ence for fire, are so far influenced by the pernicious doctrine of Fatalism, as to make little or no efforts to suppress it. They look upon fires as the act of God, determined by Him, and therefore conclude it useless to contend with Him, in attempting to extinguish those which He has kindled.

(*Concluded in next issue.*)

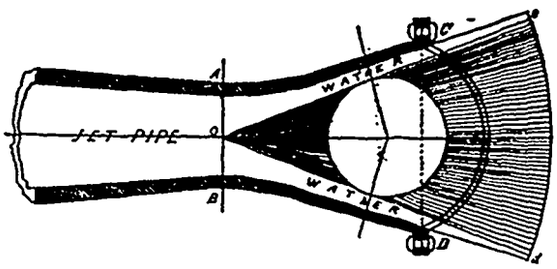
For THE CANADIAN ENGINEER.

SOLUTION OF THE "BALL-NOZZLE FIRE JET" PARADOX.

BY CHAS. BAILLAIRGE, C.E., QUEBEC.

The action of the "ball-nozzle fire jet" was considered contrary to the laws of nature, so the American scientific papers said. Not only was it thought so by scientists in general, and by hydraulic engineers, but by the inventor himself. To be sure, I merely announced the solution in general terms and without any explanatory diagram, as due to the formation of a vacuum behind the ball, and the scientific world may therefore be still sceptical on the subject or as to the true explanation having as yet been arrived at.

I am led to this conclusion from the fact that even the scientists and hydraulicians of our "Canadian Society of Civil Engineers" seemed at first sight to doubt the correctness of my enunciation of the solution, and directed the secretary to write me for a graphic and scientific explanation of how the mere pressure of the atmosphere could resist or counteract a pressure of may be 100 lbs. to the inch against the rear of the ball.



Now, as seen by the diagram, there is no pressure against the ball, or only that of friction at the circle of contact between the ball and water. The pressure is in the moving water, and is expended, not in pushing the ball, but in expelling the water through the annular space, *ab*, around the ball, and between the ball and conical or divergent nozzle, *ABCD*, the ball so adjusting itself, of course, that the sectional area of the funnel-like jet of water at *ab*, or area of the annulus, becomes equal to the sectional area of the solid jet at *AB;* and the thickness of the jet or breadth of annulus at *ab* goes on decreasing, of course, as the diameter of the cone increases at *cd*, where, supposing the velocity still the same as at *AB*, less the diminution caused by the resistance and pressure of the air, the area at the annulus at *cd* is still the same or so much greater as the velocity at *cd* is less.

Of course, the water, when first let on, forcibly projects the ball against the confining wires at *CpD*. In the meantime, the friction of the water around the inner periphery of the apex of the cone *AOB* quickly sucks away the water from the concave-conical space behind the ball, thus creating a vacuum towards which, or away from the confining wires, the atmospheric pressure pushes back the ball until, as already said, the area of the annular space for the water around it becomes adjusted to an equality with that of the solid water at *AB*.

Of course, in company with all other technologists or engineers, I can only see with the eyes of faith what I here describe, as the solid brazen funnel *ABCD* cannot be seen through, and even if it could, or if the nozzle were of glass, still would the glass and water and vacuum be all of a color, and the vacuum unseen; but that there is a vacuum there, that there must be one, must be just as obvious to the scientist as if it could be proved to exist; nor even can the engineer doubt it, when he knows how in sewers the current of water carries a current of air along with it, or as a current of water will, and does, draw away with it a film of the quiescent water it is in contact with, and those of your readers who have in your April issue studied "Taylor's System of Air Compression," cannot believe in it any more than in the explanation of the "fire nozzle paradox" unless they admit, as Taylor explains, that the water sucks down the air with it, though in this case the proof is evident from the fact of the existence of the compressed air as evidenced by its power motor action.

For THE CANADIAN ENGINEER.

THE PREVENTION OF STEAM BOILER EXPLOSIONS.

BY CHAS. BAILLAIRGE, C.E., QUEBEC.

Notwithstanding all the precautions, suggestions and scientific disquisitions by mechanical engineers, scientists and would-be connoisseurs during the last fifty years, steam boiler explosions continue to be as persistent as ever, and so they will be until some such preventive as suggested by the writer, now fully thirty years ago, shall have been insisted on by legal enactment.

I have been a close observer of these periodically recurring accidents, many of which I have seen and made a special study of, as set forth in papers read by me before the Royal Society of Canada, in May, 1891. See page 8, items 5, 6, 7, 8, of "Bibliography of the Members of the R. S. of Canada," as published by the society in the volume of transactions for 1894.

The explosion is due in many cases, of course, to the overloading of the safety valve, or to this becoming so firmly stuck and rusted *in situ* that it cannot be forced open even by such a pressure as that capable of bursting the boiler; but in many and most cases the safety valve has been found open after the explosion, an evident indication that had it been large enough to allow of blowing off the steam as fast as formed, the rupturing of the vessel would not have occurred.

There are no doubt cases where, the water becoming low and the surfaces red hot, a new supply over the unduly heated areas forms steam with such rapidity and in such quantities that the ordinary safety valve full open cannot give vent to it, the pressure increasing till the boiler bursts.

When a boy of 17, and with a friend of the same turn of mind, I built some fifty years ago a double engined steam carriage for ordinary roads, and many a trip we made with it in and about the ancient capital, till stopped by the police for frightening horses. We had returned from one of these outings, and, intending to go out again, did not draw the fire, but laid up during dinner time at my father's then residence, No. 17 Genevieve street, Cape, when hearing an uproar in the yard, I got my head out just in time to see the valve returning almost vertically downwards from the height to which it had been blown by the increasing force of the vapor from within. This vapor continued to escape from the valve in a solid cylindrical form of some ten feet at least in height, before it was sufficiently cooled down and disintegrated by the resistance of the atmo-