has extended over a series of seven to eight years, and the results obtained are of that nature which, I trust, will justify me in bringing the subject before you. The whole of the experiments have been carried on at my works in Manchester, having, at the time, a powerful apparatus, as shown in the engraving.

A is a strong cylinder of brass, with a branch communicating with the cylinder B, into which works a steel plunger *c*, which fits into the socket in the bar D. On the top of this bar the powerful lever E is applied, which, pressing on the liquid in the cylinder B, forces it through the bore of the pipe *a* (on the principle of the Bramah), and by which nearly any amount of pressure may be attained. On the top of the cap of the cylinder A, which is made air and water-tight and inserted in the bath F, a mariner's compass G, is placed, the use of which we shall presently describe.

Having adjusted the apparatus, and filled the cylinder A with the material to be experimented upon, a charcoal fire is lighted under the bath, and before applying the lever the point of the fluidity is ascertained. This was accomplished with great difficulty in the first instance, as we had no means of ascertaining, with anything like accuracy, the melting point, until Professor W. Thompson, of Glasgow, who happened to be present at one of the experiments, suggested the compass, which answered the purpose admirably. This ingenious application was effected by inserting a magnetic needle in the solid mass to be experimented upon, and, having brought the needle of the compass within its influence, it pointed directly over the centre of the cylinder, and was retained in that position so long as the material was in the solid state; but the instant the melting point was arrived at, by increasing the temperature of the bath, the needle, no longer supported by a solid substance, dropped through the fluid to the bottom of the cylinder, and, the instant that was accomplished, the needle of the compass turned round to the pole. From this arrangement it will be seen that the temperature of fluidity was carefully and accurately determined.

Leblanc's Water Gauge.—Patented by DESIRE FRANÇOIS LEBLANC.

From the *London Mechanics' Magazine*, September, 1863.

We feel much pleasure in laying before our readers particulars of a glass water-gauge which is extensively used in France, and deserves general introduction here. It is not only stronger and safer perhaps than any other gauge which shows the water level through a trans-

parent medium, but it possesses the great advantage of always denoting the presence or absence of water from the glass tube. The ordinary gauge may be quite full yet appear empty, or quite empty and appear full. It is impossible that such a result can take place with Leblanc's gauge, for reasons which the specification will best explain:—

Let us consider a rather thick-sided glass tube half-filled with water we shall readily note the wide difference in refraction which exists between the full portion of it and the empty part thereof; and now let there be a screen provided with a circular hole of about two-thirds of the outside diameter of this tube placed behind that portion of it which is full of water, and this circular hole will appear in the form of an ellipse, having its great or transverse axis perpendicular to the axis of the tube, whilst on the same screen being removed behind the empty portion of the tube the ellipse assumes a rather lengthened form, having then its great or transverse axis parallel to that of the tube.

It follows from this, first, that such a screen may be used to inform us—when no solution of continuity appears in the tube—whether this is quite empty or quite full.

And secondly, that however darkened its sides may be, unless they are altogether opaque, it will always be possible for any one to ascertain with its aid the presence or the absence of the liquid inside.

A metallic tube pierced from end to end with circular holes opposite to each other on two or three alternate diameters and encasing the glass tube, may therefore become at once both a protection against breakages and their effects, and a means of more distinctly showing the height of the liquid inside.

Such is the nature and object of the said invention for “A Dioptical Metallic, Level Indicator or Liquid Gauge,” but essentially consisting in the application of the combined dioptical properties of glass and water to the construction of a liquid gauge that should possess such requisites to clearness of indication and security of service

as have never been as yet attained, it is susceptible of any form; for example, a glass tube consisting of several short ones may be advantageously substituted for that of one piece, and lenses for either of them.

Again, a casing made of any flexible matter, as vulcanized or hardened india rubber, or simply sheets of paper or cloth, impregnated with siccative greasy substances, rolled several times and stuck on the glass tube, may also be used instead of the metallic casing.

Being given a quadrangular opaque tube, the sides of which are pierced with two circular holes opposite to each other; if you fix in each of them a plano-concave lens, whose concavity faces the axis of the tube, and whose focus lies a little behind the opposite side; the hole that faces the lens which is looked at will appear greatly reduced in diameter, the tube being empty; whilst on the same being filled with water, the index of refraction of this being pretty nearly the same as that of glass, the concavity of the lens is found to be almost annulled by the convexity of the water, and the opposite hole re-appears with its nearly full diameter. The crown glass gives the maximum of differential effect.

Figs. 1 and 2 of the foregoing drawings represent a glass tube enveloped in a metallic casing pierced with circular holes opposite to each other. The metallic casing may be simply a non-adhesive case surrounding the glass tube, but it is better to have it fixed thereon, by means of a mastic or cement, such as that of ceruse and minium, oxychloride of zinc, and such like.

A is the glass tube; B, the metallic casing; c, the mastic; d, the holes of the casing; e, the outline and direction of the ellipse, as seen in the empty part of the tube; e', the same as seen in the part occupied by the liquid.

Indicators of unlimited length and best fitted to resist expansion will be obtained by using short glass tubes joined end to end. For this purpose it is necessary that each joint should correspond with the middle of a space without holes, so long as the sealing should prevent leakage.

The mastic of ceruse and minium, by reason of its solidifying slowly in a cold place, appears to be the most suitable one to employ. The complete solidification is obtained by its being exposed for two or three hours to a temperature of from 200 degs. to 250 degs. centigrade. All mastics that solidify slowly in a cold place and quickly in a hot one may likewise be advantageously used. Colored mastics, and above all those colored with black, render more distinct the perception of the optical phenomenon.

The glass tube extends a little beyond the metallic casing, in order

to obtain a hermetical joint, in case the sealing of its extremities to its casing should not be quite water-tight, and thus to prevent acids and other agents from attacking the metal or the mastic. This disposition, however, is not indispensable, and in most cases the glass tube will be level with its casing.

Fig. 3 represents the section of the indicator, provided with lenses.

A, metallic body; A', tubulatures, capable of receiving cocks; a , a' , a'' , plano-concave lenses. There are many means of fixing the lenses in the holes; they may be screwed with an oily mastic, as in a' , or simply sealed with a mastic, specially that of cast iron in brimmed holes, as in a'' , or only not fixed by means of a sufficiently fusible enamel, provided that the glass made use of be of a dilatation pretty nearly the same as that of the metal employed, which should be little dilatable itself, such as cast iron, iron, steel. I do not mention platinum because of its high price.

Lenses may also be placed on thinner tubes by means of tubulatures, A, fig. 4, into which they are fixed, either with a mastic or with india rubber, by means of a screw cap. They may likewise be sealed with an enamel into very thin tubulatures which will attenuate the effects of expansion. By enamelling the cast iron, iron, and steel tubes, they will thoroughly be kept from oxidation.

Fig. 5 represents an enlarged view of a mode of fixing the lenses in the tubulatures.

A, lens; B, side of the tube; c , externally screwed tubulature; c , matter of the joint, which matter may be, according to the case, either a ring of vulcanized india-rubber, or amianth, impregnated with mastic or simply oiled hemp for both low and mean pressures; c'' , metallic ring that compresses the joint; d , screwed cap, screwing on the metallic ring.

Self-Acting Spanners or Screw Wrenches.

From the London Artizan, June, 1864.

These spanners are a contrivance of Mr. L. Schwartzkopff, of Berlin, whose steam hammer we illustrated in *The Artizan* of September, 1862.

A

The main feature in these spanners is the simplicity of their construction, as they can be used for nuts of all sizes by simply applying them to the nut and turning a hand-lever, without any special mechanism for *setting* them being required. The chuck a is fixed on the hand-lever, and connected with the small lever b , which is set in motion by the movable jaw A being pressed against one side of the nut. By this means the spanners will close themselves, irrespective of the gauge of the nut, so long as the latter can be contained between the two jaws.