

we have no doubt that in less time than elapsed between the contribution to the *Journal of the Franklin Institute* which we have noticed, on *Double Cylinder Engines*, and the compilation of the *Erie Report*, this gentleman will fully comprehend how rigidly correct we are, as to the present steam engine, in declaring that "the idea of assuming full steam travel as a basis of comparative mechanical action, is a misapprehension of engine duty."

This sums up, I believe, all the questions at issue of paramount importance. As to the benefits of higher steam in connexion with expansion, and as to all the other questions of principle and method which characterize these experiments, all that I claimed appears to be sufficiently admitted in relation to all *existing engines*. I have nothing to offer prematurely about prophetic combinations; these may be freely conceded to the new school of speculation and design.

There is but one thing more to say, and that is necessarily brief. This member of the Board occupies the first page and other portions of his remarks in asserting my incompetency to "comprehend" the report, while indulging in a sneer at my "boldness, intelligence, and literary ability;" also crediting me with "slight practical experience," apparently with the object of disarming my criticism. In that comprehensive school of the profession which I left to enter the Engineer Corps of the Navy to accomplish a certain purpose, and to which I returned after my resignation, a resort to such personal arguments is considered a confession of judgment. For the sake of all that is courteous among gentlemen, and dignified in scientific discussion, and truthful, I hope I am correct in supposing that these things were written in haste and have been regretted at leisure. One thing is certain, and this is, that nothing further of the kind will be noticed in the *Journal of the Franklin Institute*.

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For the Journal of the Franklin Institute.

*Construction of Arcs of Circles having Large Radii, the Versed Sine being Unknown.* By J. K. WHILLDIN, Civ. Eng.

The following method of constructing arcs of large circles, I have found to be very convenient, especially when making full size drawings of details attached to large cylinders and other circular objects.

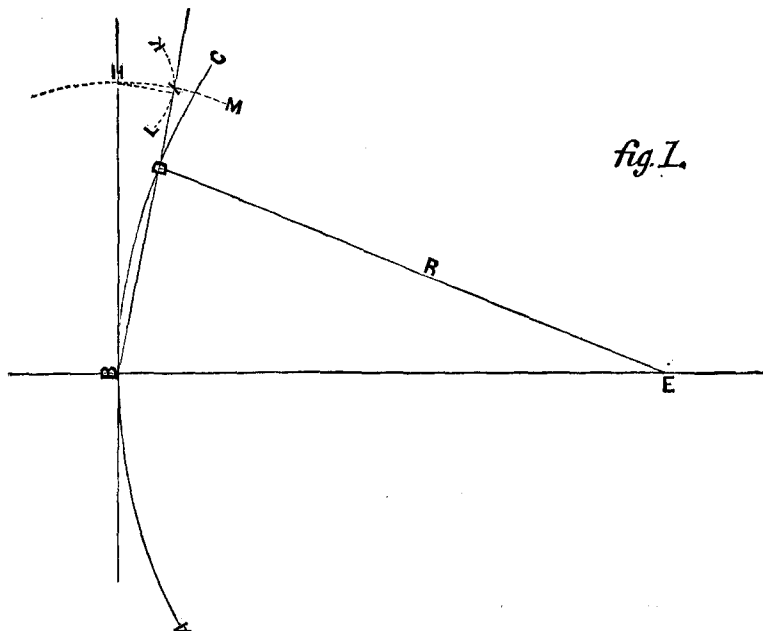
When beam compasses exceed five or six feet in length, they become rather clumsy to manage with ordinary drawing boards, and it becomes necessary in laying down arcs of large circles to obtain certain points in the desired curve, and trace a line through them by means of a batter and weights.

With the ordinary modes of constructing these curves, the versed sine is assumed as *known*, but it frequently happens that this item is unknown, and we have only the value of the radius as a basis of operations. True, we may calculate\* with this datum the versed sine corresponding to any assumed chord, but this is a tedious process, and

\* Versed sine = Radius -  $\sqrt{\text{Radius}^2 - \left(\frac{\text{Chord}}{2}\right)^2}$ .

with very large radii and small chords, unless we extend the operation to many places of decimals, we do not obtain any considerable accuracy.

The advantage of the method here given is, that while it requires no calculations, the points obtained by it are as correct as those which would be found by the beam compass, could the latter be used.



Let A B C be the arc we desire to construct, R the known radius; with the radius R taken on any convenient scale of equal parts, describe the indefinite arc H M from the point B; also take  $\frac{1}{2}$  of any assumed chord B D on the same scale as R, and describe the arc L I K from the point H; now from the point B draw a line tangent to the arc L I K, and on the line thus drawn lay off from the point B the assumed chord B D. Then will the point D be in the arc sought, and the curve may be run through it, and other points found in the same manner, by means of a batten.

*Example.*—Suppose  $R = 10$  feet, and suppose we take a chord  $BD = 14$  inches.

We will begin by taking R, say on a scale of  $1\frac{1}{2}$  ins. to the foot, which will give us 15 ins. as a radius to describe an arc H M from the point B. Again taking  $\frac{1}{2}$  of 14 ins. (the assumed chord) on the same scale, we have  $\frac{7}{5}$ ths of an inch as a radius to describe the arc L I K from the point H; drawing the line B I, and laying off on it from the point B the actual length of the chord B D = 14 ins., we obtain the point D through which to run the curve.

The foregoing construction is based on the well-known fact that the

angle  $HBD$  contained between the chord and tangent is one-half of the angle  $BED$ , which is measured by the chord  $BD$ ; and the taking of the radius  $R$  and  $\frac{1}{2}$  the chord  $BD$  on a scale of equal parts, is merely a convenient mode of constructing the angle  $HBD$ .

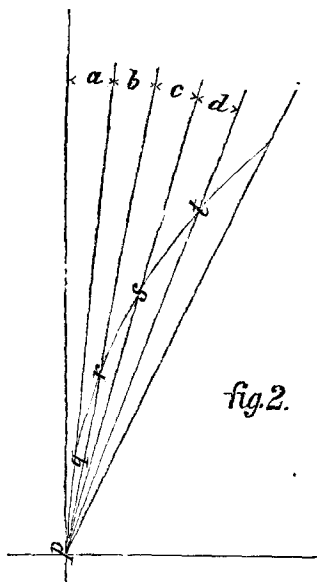
The inclination of the chord being thus found, and its length  $BD$  being already known, the point  $D$  is therefore determined.

The angle  $HBD$  may also be constructed by taking the chord and the diameter of the large circle, both on the same scale of equal parts.

Railway curves are sometimes projected by methods analogous to the above by means of the transit and chain. Thus, in fig. 2, if  $a, b, c$ , &c., be equal angles, and we commence at the point  $p$  and lay off the equal distances  $pq, qr, rs$ , &c., then will the points  $p, q, r, s$ , &c., be points in a circle, whose magnitude depends on the equal measures  $pq, qr$ , &c.,

or, if these be constant, on the equal angles  $a, b, c$ , &c.

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### *On Electrical Machines.* By E. S. RITCHIE.

The electrical machine known as the Ruhmkorff Induction Coil, resulted from the researches and discoveries of Faraday, Henry, De la Rive, Fizeau, and others.

Mr. Ruhmkorff of Paris was the first to construct this instrument, following the arrangement of Faraday, surrounding an electro-magnet by a helix of insulated copper wire, to which he applied the automatic interrupter of De la Rive.

The important discovery of the action of the condenser to the interrupter, by which the intensity of the induced current is increased so as to pass an interval, is due to Fizeau, and was immediately adopted by Ruhmkorff.

The limit which Ruhmkorff attained in his most powerful coils was to throw the spark less than one inch.

Mr. Header, in 1857, improved the apparatus by more carefully insulating the helices, and obtained sparks of three inches.

During the spring of 1857, I attempted the construction of the instrument, following the general form adopted by Ruhmkorff; but beyond the narrow limit already attained, I found it impossible to make one which would not destroy itself by the discharge taking place within the helix, between the outer and inner portions, which