throughout the surface of the gate, the preponderance of pressure is again shifted from one side to the other of the axis of rotation, and the gate rises.

The type with siphon control falling down stream admits trussing or bracing, etc., so that it is possible to make it very light and at the same time strong and stiff against warping and of any reasonable length. It may be advantageously used up to 10 to 12 ft. lift on high spillways and dams. The width of that part below the axis of rotation in any of these movable crests should be not less than five-eighths the width of upper section, exclusive of width of flap leaf; the relative proportions of parts of gates should be computed to meet the special conditions in each case.

Steel plates are hinged to edges of lower sections and move along inclined planes in order that there shall be elasticity in the system even under considerable wear at axis and inaccurate work. The gates will not be subject to wedging and obstruction by gravel, chips, etc., and these narrow leaves remove most of the objections that have been made to drum weirs, etc., the leaves of which must be nearly in contact with the curved surfaces of hydraulic chambers, and are often wedged. These plates may be in sections of desirable lengths, the joints between lengths may be stopped against leakage by strips of pure rubber packing, allowing any section to rise or descend enough to pass over any chance pebble or chip without serious leakage, or straining the gate, and the plates as a whole to adjust themselves to wear or inaccurate workmanship, location of axis or informing the plane surfaces of the hydraulic chamber.

4. The air passages to remove vacuums that form under the gate, due to rapid flow of water over it when down, are not novel except in the particular disposition of them. Vacuums more or less complete under overfalls increase materially the pressures on the upstream faces of gates and dams; cause tremblings and vibrations in dams, and in old bear-trap forms sometimes determine whether they can be worked at all in certain positions or phases of their motion.

The question of prevention of partial vacuums, then, is of some importance in all dams, whether movable or fixed, and especially so in bear traps, where little or no attention has been given the subject.

Regulation of Levels of Reservoir With Spillway Crests and Sluiceway Gates.—Some criticisms of automatic movable sluice gates have been based upon the opinion that their movements are so rapid that there would be thrown into the stream below the reservoir large amounts of water en masse, thus creating waste of such magnitude that damage to animal life, or to property, might result.

This objection is well founded, but, when it is considered that the movable crests, or spillway gates proposed are in fact hydraulic engines, capable, if properly constructed, of as smooth, gradual and certain movement and control (and by similar methods) as any other hydraulic press or engine, the point is of small importance.

It is necessary for this purpose in a series of sluiceways controlled by automatic gates to provide one and only one sluiceway of the series, with a hydraulic gate to be operated carefully by hand, in order to make the increase in discharge as gradual as it would be over a fixed or movable horizontal weir of suitable length, by filling in by gradual increase in discharge the differences in total discharge caused by the sudden periodic gate movements.

For instance, suppose there is an available site 350 ft. in length for a spillway to be used in connection with a large reservoir, and that the maximum flood to be wasted is about 25,000 sec.-ft. and it be desired to store all water practicable in the reservoir, with a fluctuation in its water level of about 2 ft.

The effective depth of the sluiceways, if 50 ft. wide each, must be 9 ft. at maximum flood level, and there must be six of such sluiceways of that width to discharge the maximum floods of 25,000 sec.-ft.

The sluice gates or movable crests may be made of 7-ft. lift each, and the water levels in the reservoir must be so controlled as to rise not more than 2 ft. above their crests when raised.

Each 50-ft. sluiceway 7 ft. deep will discharge approximately 3,000 sec.-ft. When the water rises to the limit assumed there will be 9 ft. depth in the sluices and the discharge of each will then approximate 4,500 sec.-ft. The discharges may be less than above given, but they are assumed for the purposes of a demonstration; accuracy is not now in question.

One of the sluice-gates is to be of most careful construction, and fitted in all its parts for hand control and operation, and five of them are supposed to be operated automatically by siphon, all gates being of a type falling down stream from the reservoir. These latter have the siphon throats and their air-entrance breaks adjusted in level so that the gates will fall in succession, upon increments of, say, about 3 in. in reservoir levels, beginning with the first gate falling when that level reaches 7 in. above the crest when raised, and the last or sixth gate falling when the water level of the reservoir is about 3 in. below the maximum safe limit named above. Now, when the water level in the reservoir rises until it is nearing 7 in. above the crests of the gates—at which level the first gate is arranged to fall—the operator would begin to lower the hand-operated gate at a rate that preserves the level of the reservoir water until that gate be fully depressed.

Whenever the first automatic gate goes down, the hand-operated gate should at once be raised, and the same gradual movement of the hand-operated gate be resumed between the falling of the first and second, etc., and succeeding automatic gates, if such care be necessary. It is, then, practicable to make the discharge from a reservoir by the use of these gates, or indeed of any of the "bear-trap" family, as gradual and regular as by any other device, even if that device be a fixed weir, but the controlled sluiceways have the material advantage over the fixed weir of allowing the storage of 7 ft. (in this case) depth of water over the entire surface of the reservoir, which cannot be done by a fixed weir of same length of crest with as little waste and as little fluctuation in water level in the reservoir, and the sluices moreover, serve admirably for drift chutes.

In some very large reservoirs now in existence, or under construction, this additional storage of 7 ft. in the reservoir might run to a hundred thousand acre-feet or even much more, a matter of very great importance in our arid region, where water is so precious for irrigation and domestic use.

EXPLOSIVE PRODUCTION.

The United States Bureau of Mines has compiled some figures on the production of explosives in the United States in 1912. It appears that there were manufactured, 230,233,369 lbs. of black powder; 24,630,270 lbs. of permissible explosives; and 234,460,492 lbs. of high explosives, such as dynamite, nitroglycerine, etc. Of the high explosives, 89,703,081 lbs. were consumed in mining other than coal and 4,668,399 lbs. of permissible explosives in the same industry.