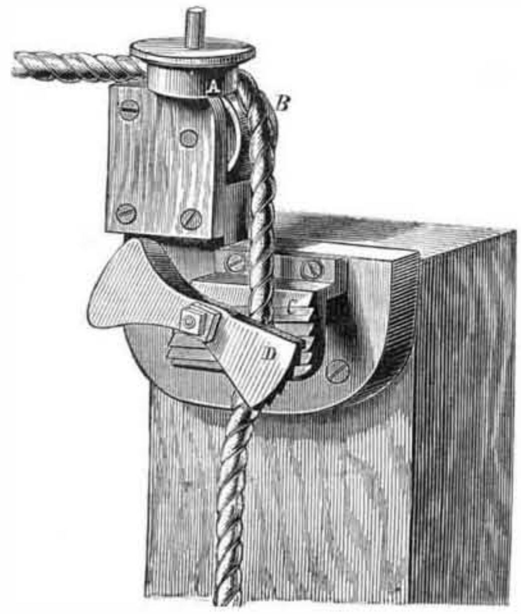
RIORDAN'S CLOTHES LINE HOLDER.

The object of the little article shown in the engraving is to overcome the trouble of putting up and taking down a common clothes-line, which is usually fastened by knots, the tying and untying of which is a matter often so annoying that the line is left up and exposed to all weathers. With this clothes line holder once set up, no further trouble can possibly be experienced in this matter, as all that is to be done in putting up the line is simply to pass the ends of it over the pulleys, A and B, one of which is vertical and the other horizontal so that the rope may run easily. The end is then pulled downward, until the line is brought to a proper tension, when it is introduced between the catching jaws, C D, by pressing it laterally to the left. The jaw, D, swings loosely on its pivot, and when the line is brought against it and pulled downward it swings, and thus admits the line, which is now let go, and as the outer end of D is weighted, it immediately presses up against the line and prevents it from running backward. The two jaws are made with a slope in contrary directions, and both are corrugated to assist in holding the line. When it is desired to take down the line all that is to be done is to pull the end downward and sideways to the right, thus withdrawing it from between the jaws and letting it run back over the pulleys.



It will be seen that not only does it afford the easiest means of putting up and taking down the line, but also that the line can be tightened to any required degree, thus dispensing with unsightly center props, and the holder may be set at any hight from the ground, and can be operated with one hand with equal facility at whatever hight.

The working parts are of cast iron, mounted on a block of wood, for facility in setting up, and are very little larger than the engraving. For further information address the patentee, P. Riordan, Arsenal, Washington, D. C.

Patented through the Scientific American Patent Agency, Dec. 31, 1867.

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THE WATCH.—No. 4 of the articles on this subject is unavoidably postponed until the next number on account of the pressure of matter upon our columns. We shall resume their publication in the next number.

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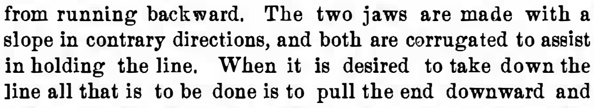
ON THE STRENGTH OF BOILERS.

The capacity of boilers to resist rupture by the pressure of the steam, and the unequal expansion of the material of boilers from unequal heating, is a subject of very great importance, and not generally understood. Some illustrations and remarks relative thereto will be found below.

Any tube closed at the ends and subjected to an elastic pressure from within, will rupture longitudinally (from *a* to *b*) with about one half the force per square inch required to break it transversely, as from *c* to *d*.



For example, a cylindrical boiler, without tubes or flues, made of a single piece of homogeneous iron, one quarter inch thick, without seams, may be conceived, twenty feet long, and thirty-six inches in diameter. For convenience, we will assume that each square inch of the iron of the cross section, from *c* to *d*, and of the longitudinal section, on the horizontal plane, from *a* to *b*, has the ability to restrain a force having a tendency to rupture it, equal to fifty thousand pounds.

The circumference of the boiler is about one hundred and thirteen inches, consequently the area of the cross section of the iron has about twenty-eight square inches; it would, therefore, require one million, four hundred thousand pounds pressure against the heads to pull it apart with a transverse rupture. The whole number of pounds representing the transverse strength, divided by one thousand and seventeen, which is the number of square inches area of the heads, against which the steam would press to cause the transverse rupture, gives thirteen hundred and seventy-six pounds as the pressure per square inch against the head required to break such a boiler in two transversely.

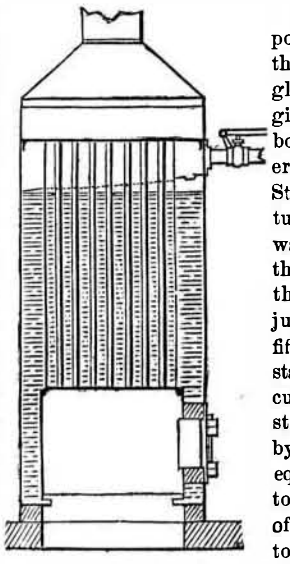
The longitudinal section contains one hundred and thirty-eight square inches of iron; consequently, it requires six millions, nine hundred thousand pounds pressure to break it in two in the longitudinal direction. The area of the surface against which the steam would press—the boiler being two hundred and forty inches long and thirty-six inches wide—is eight thousand, six hundred and forty square inches; which, used as a divisor for the sum of pounds, representing the strength to resist longitudinal rupture, and we have seven hundred and ninety-eight pounds per square inch, as the pressure necessary to pull it apart with a longitudinal rupture. Whether such a boiler could resist transverse rupture until the pressure of the steam reached 1,376 lbs. to the inch, and longitudinal rupture up to 797 lbs. to the square inch, is not material to this particular inquiry.

It is important for engineers and others to know, that a boiler is nearly twice as strong to resist transverse rupture as the longitudinal, because it will be then possible to determine that some other force than the direct pressure of the steam has been the cause, when a boiler is found broken transversely, and not longitudinally, all other conditions being equal, as contemplated herein.

If a boiler of the cylindrical form has flues, or tubes, it would increase the ability to resist transverse ruptures, for two reasons, which should be considered:

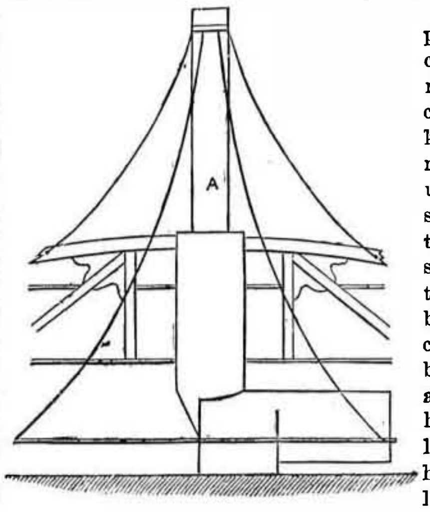
1st. The part of the area of the head covered by the area of cross section of the flues, or tubes, would have to be deducted in determining the sum of the pressure of the steam against the heads acting to pull the boiler apart transversely; and,

2d. The strength of the tubes, or flues, should be added to the strength of the shell, as if they were stays between the heads, increasing the ability of the boiler to resist rupture transversely.

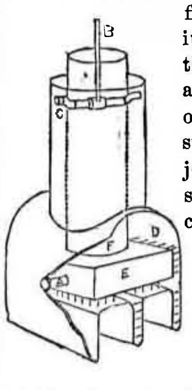


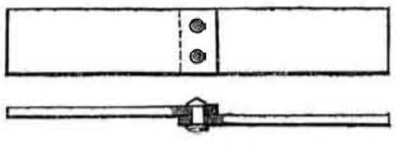
Yet, notwithstanding these important considerations, I do not think there has ever been a single example noticed of the longitudinal rupture of an upright boiler. The cut represents a boiler which exploded disastrously on Stone street, New York; the rupture was transverse, and therefore was not caused by the pressure of the steam. It was established by the evidence before a coroner's jury that this boiler carried but fifty pounds of steam at the instant of the explosion, yet a calculation based upon the actual strength of the iron, determined by actual experiment that a force equal to sixteen hundred pounds to the inch, upon the whole area of the head, would be necessary to break it in the manner it was ruptured; that is, transversely through the intact sheet, about twelve inches above a transverse seam.

If the force with which the tubes would expand, if made hotter than the shell, should be considered, or the increased circumference of that part of the shell above the water from the same cause, should be taken into account, in addition to the pressure of the steam, the explosion may be accounted for.

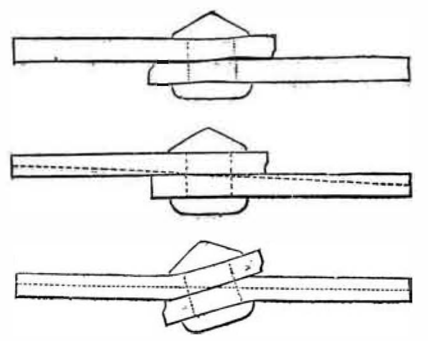


No class of explosion is more common than the rupture of steam chimneys on the kind of boilers almost universally used on river and sound boats along the Atlantic coast, such as shown in the cut. I do not believe a single case can be remembered in which a steam chimney has been ruptured longitudinally. I have known of a large number which have burst transversely, and leaks in the transverse seams are so common that scarcely one can be found which does not leak. It is not the pressure of the steam which is the cause of either the leaks, rupture, or explosion, in this part of the boiler. But if the force with which the uptake flue (F), on the cut, expands upward when it is heated to a higher temperature than the outside shell, is taken into account, in addition to, or even without the pressure of the steam, it can be understood why such parts of a boiler give way when subject to only twenty-five pounds pressure of steam, after the water test has shown them capable of withstanding fifty pounds.





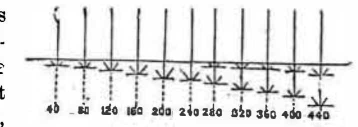
It has been found by actual experiment that single riveted seams have but fifty-seven hundreds of the strength of the iron elsewhere than through the rivet holes. The ratio of weakness is greater than the proportion of the iron, cut out in punching the holes. This is probably due in part to the distortion of the iron by the punch, immediately about the hole, putting the material in a state of tension, or strain. The caulking tool also buckles the iron and thereby adds to the tension; and the lap of the sheet throws it out of the line of the tension exerted by the pressure of the steam, the tendency being to bend the sheet as shown in the cut.



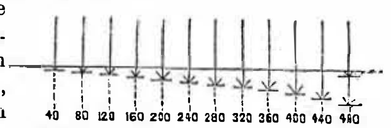
As all structuers are only as strong as their weakest part, it would seem to be a reprehensible error in boilermakers to continue to construct boilers with invariable lines of weakness, like the seams, having but little more than half the strength of other parts. But it has been almost invariably noticed, when examples of exploded boilers were being examined, that the rupture did not either begin with, or follow the rivet holes, or any weak part of the iron with flaws, which is also an indication that some other force than the elastic pressure of the steam caused the initiatory rupture.

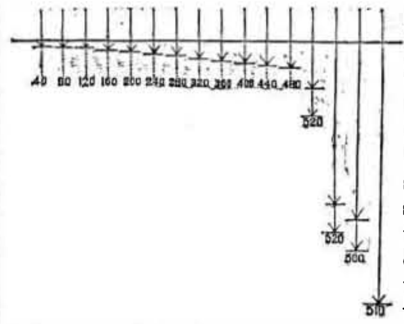
Any piece of iron subjected to a tensile strain will be stretched to the extent which will give it a permanent set by about one half the force which will break it. This curious fact was discovered and demonstrated by Professsor Daniel Treadwell, whose essays on some of the qualities of metals are extremely valuable.

The experiment was constructed by stretching a piece of wire along a table, about fourteen feet in length, and by means of a lever, after marking its length, subjecting it to a tension of forty pounds. The extension for that weight, and for each weight applied is shown full size on the cut. The weight was removed after each application, and it was found that two hundred and eighty pounds gave the first permanent set; that is, the iron did not recover its original length after the application of that weight. The continued additions to the weights shown, increased the permanent extension until four hundred and forty pounds were sustained, without breaking the iron, which will be noticed, is nearly double the weight which gave the first permanent stretching of the wire.



Another series of the application of the successive weights from forty pounds upwards, was then began, with the same iron; but no additional permanent set was given to the wire until four hundred and forty was passed. Five hundred and twenty was reached without breaking, which weight being removed, and applied again, was suspended for several hours, stretching the wire slowly, as shown, when it was removed; and afterwards the wire was broken with five hundred and ten pounds tension.





From this we may conclude that if we find a part of a boiler which has burst, of an equal strength with the ruptured part, not stretched or distorted, that it was not the pressure of the steam which caused the initiatory rupture.

If the pressure of the steam were the only force to be restrained in boilers, it would be easy for the boilermaker, or engineer, to provide boilers which could not possibly be burst. For instanec, if a boiler of certain dimensions, made of quarter-inch iron, should burst, make the next one to take its place of iron half an inch thick. Or why not four inches thick? If iron with a tensile strength of 50,000 lbs. to the inch is ruptured, why not take high steel, with a tensile strength of 120,000 lbs. to the square inch? These seem to be natural questions to ask, but they are answered by the statement that it is not the strongest boiler which is found to stand the best, but the boiler which is made of the softest and most ductile materials. A boiler might be made of iron so thick that it would not conduct heat enough through to the water to generate steam at all, while the iron would be entirely destroyed by unequal expansion, from the difference of temperature between the surface of the plates exposed to the fire, and the one exposed to the water. And although a boiler made of high steel would withstand a much higher cold water test than an iron boiler of the same thickness, it could not withstand unequal heating so well, on account of its greater density; and, consequently, the greater force with which it would expand and contract, as it was heated or cooled unequally. Metals expand, as they are heated, with a force which exactly equals the force with which they would resist compression at the same temperature