(Continued from page 192).

One of the chief obstacles to high head per stage in certain types of centrifugal pumps has been the leakage from the discharge, past the impeller, back to the suction chamber. In this pump this has been prevented by the use of special labyrinth packing rings, instead of the plain, straight, water packed joint commonly employed. At each joint there is one labyrinth ring attached to the impeller and another meshing with it set into a recess in the pump casting and secured in place by the act of letting the cover down upon the lower pump casing. The two labyrinths intermesh in such a way as to form a long, tortuous passage in which any leakage currents are repeatedly broken up. At the same time the water within the labyrinth is set in motion by the drag of the moving ring, creating a counter centrifugal force in opposition to the leakage. A packing of this nature permits of much greater clearance in both radial and axial directions at once than does a straight water-packing, and furthermore, it lasts longer, as the velocity of the water through it is much less.

Simplicity of construction and accessibility for inspection are essentials for any pump that is to be installed in a boiler room and entrusted to unskilled labor. It should be possible to get at the working and wearing parts of a pump without disturbing pipe connections. The casing of this pump consists of two parts only, the bottom casting and the cover casting. In the bottom casting are formed the inlet and outlet passages to the piping, while both castings contain passages leading from the delivery of the first impeller to the inlet of the second, these passages being cast in the solid metal. Smoothness and exact form of the passages are secured by the use of dry sand moulds exclusively. The top or cover casting, when raised, exposes the shaft and the impeller, that is the entire interior and all working parts of the pump, and after removing the shaft bearing caps, the impeller may be lifted out entire, so that all parts are rendered accessible by the breaking of only one packed joint, namely, that between the two halves of the main casting. The connections to the suction and discharge pipes need not be disturbed in any way. The flange of the suction opening may be seen at the end of the pump under the bearing, while the discharge opening is directed horizontally on the farther side of the pump.

The bearings of a boiler feed pump destined to be operated for long periods without attention should be the best obtainable. In the present case they are all of the ring-oiled type used for electric motors and generators. They are of very ample dimensions and are supported on hollow brackets or pedestals entirely separate from the pump casting. These pedestals contain oil wells and are fitted with the usual cocks and gauge glasses.

While the impellers are in perfect hydraulic balance, one of the bearings is made of the marine thrust type in order to take care of any end thrust that might be developed by possible clogging of the balancing passages in the impellers. A few words in explanation of the method of balancing may be of interest. On the rear side of each impeller, that is the side opposite from the inlet, is a chamber encircled by the labyrinth rings and of the same diameter as the inlet chamber. This balancing chamber is connected to the inlet by a small hole through the impeller disc itself. It therefore contains water at the same static pressure as the water entering the impeller, and any reaction due to the entering column of water is balanced by an additional static pressure generated by the impact of this entering column of water on the small holes connecting the two chambers.

Leakage of water outboard around the shaft at the discharge end of the pump or leakage of air into the suction side of the pump are prevented by packing glands, which in addition to packing material under pressure, have a central open part to which water under pressure is introduced, effectually preventing the entrance of air. As pump shafts are sometimes injured by excessive friction and scoring due to improper use of the wrench on the nuts in drawing up the followers of the packing glands, and also to protect against corrosion by water, the shaft is protected by bronze sleeves extending from the outside packing up to the impeller. In case of scoring or erosion of this sleeve it can be replaced without renewing the shaft. Leakage of water around the shaft where it passes through the diaphragm separating the two stages is prevented by a long bronze-lined water-packed joint in which there is no rubbing contact.

The pump is directly driven through a flexible coupling by a steam turbine upon the same bed plate. The turbine is designed to receive steam at 200 lbs. gauge pressure with 150° F. superheat, and to exhaust into open heaters. The power for operating the pump, therefore, costs practically nothing, as all of the energy of the steam is returned to the boiler in the feed water, including even that expended as work and friction in the pump and turbine.

The governor of the turbine is an interesting feature. The pump can be controlled by an ordinary pump governor, of either the constant or excess-pressure type, inserted in the steam line ahead of the turbine, the turbine governor acting merely as a maximum speed limit. The turbine governor is driven by a worn gear from the shaft at a speed of 900 revolutions per minute, making possible the use of a heavy, powerful construction. As an additional guarantee against excessive speed, an emergency governor is fitted to the end of the shaft. In case of overspeeding this governor trips a level, which relieves steam pressure from under a piston controlling the emergency valve in the steam pipe outside of the turbine The pipes connecting the emergency governor and the emergency valve may be seen. Even in the case of failure of both governors the turbine could suffer only minor damage, as the wheel is so designed that long before its limit of strength is reached, the buckets will fly off, upon which the disc will come to rest. The single solid disc of this turbine is comparatively easy to balance, although it is quite difficult to balance a shaft with several discs threaded on it.

In a turbine of this type the best steam economy is secured when the nozzles are receiving steam at the full pressure. In order to make possible the running of the nozzles at the highest efficiency at all times, including periods of light load, it is only necessary to supply hand or automatically operated valves for shutting off one or more nozzles as may be required. Such valves may be observed at the top of the machine.

Where the amount of exhaust steam available in a plant is more than is required to heat the boiler-feed water up to 210 or 212° F., these turbines admit of being run with exhaust steam from other auxiliaries, exhausting into the main condenser, or they can be arranged for mixed flow, that is, with certain nozzles designed to receive live steam and others to receive exhaust steam.

The machine here described and illustrated is one of two shipped to the Detroit Edison Company by the De Laval Steam Turbine Company, of Trenton, N.J. The pump has shown under test at full load an efficiency of over 60 per cent., which, considering the capacity is unusually high. Larger pumps of this type and make have shown efficiencies above 85 per cent.