

to close the openings on that side, the communication being kept up by the unbroken pipe. In any case, either to replace a broken pipe by a new one or to reverse the couplings, is an operation of but a few seconds only. The pistons used in the cylinders consist of two cup leathers, one inverted and inside the other. To insure a perfectly tight fit these are expanded by light steel springs, and the space between them and the body of the piston is filled with shot, the weight of which bears evenly on all parts of the cup leathers and prevents any risk of air escaping through it. In practice these pistons have, it is stated, not needed attention, the moisture due to the compression of the air being found sufficient to keep them soft and in working condition, the cylinders being oiled about once a week only.

The action of this brake is as follows:—When the air is let out through the pipes from the reservoir, it enters the upper end of each cylinder, escapes through the valve or cock, in each, and by the pipe connected therewith into the receiver. Instantly then the pressure per square inch of area on both sides of the pistons is in equilibrio, but by virtue of the area of the upper side of the piston being greater than that of the underside by a quantity represented by the area of a cross section of the piston rod, the pressure on the upper side preponderates by that amount, and this together with the weight of the brake gear, immediately causes the pistons to descend to the bottoms of the cylinders, in which position the brakes are off. The air is kept constantly on, and to apply the brakes, it is only necessary to open any one of the valves or cocks in the air pipes, which can be done either by the driver, guards, or passengers, in either of which cases the air escapes from the upper sides of the pistons, and that on the underside not being able to escape—its pressure closing the valve by which it entered—immediately expanding lifts the pistons and applies the brakes.

As the normal condition of these brakes is to be "on" for purposes of shunting, disconnecting, &c., "each receiver is provided with a cock, by turning which the air escapes and the weight of the apparatus causes the brakes to come off the wheels. In the event of a train breaking up, the air escapes from the upper parts of all the cylinders and the brakes are instantly applied to each part of the train. To enable the passengers to communicate by signal, the carriages are fitted with a valve box communicating with a large whistle, the escaping air sounds the whistle; but instead of a whistle, Messrs Steel & McInnes are now using a pair of trumpets constructed after the manner of fog horns, which not only are very cheap as compared to the large whistles, but it is stated by Mr. Day, will make sufficient noise at all times of wind and weather to ensure the signal being heard.—*Engineering*.

#### SAW SHARPENING AND SETTING.

Although machines have been contrived by means of which the gullet-teeth of circular and other large saws can be ground on an artificial emery-wheel, yet such appliances fail when employed for saws with angular teeth; so that, hitherto, the sawyer has had to depend chiefly on his file, and on his manual skill. To sharpen a saw to cut well, it should be clamped between two parallel strips of wood nearly as long as the saw, the whole being firmly retained between the jaws of a bench-vice. Should the saw be a bow-saw, it must be removed from its frame previous to being set. In all cases the strips of wood should clench the blade so near the teeth as only just to allow of the play of the file between them. Things being thus adjusted, a three-square file, known as a saw-file, is chosen and removed, *pro tempore*, from its handle. In order to insure equality in the length of the teeth, the file held parallel to the blade of the saw, is passed along the tops of the teeth for a few times.

The operator then proceeds to sharpen tooth No. 1 nearest to him, which he does by working the file crosswise in the groove before the first tooth, keeping the file nearly level, but slightly pointing to his right shoulder. In the same manner he sharpens the 3rd, 5th, 7th, &c., teeth, always skipping one until he arrives at the end of the saw. He then removes his saw from the vices, and proceeds to place it in the contrary direction. Again he takes the file in his hand and operates on the remaining teeth, viz., 2nd, 4th, 6th, &c. In this mode the cutting edges of the teeth are alternately sharpened.

But were the saw employed in this state, it would be found to bind or cling to the work in a most tiresome manner, owing to

the "kerf" or width of cut, being the same as the thickness of the blade of the saw, the latter therefore finding much resistance in its passage through the cut portions. To remedy this defect the saw requires "setting," and to effect this, every alternate tooth is slightly bent out of the straight line in opposite directions. Sawmakers set their saw by striking the alternate teeth with a narrow-headed hammer on a smooth anvil, to which a proper inclination is given, then turning the saw over, the untouched teeth are bent in the opposite direction. This is, undoubtedly, the best mode of setting a saw, but sawyers generally, who are not sawmakers, are content with bending the alternate teeth in contrary directions with a slotted steel plate somewhat resembling a key with wards. Several contrivances have lately been brought forward under the name of patented saw sets, by means of which the amount of bend given to each tooth becomes a fixed and invariable quantity. If a saw be properly set, a needle placed between the first teeth, will run from end to end on tilting the saw

#### THE ARCTIC EXPEDITION.

On page 256 will be found a chart of the circumpolar regions which will be useful for reference to our readers and for which we are indebted to the *Graphic*.

The centre is of course the northern axis of the earth, the vertical line is the meridian of Greenwich to the pole, and the 180th degree of east and west longitude on the other side of it, all the radiating lines are meridians of longitude (slightly distorted by the curvature of the earth), whilst the circular ones are parallels of latitude. It will also be readily understood that what is generally meant by the north-west passage is any passage or channel of water that may exist between Davis Strait and Baffin Bay to the east, and Behring Strait on the west, whilst the north-east passage is that which, passing round Norway, Lapland, and Russia, finds its outlet in Behring Strait.

With this simple description of the nature of our map, we will point out what has been done in that which may be called modern times. In the year 1818 the extent of our knowledge of the geography between Davis Strait and Behring Strait was limited to the coast line immediately in the vicinity of the Coppermine and the Mackenzie rivers, and between Behring Strait and Ice Cape—and with the exception of that portion which within the last few years has been added to our chart by the American discoverers, Kane, Hayes, and Hall—the whole of the vast coast line between the points indicated, and the whole of the mass of islands lying to the north of it, is due to British energy.

The actual accomplishment of the north-west passage is still to be effected, but that water communication exists is established both by the voyas of Sir John Franklin and that of Sir Robert McClure. The former sealed the discovery with his life, whilst the latter connected the communication by passing over the ice-covered strait, and returning to England by the strait he had not entered by. The tracks of these two discoverers are clearly delineated on our map, as also are those of Sir Leopold McClintock in the "Fox."

**ORNAMENTATION OF COPPER AND BRONZE.**—A new mode of ornamenting bronze or copper work is described as follows: After the object has received the desired form, the drawings are made with water colors, the body of which is white-lead. Those portions of the surface which are not painted are covered with varnish. The article is then placed in dilute nitric acid, whereby the paint is dissolved, and the surface of the metal is etched to a certain depth. The article is then washed with water and immediately placed in a silver or gold bath, and a layer of the precious metal deposited by electricity on the exposed portions. When the latter operation is finished the varnish is removed, and the whole surface ground or polished, so that the ornamented portion is just even with the rest of the surface. A specially fine effect is obtained by producing a black bronze of sulphuret of copper on portions of the surface between the silver ornaments. A copper vase then has three colours, black and white drawings on a red-brown ground of suboxide of copper.

Mr. J. Williams, in a paper before the Chemical Society of London, proposes to substitute the freezing and boiling points of mercury for those of water, and to divide the scale into a thousand parts.