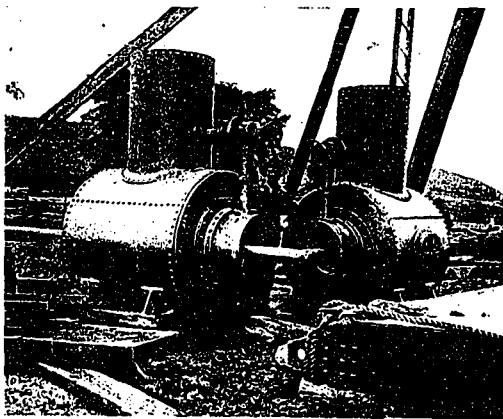


order, and these having been set neither he nor the gate-men can err by using their levers at the wrong time.

In order to get a clear idea of the complete mode of operation, let us assume that both lock chambers are down at the lower level, empty, as they are at the end of the winter, or when it is desired to prepare them for



FIFTEEN-INCH TURBINES TO OPERATE PRESSURE PUMPS.

navigation purposes. The annular space in each of the presses if empty will be filled with water. The main valve on the connecting pipe will be closed and water will be pumped into one of the presses until the ram, with its superimposed chamber rises to the level of the upper reach. An examination of the case will show that it is necessary that the uppermost chamber, in order that it shall be able in descending to cause the other to take the full upward stroke, must contain a volume of water greater than the rising chamber contains. This extra amount of water is equal to the volume of one of the rams, since the change that takes place during the relative motion of the two chambers is that the ram of the descending chamber becomes constantly immersed while the other protrudes. In other words, the descending chamber is losing weight while the ascending is constantly becoming heavier. It is also necessary that some extra weight be provided to overcome the friction of the guides, and of the stuffing boxes of the main presses. The area of each lock chamber is so great that it requires only an additional depth of 8½ in. to give an extra load of water of 100 tons, which is sufficient for ordinary operation. The addition to this weight will, of course, have the effect of accelerating the time of the relative change in position of the chambers. The ordinary time required in raising the chamber through the whole elevation is about two minutes. But this will depend upon the adjustment of the main glands, the nicety of the working of the guides, and the manipulation of the main valve in the hands of the lockmaster.

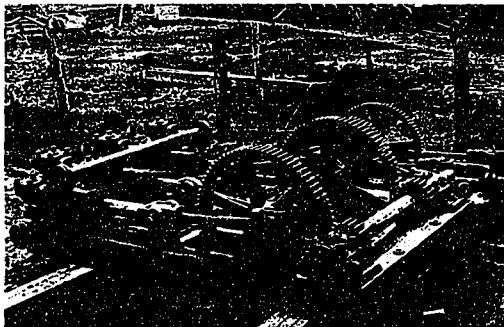
An ordinary lockage is conducted in this manner: Suppose 100 tons of "surcharge" has been found to give sufficient additional to the descending chamber. The uppermost chamber will then be required to stop with its floor 8½ in. lower than the bottom of the upper reach. On communication being established with the reach, it receives from the reach 100 tons more than the lower

chamber contains, assuming the depth in both reaches to be the same. Then the total operations to make the lockage, if the gates adjoining the reaches are opened and the seal tubes are inflated, consists in hauling the vessel into the chamber and mooring her there securely, closing the gates, deflating the seal tubes, and opening the main valve between the presses. The heavier chamber then commences to descend, the motion being allowed to increase gradually by the gradual opening of the valve until it reaches the maximum speed. At about three-quarters of the stroke the main valve is slowly closed, communication between the presses being entirely cut off when the end of the journey is reached. The change in elevation being made, the seal tubes are inflated, the gates are opened, and the vessel or vessels are free to go on their journey, after being towed out by the capstans. The "surcharge" contained in the descending chamber simply flows out into the lower reach, while a similar quantity to perform the next lockage is admitted into the chamber which has just reached the higher elevation.

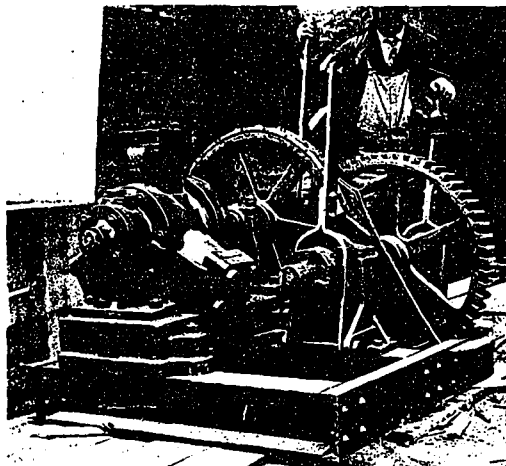
The record lockage, up to Jan., 1907, at the Peterborough lock was 6½ minutes, being the whole time from the stopping of the vessel in the lower reach to her proceeding on her journey under her own steam in the upper one.

From this description, it will be seen that in order to have the finished structure successful in operation, accuracy from start to finish must have been constantly in mind. This fact, more than all others, probably, was impressed upon the author during the progress of the work: Eternal Vigilance is the Price of Accuracy, and Accuracy is the Price of Successful Operation in a Hydraulic Lock.

It is worthy of note that the locks employed on the Trent canal, both at Peterborough and Kirkfield, can properly be labeled "Made in Canada," being built for the Canadian Government



THREE-THROW SINGLE-ACTING PRESSURE PUMPS.



THREE-CYLINDER HYDRAULIC GATE ENGINE.

by Canadian contractors and absolutely under the direction of Canadian Engineers. The water load of the Peterborough lock is double the larger European ones.