The adjustment for collimation is made in precisely the same manner as when wires are used, viz., with the aid of four steel capstan screws V.

I have just mentioned double fneed levels. Such levels do not appear to be much known outside of Continental Europe; but well deserve to be more widely known and better appreciated that they are, generally speaking.

A double faced level consists, as all other spirit levels, of a longitudinally curved glass yial or tube filled entirely with alcohol or ether, excepting a small volume of air imprisoned to form a bubble at the highest point of the tube. The bubble tube of such a level is, however, formed of two halves of semi-circular cross section, having their inner or concave surfaces ground longitudinally so as to assume a uniform convex curvature, and which are subsequently united along their sides and hermetically sealed at their ends after being filled with spirits, as just described. Scales having divisions suitably proportioned to the degree of longitudinal curvature are engraved on the upper and lower outside faces of the tube, symmetrically on either side of a plane passing through the centres of the generating circles of the upper and lower interior ground surfaces of the spindle shaped tubular envelope, and the whole glass tube when completed is inclosed in a brass tube mounted on a brass plate. So that, if the air bubble is brought to the centre of the divided portion of the double faced tabe on one side, upper or lower, it will also lodge precisely in the middle of the scale engraved on the opposite side when the tube is reversed; the bottom being brought to the top, or vice versa.

When a double faced level is fixed to the side or top of a telescope, mounted as that of the tacheometer, it is evident that unless the air bubble, after being brought to the centre of the divided scale and summit of the tube on one side, also comes to rost in the centre of the scale when the telescope is inverted, by lifting the transverse axis out of its wyes and causing the journals to exchange places,—the optical axis of the telescope cannot be a truly horizontal line in either its elect or its inverted position—and that when the instrument is not in such perfect adjustment the horizontal line of sight must invariably lie midways between the pointings made with the telescope in the said erect and inverted positions.

Hence, in order to establish the correct elevation of a truly norizontal line of collimation, we need only take the mean of two rod readings, one of which is taken when the telescope is in its erect position, or say with the pinion head on top and the double faced level O on its right hand side, and the other when it is in its inverted 'position or with the level on its left side and the pinion head below the tube. For, by inverting the telescope, we not merely correct the first reading for the inelination of the line of sight to the horizon, but also for any error of collimation by which the said line might be affected.

It will thus be seen that by working with a double faced level, we reduce by onehalf the number of readings that have to be taken when an ordinary pivot or geodesic level, with independent striding level, is used in carrying on precise levelling operations. For, in such case we have to make one reading with telescope erect and level direct, another with telescope erect and level reversed, a third with level reversed and telescope inverted, and a fourth with telescope inverted and level direct. рθ

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