which was kept confined till the prison was broken, then each minute particle expanded with a suddenness analogous to an explosion, and the whole mass was set in motion towards the broken door of its prison, which now weakened as to its surroundings, grew larger as the crowd pressed against its borders. The opening may not have reached its present size until the boiler was well on its way .- Manufacturer and Builder.

AN INTERESTING BOILER EXPERIMENT.

Numerous instances are on record of strong boilers, well made in all respects and handled with good care, having suddenly ex-Ploded with terrific violence, just at the instant when the valve was opened to admit steam to the cylinder; or at the moment when cold water was injected into the boiler. The usually received theory of this class of explosions is that by opening the valve or throwing in cold water, the pressure of steam on the surface of the water is suddenly reduced, whereupon the water, charged as it is with the tremendous energy of its heat, leaps from its place, divides, and strikes with the solidity and force of cannon balls against the interior walls of the boiler, tearing everything to pieces with its resistless momentum. Water may in fact be easily heated to such a degree that a pound of the liquid will equal a pound of gunpowder in energy. At sixty pounds pressure to the square inch every cubic foot of boiler water has the energy of a pound of gunpowder. Given the proper conditions for discharging that energy against the boiler, and it will be rent as if it were exploded with a corresponding weight of cannon powder.

In the Scientific American of July 3, 1880, we presented an engraving and description of an improved form of boiler, in-vented by Mr. Daniel T. Lawson, of Wellsville, Ohio, which was designed by him to promote safety in the use of steam by preventing all danger from explosions or injurious strains arising from the causes we have mentioned. In the article describing his invention Mr. Lawson's theory was fully set forth; it differs somewhat from that we have stated as ordinarily held. Mr. L. claims "that when water is superheated it becomes as explosive as gunpowder, exploding by bursting into steam from a reduction of pressure." This explosive formation of steam produces a concussion on every inch in the boiler, much greater, Mr. L. thinks, than the regular steam pressure. "There is abundant reason to believe," he says, "that it is this concussive action which causes the numerous and mysterious boiler explosions, and which cause is wholly independent of the amount of water in the boiler ; in fact the greater the amount of water in the boiler the more terrific the explosion.'

We are not disposed at this time to question the correctness of Mr. Lawson's theory; but will only suggest that the other mentioned theory better explains the actual result, since steam has a yielding or gaseous action, whereas projected water acts like a 6ilo8

Mr. Lawson has lately tried, at Pittsburg, P., a very interesting and important practical experiment, for the purpose of verifying his theory and demonstrating the advantage of his invention. His first step was to prove that boilers were liable to and did explode in the manner he asserted ; and this he has apparently proved by actually getting up an explosion, which took place at the time, and hour he named and in the way he said it would, namely, by simply opening the boiler valve and letting off some steam.

This experiment has been heretofore tried by various en-Sheers, some of them very learned, but Mr. Lawson is the only one, so far as we know, who has succeeded. He has certainly taught us a good lesson in the boiler explosion art, which we that think will result in great benefit. A letter in the Tribune gives

the following particulars: "The experiments were made in June, at Munhall Farm, on the Monongahela river, nine miles above Pittsburg, Pa., where the Monongahela river, nine miles above signal the United States Government Commissioners made signal failures in their attempt to produce the same result a few years ago. The same foundations, furnaces, water supply, and bomb proofs were used on this occasion. The boiler was made of the very best iron, and showed a tensile strength of 624 pounds to the the square mch, according to the United States standard. It was six feet in length by thirty inches in diameter. Before being taken to the ground it was tested by the boiler inspector of this country and pronounced one of the best and most perfect steam boilers he had ever examined.

The cylinder of an old steamboat engine was connected a quick-lifting valve. The steam was permitted by means of Haven, Conn.-Manufacturer and Builder. with the boiler by means of a two-inch pipe, in which was fitted

this valve to enter the cylinder in the same manner as it enter he cylinder of any ordinary engine, with the exception that its was not cut off suddenly, as in a working engine. Had it been, Mr. Lawson claims the explosion would have been still more When the pressure reached a certain point the furcertain. nace was fed with petroleum by means of a small pipe connected with a tank located at a safe distance.

The majority of those who saw the boiler were of the opinion that it would safely stand 500 pounds pressure, and would not give way to less than 600. In order to save time no test was made until a pressure of 325 pounds to the square inch had been obtained. The valve was then lifted quickly, and the steam rushed into the cylinder rapidly, but with no other effect than to produce a shock distinctly noticeable by those in the bombproof.

The final test was made at a pressure of 380 pounds, a little over half the capacity of the boiler. At this time the water was eight inches above the fire line, the boiler being at least threefourths full. No somer was the cylinder filled by the rushing steam than a slight shock was felt, followed by a terrific report. Vast volumes of steam enveloped everything, but there were no signs of any hot water, it all having burst into the steam when the pressure was removed.

The report had scarcely died away before a shower of condensed steam began falling, accompanied by pieces of iron, bricks, steam pipes and other *débris*. Scarcely a vestige of the furnace or boiler was left. The latter had not merely given way at a single point, but was literally torn into fragments. One of the largest pieces yet found was about a foot and a half long and a foot wide. It had been blown fully half a mile. One of the heads was found nearly half a mile from the bomb-proof. The other one had not been found at last accounts. The most of the pieces picked up were of irregular shape, with very ragged edges, showing the iron to have been of excellent quality.

Mr. Lawson has invented a boiler which he believes to be proof against explosions of this kind. It is constructed with a partition intervening between the flues and the top of the boiler, thus creating a steam compartment over the water, to be supplied with steam from the water through valves in the partition, which valves, to ensure safety, must be smaller in the aggregate than the port or valve through which the cylinder is fed from the steam compartment. By this means the pressure is kept approximately uniform upon the surface of the superheated water, thus preventing the dangerous effect which must follow the sudden reduction of pressure from its surface. Mr. Lawson's next step will be to show that his improved boiler cannot be exploded.

THE BIGELOW BOILER.

The accompanying illustration represents a return tubular boiler, manufactured by H. B. Bigelow & Co., of New Haven, Conn.; and while not distinguished by any special novel features of construction, is an excellent representative of this very serviceable and popular type of boilers. A glance at the excellent engraving annexed, which shows the boiler in place, with a portion of the masonry removed to permit of better inspection, will give our mechanical readers a fair idea of this generator and will render an elaborate description unnecessarv

In general terms, we may explain that in these generators the heated furnace gases pass beneath the boiler, the same as in a plain cylinder boiler, returning through the tubes into a smoke chamber, and thence to the stack. This type of boiler has long been held in the highest esteem, because of its excellent steaming

capacity. With sizes over 40 horse-power the manufacturers call attention to the fact that they place a man-hole in the front head under the tubes, which has the advantage of enabling a man to pass along the whole length of the boiler and remove any sediment that accumulates on the bottom, as well as giving him the opportunity of examining the tubes and other points inside

With this boiler the makers furnish the front properly fitted, grate bars, binder bars, back and side doors, anchor bolts, safety valve, try cocks, blow-off cocks steam and glass water gauges. The boilers are made of the best material, and submitted before leaving the factory to a hydrostatic pressure of 150 pounds to the square inch. They are supplied to order of any desired power from 20 horse power. Further details will be furnished on application to the manu-