THE RIVETING PRESSURES REQUIRED FOR BRIDGE AND BOILER WORK.

At a general discussion of this subject before the Engineers' Club of Philadelphia, Mr. Wilfred Lewis referred to a number of letters received expressing interest in the subject, and read a letter from Mr. David Townsend stating that he was prepared for the manufacture of rivets to be driven cold, a number of which were exhibited.

In regard to the pressure required for driving such rivets, Mr. Lewis recalled some experiments made by William Sellers & Co., Incorporated, between the compression platforms of their testing-machine. A number of ⅜-in. rivets were subjected to pressures between 10,000 and 60,000 lbs. At 10,000 lbs. the rivet swelled and filled the hole without forming a head. At 20,000 lbs. the head was formed and the plates were slightly pinched. At 30,000 lbs. the rivet was well set. At 40,000 lbs. the metal in the plate surrounding the rivet began to stretch, and the stretching became more and more apparent as the pressure was increased to 50,000 and 60,000 lbs. From these experiments the conclusion might be drawn that the pressure required for cold riveting was about 300,000 lbs. per square inch of rivet section. In regard to the pressure for hot riveting, he said that until quite recently, within the last decade, there was never any call for a pressure exceeding 60,000 lbs., but that now pressures as high as 150,000 lbs. were not uncommon, and even 300,000 lbs. had been contemplated as desirable.

A letter from Mr. Henry G. Morse, President of the Edge Moor Bridge Works, was also read apropos of the discussion at the previous meeting on the strength of bolts as developed by long or short nuts.

Mr. F. H. Lewis: I have never seen a riveter of any kind that can always be relied upon to drive the rivets tight. Even those having pressures of 75 tons sometimes drive rivets that are loose, and this is probably due to the buckling of the plates.

Mr. Henry G. Morris: I have here an old sample which is intended to show that even the old toggle-joint riveter, if properly worked, will drive rivets that fill the holes even when they are badly matched.

Mr. Henry J. Hartley: This is a question which is occupying a great deal of attention at present among bridge and boiler men, and I know that some series of tests to get at the facts are now being carried on. The necessary pressure must, of course, be enough to upset the bolt and form a head upon it; but this will vary with the fitting of the holes, the temperature, and several other conditions. Books give little data on the subject, but I think the matter is of great importance, and would like to see it continued at another meeting, with the hope that more positive facts can be given. I, for one, will try to have something a little more definite. My personal opinion now is that machine-driven riveters do better work, and that the fault lies in the way that they are used, the riveter being generally run at one pressure, no matter what the diameter of the bolt and the thickness of the plates.

Mr. James Christie: I remember many years ago in the West they used to drive boiler-rivets cold, but afterward abandoned it on account of the deterioration in quality of the rivet iron.

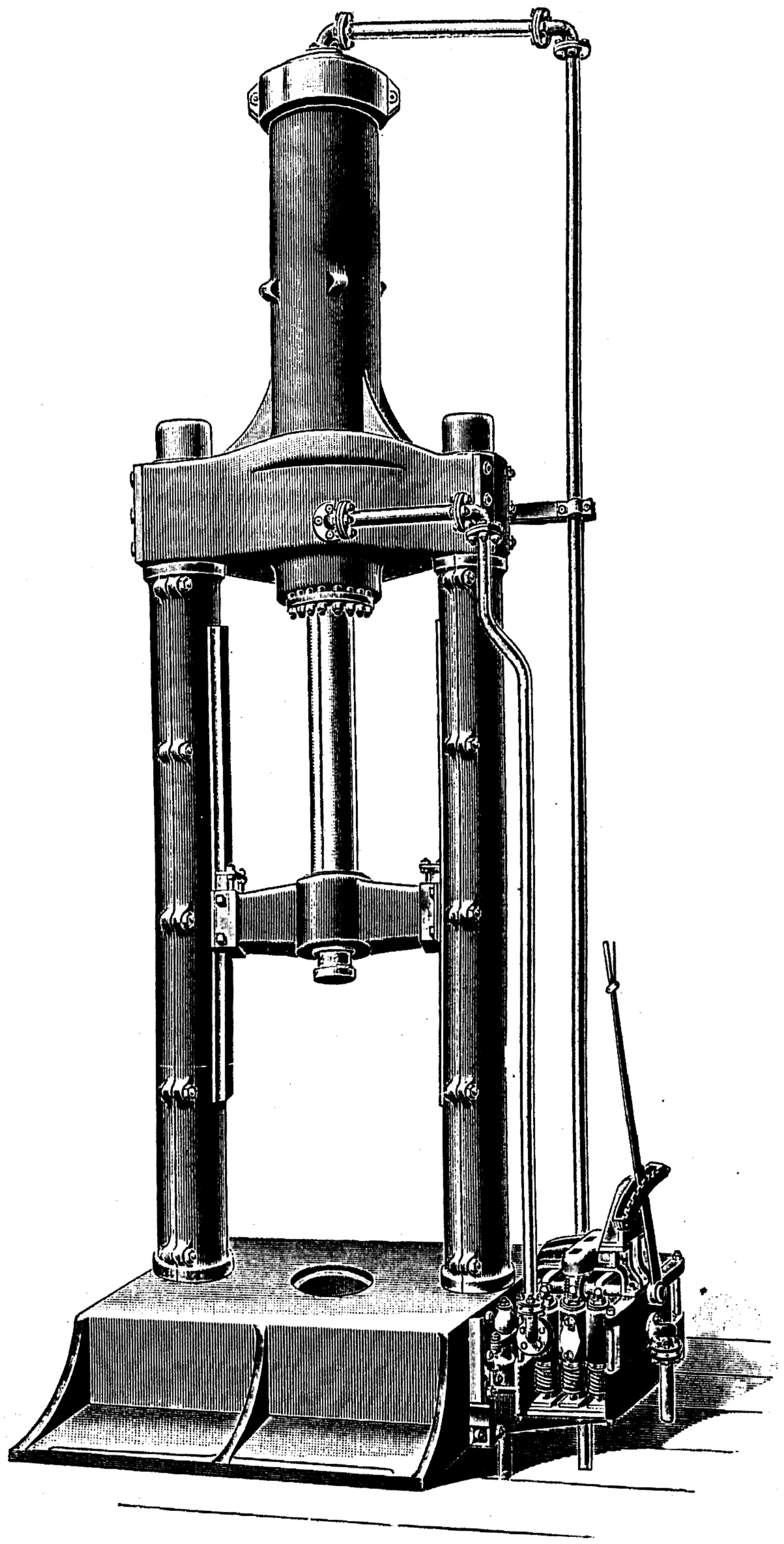
Since critical systems of inspection and testing material have become common, the importance of having rivets solidly driven has been more thoroughly appreciated than formerly. Hand work is avoided where possible, and higher pressures are used than before. Machines are preferred that will deliver the maximum pressure to the rivet with certainty. The direct hydraulic ram has the advantage of compactness, and when its fluid is stored in an accumulator there is a sudden impact or elevation of static pressure on the rivet at the termination of each stroke—a circumstance highly favorable to the riveting operation.

It has been found in girder work, that for red-hot rivets of iron or soft steel, with length of grip not exceeding three diameters, a pressure of 50 tons per square inch of rivet section has been sufficient to completely fill the hole. Longer rivets require higher pressure, and in extreme cases this pressure must be doubled to secure solidity. The shape of the head can be modified to a form favorable for the flow of metal into the body. The results of some experiments are submitted on the board, illustrating the advantage of high pressure on the riveted joint.

At a subsequent meeting Mr. Henrik V. Loss exhibited a number of indicator cards taken by him from a bridge riveter at the Pencoyd Bridge Works a couple of years ago, by using a common steam indicator in connection with a pressure producing cylinder. These showed great variation in pressures existing with rivets of one dimension, amounting to about 50 per cent. for ¾-in. rivets, and 25 per cent. for larger ones. Although it is almost useless to try to formulate definite rules for the power necessary to do the work, it will be seen that if the average be introduced in comparing the two sizes, this average pressure amounts to about 1,800 lbs. per square inch on a 10-in. cylinder, which, when subtracting the pullback, gives 65 tons for either ¾ or ⅞-in. rivets. Does this mean that a large rivet takes no more power than a smaller one?

It is a fact that in many cases of upsetting, a small rivet requires greater power than a large one, probably due to the rapid cooling effect of the surrounding cold dies upon the heated bar.

A greater pressure, however, is necessary for boiler work, and ¾ or ⅞-in. rivets with grips like those used in bridge work



16-INCH PROJECTILE PRESS.

would require at least 75 to 80 tons, although for the smaller grips that usually prevail a pressure of 65 tons for the above dimensions would be sufficient. Upsetting a short rivet is a fair test of the strength of metal, for which definite rules can doubtless be laid down for the power required with reference to the diameter, but with long rivets this becomes almost impossible, as it can readily be supposed that for each length there is a corresponding diameter, which will give the smallest resistance per square inch of metal, a fact which was corroborated by the great irregularities in power lines of the cards shown that were taken from this class of work.

With regard to the energy consumed, a ¾-in. rivet needs about 7,200 foot-pounds, while a ⅞-in. rivet requires about 9,500 foot-pounds to form a head and fill the hole, if the work is about in the proportion of the squares of the diameters.