

pressure in the pipe of course varied slightly. The pressure was read at intervals of one or two minutes, and the mean value during the whole trial was accepted as the pressure under which the flow took place. The extreme variation of the pressure was about one pound per square inch.

Three different sized nozzle tips were supplied with the wheel. These nozzles tapered gradually on the inside from the diameter of the supply pipe to that of the actual orifice. The outlet diameters were : .5277 in., .6307 in., .7532 in. Sets of trials were made, using the largest and smallest of these nozzle tips, the largest giving the more satisfactory results. The water was discharged from the motor into a flume beneath, whence it ran into measuring tanks, and all the water used was thus actually measured. For the purposes of these trials two tanks were used, each of the capacity of 1,000 gallons; these had both been previously calibrated. The power given by the wheel was estimated by means of an absorption brake and a revolution counter. The shaft was provided with an 18-in. diameter brake wheel of special design, and the power was taken off this. In the earlier trials the brake consisted of one or more cords embracing a suitable arc of the periphery of the brake wheel, and having spring balances attached to the tight and slack ends to indicate the corresponding tensions in the cord. As the power varied slightly all the time, both readings were taken at intervals of one or two minutes, and the means used in calculating the final result of the trial. Later a direct-reading, self-adjusting brake, designed by Mr. Withycombe, was substituted for the cords and spring balances with very satisfactory results.

An ordinary revolution counter was used, but arranged to be thrown in and out of engagement with the shaft at the beginning and end of each trial. The necessary readings could thus be made at leisure, ensuring greater accuracy.

In addition to the revolution counter a tachometer was connected to the shaft. This served as a guide when adjusting the load on the brake wheel previous to a trial to give a desired speed of running. It also served to indicate any considerable departure from the intended speed which might take place during a trial, and which would vitiate the accuracy of the calculated results.

Before passing to the examination of the experimental results of the trials, it may be well to make a brief theoretical analysis of the subject. The elementary theory of an impulse wheel is very simple—so simple, indeed, that no attempt seems to have been made to consider to what extent known and observable phenomena may modify theoretical calculations; but rather the elementary theoretical result is generally taken as the last word which can be said on the subject from a theoretical point of view.

In the following investigation the efficiency is deduced from a consideration of the circumstances, as far as they can be mathematically expressed, under which the mechanical action takes place.

In the elementary theory of the impulse water wheel the assumptions generally made are substantially as follows:

1. That the jet has the theoretical velocity due to the available head of water. 2. That the jet strikes the vane centrally and tangentially to the wheel. 3. That the jet passes over the surface of the vane without any loss of relative velocity. 4. That the vane is so formed as to turn the stream through an angle of 180 deg. completely back on itself.

(To be Continued.)

FIRES AND FIRE-PROOF CONSTRUCTION.

Editor CANADIAN ENGINEER:

STR.—I have, as requested, looked through the pamphlet you were kind enough to send me, on the Paris Charity Bazar Fire, by Arch. E. O. Sachs, author of *Fires and Public Entertainments, Modern Opera Houses and Theatres, etc.*

This paper was prepared by the author for the Architectural Association, and read at its second ordinary meeting, session of 1897-98, Hampden W. Pratt, F.R.I.B.A., president, in the chair, and was commented on after its reading by Richard Roberts, L.C.C., vice-chairman Theatres Committee, London County Council; Sid. Gamble, A.M., Inst. C.E., F.S.I., second officer Metropolitan Fire Brigade, Major Fox, chief officer Salvage Corps; Thomas Blashill, F.R.I.B.A., F.S.I., superintending architect London Common Council; Capt. Dyson, chief

officer Windsor Fire Brigade; William Archer; Henry Lovegrove, A.R.I.B.A., F.S.I., district surveyor for Shoreditch; Max Clarke, A.R.I.B.A. It has been published by the British Fire Prevention Committee, C. and E. Layton, publishers, Farringdon street, London.

I find the consensus of opinion in this case to be that while the fire was caused by an explosion of some of the essential oils used in the exhibition of the Kinemetographic views, the conflagration and the destruction of the building were disastrously hastened by the fact of the roof drapery having been immediately ignited by the explosion, the flames in an instant running along the whole building, some 300 feet in length by about 40 in breadth, setting fire to the woodwork and flimsy paper and other decorations of the interior, which, falling from above directly onto the heads of the lightly-clad ladies in attendance, set fire to their hair, their head gear and dresses, thus causing the simultaneous and almost instantaneous death of 124 persons on whose heads and shoulders at the same time the broken glass from the continuous skylight was falling, cutting into their flesh and inflicting painful wounds and bruises. Still, quick as the destructive element was in bringing about this most terrible result, the committee is of opinion that had the several emergency doors which were barred and bolted at the time, been opened as they should have been by persons told off in advance to do the duty, not one half of the fatalities would have occurred, maybe not one tenth of them, as the victims issuing into the open could have been cared for by outsiders, who would have seen to the safety of all of them and have probably reduced the casualties in most cases to more or less severe injuries to be got over in course of time.

Mr. Sachs recalled the Vienna Ring Theatre fire of 1881, with its 450 fatalities; the Opera Comique fire in 1887, with a death roll of 115, and other great catastrophes; the Exeter theatre fire of 1887, where 160 lives were lost, followed by a serious fire at Oporto with the loss of another 100 lives. He might also have remembered the Bordeaux theatre fire, the Santiago church horror, where 2,000 souls were hurled into eternity, and the Brooklyn theatre fire of 1872 (I believe), where 276 more lives were sacrificed. Mr. Sachs comments upon the fact of how soon these disasters fade from memory, most of them, he says, having been forgotten within from three to seven days of their occurrence.

The London Committee calls on Parliament, or intends doing so, to interfere and force municipalities to attend to the safety of the public by refusing to sanction the erection of such flimsy and dangerous structures and decorations, and I am certainly at one with the committee in refusing to understand how it is to be considered as interfering with the individual liberty and action to enact such laws, any more than legislating on compulsory vaccination and other hygienic safeguards to the public health: for, as above set forth, there is no doubt that, had not the incriminating ceiling cloths been there, or one of asbestos or other inflammable material, and parties at hand to open the seven doors of the building aggregating some 40 feet in width, the Charity Bazar horror would not have been to any extent as serious as it has proved to be.

(Continued on Page xv.)

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