## 154 HYDRAULIC LIFT LOCK ON THE TRENT CANAL.

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 main 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 popular language, the descending chamber is losing weight while the ascending one is constantly becoming heavier. It is also necessary that some extra weight or "surcharge," as it is called, be provided to overcome the friction of the guides and of the stuffing boxes of the main presses. The area of each of the lock-chambers is so great that it requires only an additional depth of 81 inches to give an extra load of water of 100 tons, which will, no doubt, be quite sufficient. The addition to this weight will, of course, have the effect of accelerating the time of the relative change in position of the chambers. It is intended that the actual time required in raising the chamber through the whole elevation, will be about three minutes. But this will depend upon the adjustment of the main gland, the nicety of the working of the guides and the controlling of the main valve in the hands of the lock-master. In the European locks this part of the lockage is readily performed in three or four minutes. Suppose that the uppermost chamber will be required to stop, say with its floor 81 inches lower than the bottom of the upper reach. When communication is established between it and the reach it will have a load of 100 tons in excess of that in the lower reach, assuming that the depth of water in the two reaches is the same. Then the total operations to perform the lockage, assuming that the gates adjoining the reaches are open and that the watertight joint between the chambers and the reaches is made, will consist in hauling the vessel into the chamber and mooring her there securely, closing the gates, deflating the water-tight joint and opening the main valve between the presses. The heavier chamber will commence 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. Theoretically it would appear possible to have an ideal surcharge which would perform the required stroke without the operation of any valve whatever. The change in elevation being made, the water-tight joints are again made