeveloped water horsepower in the entire country, approximately 40,000,000 is located within the boundaries of the so-called Western water-power states, where the Government still retains as proprietor 760,000,000 acres, or more than two-thirds of the aggregate acreage of those states combined. To develop power in that section it is therefore nearly always necessary to use some part of the public domain, if not for the dam site itself, at least for flowage, for transmission right-of-way, or for some other purpose. The existing laws forbid such use except under permit by the Secretary of the Interior, revocable without cause at any time by himself or by his successor in office."

How far and how long ammonia can be spared for refrigeration cannot now be said. Plants most extravagant in its use will naturally be closed first. The efficient plants are in the best position so far as this question is concerned.