THE FORM OF BOILER-HEADS.

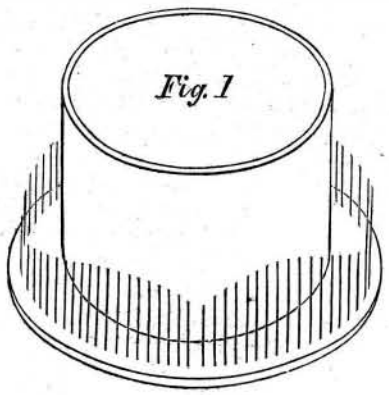
As an introduction to this very important subject, nothing requires to be prefixed by us to the following letter:

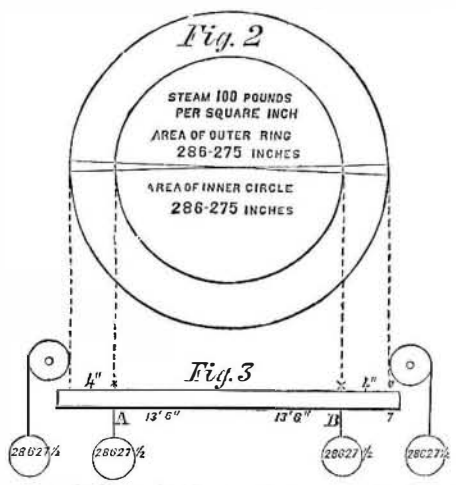
MESSRS. EDITORS:—The explosion of the drum-head of the steamboat *Falls City*, which occurred April 14, 1858, on the Mississippi river, gave rise to the accompanying correspondence between two mechanics as to what is the proper form for boiler-heads of cast-iron. You will perceive by the diagrams that both parties feel confident of the strength of their position.

JOHN ROY.

Mr. M——,

In our conversation yesterday you remarked that cylinder-heads stood better when hollowed out towards the center than if the edge thickness were carried straight across the whole head. The impression left on my mind was that if such were the case in steam cylinders, the same might be expected on the heads of steam boilers. As you will see by the inclosed sketch, I have been trying to account for this greater strength with a reduced quantity of metal, and I must confess that I have been unable to find it. Should your time permit you to examine these





figures, I think you will find the strain at the center equal to the greatest strain, and that around the edges the least, with the greatest quantity of metal to sustain it.

If we look upon Fig. 1 as representing a circular plate of iron, 27 inches in dimeter, with an area of 572.55 inches, loaded with a weight of 100 pounds upon every square inch of its surface, this will be equal to 57,255 pounds. Now, supposing the upright cylinder to weigh

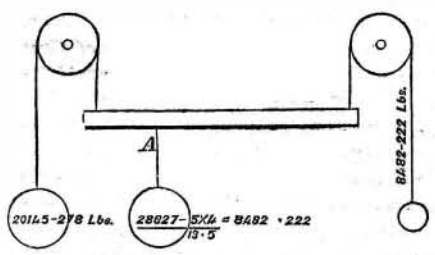
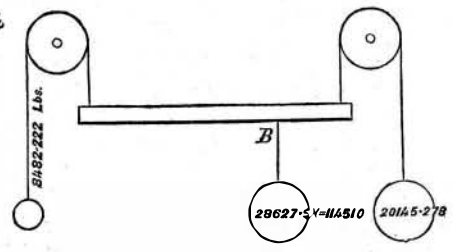
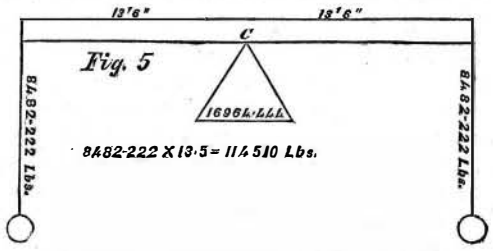


Fig. 4



this amount, I will call the diameter 19 inches, and the vertical lines points of support for the 27 inch diameter plate. I look upon this weight as an equivalent for the steam acting upon the end of a steam boiler, for if the area be divided equally by a circle, the diameter of that circle will be about 19 inches, as at Fig. 2, and the weight on the outside is equal to the weight on the inside of the circle, and may be considered as a beam, Fig. 3, with half the weight suspended at A, and the other half at B. It will be very evident that A or B will act with a leverage of 4 inches and consequently with four times the force of themselves, 28627·5×4=114510 pounds, and this is the maximum strain upon the metal, and this strain is continued to the center, for although the leverage is increased the pressure is diminished in the same ratio; for if I consider the weight to be acting on a bracket, as in Fig. 4, instead of a beam, the same result would follow, for 28627·5×4÷13·5=8482·222 pounds necessary to support the bracket at the outer end from the weight acting at A, and the same from the weight at B,



equal to a weight of 16964·444 pounds placed at C, and acting as if the weight were placed under the beam, as at Fig. 5, for a fulcrum with half the weight suspended at each end. The metal at C would be strained to 8482·222×13·5=114510 pounds. This in my opinion would indicate an equal thickness for the materials at the center, and at A and B, and might be diminished towards the edges, just like the common beam. I know there are many mechanical advantages obtained by not following this theory, such as rounding the edges so as to take away all the sharp angles, &c. The *Falls City* blew the circle of greatest pressure out of her drum-head as neatly as if it had been punched, and I think that had it been of equal thickness throughout it would not have burst.

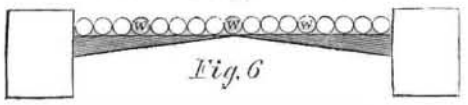
Should you see that I have erred in thus measuring the strains, be kind enough to correct them.

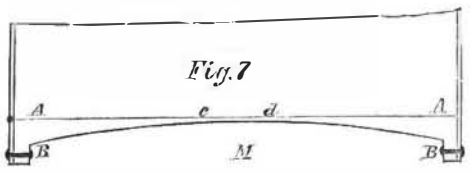
J. R.

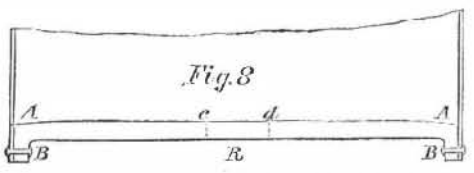
New Orleans, May 9, 1859.

Mr. R——,

Your very interesting communication in regard to the subject matter of our conversation on Sunday last, was duly received, and would have been answered earlier, but for the conjoint influence of business, &c. I examined the diagrams and the text in elucidation of them, with some attention, but not with that attention which I would have given it, had I not observed that the whole







of your reasoning was based upon an erroneous hypothesis, viz. illustrating your views by comparing a boiler-head to a beam. You have erred in comparing it to a beam resting upon each end and lying loosely, instead of comparing it to a beam whose ends are permanently fixed, with the weight or pressure equally distributed over its surface. The annexed rough sketch exhibits the correct form of a beam of *greatest strength* with *least material*, when the ends are *permanently fixed* and the *weight equally* distributed over its surface. The balls (*w*) are assumed to represent the weights distributed over the whole surface equally, and this is the precise form of a properly-constructed boiler or cylinder-head—which is an infinite number of beams fastened at their extremities and converging to a center. The correctness of my views appears so evident either with or without the forego ng demonstration that I might rest my case here, being assured that your unassisted reflection will inevitably lead you to the same conclusion; but elucidating the matter still further I annex a sketch of the general form of boiler-head I deem the best, and that which you approve of. Assuming that they are of equal diameters and of the same thickness at A B, let the diameters be 27 inches, area 572·55, pressure 100 pounds per square inch. Then the pressure upon the whole surface of each resisted equally by the thickness of metal at A B, will be 57255 pounds. Assuming a circle of 10 inches from *c*, to *d*, in the center of each head, what is the pressure which the thickness of iron at those points resists? Area 78·54×100=7854 pounds. In my head this decreased pressure is prorerly sustained by a decreased thickness of metal, but in your's by an increased thickness, violating every correct rule in the proportioning of material to resist pressure.

A fracture in a boiler-head, assuming the material to be without imperfections, of which theory can take no cognizance, will be a circle; this is evident. Now I submit it to you, is it not preposterous that a circle, say of one inch diameter, sustaining a pressure of 78·54 pounds only, in the center of your head, requires say four inches thickness to retain it in its place, while the whole circle of 27 inches sustaining a pressure of 57255 pounds requires only a thickness of say 2 inches. Again, let us test our plans by the method of carrying them to an extreme. Thickening the edged of my head and reducing the center to $\frac{1}{8}$ of an inch, and reversing the operation in your's, thickening the center and reducing the edges to $\frac{1}{8}$, need I ask you what would be the result?

The head of the drum of the *Falls City*, if I understand you correctly, blew out close to the rivets or at the "circle of greatest pressure." This example conclusively demonstrates the inaccuracy of your theory, for it is evident that no amount of thickness added to the middle would have contributed in the slightest degree to strengthen the head, as the pressure and the weakest part would remain unaltered.

I feel confident that, when you have investigated the principles involved in our controversy, you will agree with me.

A. M.

New Orleans, May 11, 1859.

LAKE SUPERIOR IRON.—Several of our contemporaries state that a gigantic company, with a capital of $1,000,000, and with prospects of no ordinary character, has recently been formed, under the title of the St. Mary's Canal Mineral Land Company, the object being to work lands covering a surface of 182,000 acres; and proved to be rich in iron-stone, from which the finest quality of iron ore may be produced, situated in the upper peninsula of the State of Michigan. It not unfrequently happens that where two metals of vastly different commercial value exist in the same locality, the poorer of the two is neglected to an unjustifiable degree; and from the fact of Lake Superior having proved itself to be so fabulously rich in metallic copper, the iron, which seems to abound to an almost equal extent, has received comparatively little consideration. Year by year, however, more iron is shipped from the locality, and already several prosperous companies are in active operation. The quantity of iron ore shipped from Lake Superior was, in 1855, 1,447 tuns; in 1856, 11,297; in 1857, 26,184; and in 1858, 31,035 tuns. The company in question has both copper and iron locations, and it is believed that from each a fair profit will be raised, so that from the whole a large remuneration may be expected.

TINNED LEAD PIPES.—At Nantes, in France, there is a manufactory where they tin lead pipes inside and out, by passing them through a bath of melted tin, from which they emerge completely covered with the latter metal, all the pores and cracks filled and proof against oxydation. This is not a new process but is the first application of it in France on a large scale. It was patented in this country, 20 years ago, by Mr. Ewbank, formerly Commissioner of Patents.