full lift of the sector, or about 11 ft. 2 in. The head on the inside of the sector is readily controlled through the discharge well in the north abutment. The water is discharged through a vertical weir tube operated by a hand wheel, controlling the discharge head, and hence the head on the sector. The annular weir consists of a cast iron tube 36 inches in diameter set below the river bed, supported through a reinforced concrete slab in a well formed in the abutment, and in which telescopes a second tube balanced by counterweight and operated by hand, through which the water must pass to escape from the well, the maximum escape head being equal to that necessary to raise the sector to its extreme elevation.

Construction was commenced in the fall of 1913, but actual progress did not begin until January, 1915. Excavation was then commenced, and concreting was in progress day and night from the middle of February until completion in May. About 18,000 sq. ft. of cellular cofferdam were built, enclosing the sector well and abutments, and later, portions of the stop-log section. In the sector well the excavation was in blue clay, almost bordering on rock, with occasional layers of sandstone 2 to 3 ft. thick. Because of the amount of water present and the low temperatures prevailing, it was necessary to handle practically the entire amount (about 10,000 cu. yds.) by hand, loading into stone skips which were removed by derricks and dumped into 1½ cu. yd. cars in dinky trains on a trestle to the bank. Concrete was placed from a switching track from a mixer plant located on the north bank. Three small Marsh-Capron mixers turned out about 2,500 cu. yds. of concrete per month. Erection of the steel sector was accomplished by setting up a wooden cofferdam around the sector well. Wooden sills were anchored to the scour mattress when concreted and held the toe of an A-frame upon which were placed 2-in. planks for the outside of the cofferdam. There is a steel footbridge over the sector dam, and this was erected first, and the frames for the sector proper were handled from this bridge.

The contractors for the dam were Janse Brothers, Boomer, Hughes & Crain, of Calgary, and the construction was under the immediate direction of Mr. A. M. Crain, Assoc.M.Am.Soc.C.E. The design was made by the Department of Natural Resources of the Canadian Pacific Railway, Mr. A. S. Dawson, chief engineer, and the entire work was carried out under the supervision of Mr. H. B. Muckleston, assistant chief engineer, Calgary, Alberta.

An untreated steel containing about 1½ per cent. manganese is claimed to be fully as tough, and is stronger than a nickel steel of about 3¼ per cent. nickel.

The Great Falls Power Co. and the Thompson Falls Power Co., subsidiaries of the Montana Power Co., have entered into contracts with the Chicago, Milwaukee and St. Paul Railway for the electrification of about 430 miles of its main transcontinental line from Harlowtown, Mont., to Avery, Idaho. and for electric power to operate the same. Under these contracts, which cover a period of 99 years, to go into effect on or before January 1, 1918, the railway company is bound to take and pay for 20,000 kw., about 26,500 h.p., and has taken an option on additional power to the extent of 30,000 kw., about 40,000 h.p., which option must be exercised one-half in five years and one-half in 10 years; but not less than one-half the amount under option must be taken. On August 11 water was let over the spillway of the dam which the Montana Power Co. has been building for the past three years for its hydro-electric plant at Big Falls on the Missouri River, 14 miles from Great Falls. The dam alone cost about $5,000,000.

TRACTION EQUIPMENT FOR ELECTRIFIED STEAM RAILWAYS.

The committee on heavy electric traction of the American Electric Railway Engineering Association, has compiled some very complete tables relating to the general types of electric locomotives in operation on railroads in America and abroad. They do not cover locomotives used on interurban lines or those used for switching in industrial plants, mining operations, etc., being limited entirely to the practice on electrified steam railroads and on lines acquired or owned by steam railroads. There are two, the first relating to American, and the second to foreign lines. They give under each railroad the number of locomotives in use, description of the service, system of traction and voltage, kind of contact conductor employed, wheel arrangement, total weight and weights of parts, horsepower rating, speed, type of drive and connection, and principal dimensions. Practically all the available systems are represented. An analysis of the tables indicates that of a total of 301 domestic locomotives listed 115, or 38 per cent., are used in connection with 600-volt d-c. third-rail operation, the remaining 186, or 62 per cent., being used in connection with some form of overhead trolley, and that of the locomotives using overhead trolley 72 per cent. are in connection with the alternating current system. It is noted that the foreign locomotives except those in England and France operate in connection with some form of overhead trolley.

These tables, to be presented in the report of the committee, at the convention of the Association in San Francisco, October 4-8, are accompanied by a very interesting study of the present trend of electric locomotive design. In regard to the electrical equipment, it is stated that the practice of using forced ventilation is becoming quite general especially where alternating current or high voltage direct current equipments are used. There is a distinct weight and cost economy resulting from the use of forced ventilation which more than justifies the provision and maintenance of the blowing apparatus. In the case of the Pennsylvania Terminal locomotives where forced ventilation is not used at present for the short haul, service provisions have been made for adding forced ventilation and thus materially increasing the motor capacity when required later on in connection with extensions. The later type New York Central locomotives are equipped with forced ventilated motors.

The most interesting features which develop from a study of electric locomotives is the design of the mechanical parts, especially the wheel arrangement and the method of drive. There is a great divergence of practice in regard to these features. Where locomotives are used for high speed operation leading and trailing wheels are provided by a majority of the roads and in some cases even where the speeds are low and where the line contains numerous track curves it has been thought advisable to provide trucks for leading the locomotives into and out of curves and to prevent oscillation and excessive side pressure on track rails. The majority of foreign locomotives use two-wheel trucks. The latest type of New York Central locomotive has the guiding trucks equipped with motors.

Method of Drive.—Probably the greatest amount of ingenuity and effort in developing the design of electric locomotives has been devoted to the question of type or method of connection between the motor shaft and the axles. A very considerable portion of the weight of the electrical equipment is in the motors and to carry these