where it was rolled into a true cylinder and one end to a socket, all in one process. Immediately on leaving the rolling mill, the pipe was entirely coated with a rust-preventing preparation, by vigorously rubbing the surfaces with wire brushes. Three coatings were applied.

Before leaving the works, every pipe was tested at an hydraulic pressure 50 per cent. over and above the corresponding working pressure.

The type of joint used is shown in Fig. 3. It may be described as a spigot and faucet joint with packing flanges, the one sitting on the rolled-up faucet, the other wedging into the faucet a specially prepared hemp packing. The two flanges are of steel and accurately machined.

This joint, which is highly suitable for considerable pressures (it has been tested, in fact, up to 90 atm.), renders the erection extremely easy; a matter of capital importance in the case of the Loch Leven plant, where the six pipe-lines aggregate upwards of 2,000 pipes.

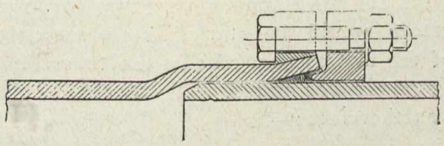


Fig. 3.—Patent High Pressure Muff.

Further, the packings can be got at from the outside without removing any pipe, and may be, if necessary, screwed tight when working. This type of joint also makes unnecessary any special expansion allowing the pipes to play freely under the influence of changes in temperature; every pipe, in this case, being an expansion.

All the bends, however, are for the sake of greater rigidity fitted with a special flange joint; flange welded on the bend itself, and loose flange sitting on the up-rolled end of the adjacent straight pipe.

The "Sleeve Pipe" shown in Section in Fig. 3, makes it possible to disengage and remove any pipe in case of necessity.

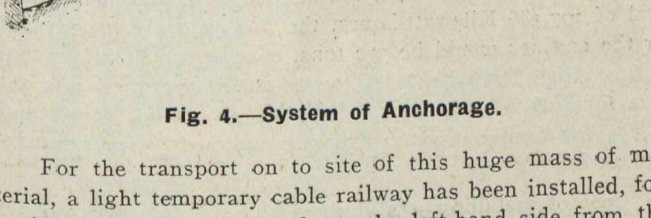


Fig. 4.—System of Anchorage.

For the transport on to site of this huge mass of material, a light temporary cable railway has been installed, following along the pipe track on the left-hand side from the power house up to "B. Station," at which point it crosses over the pipe-trench to the right-hand side.

The pipes were brought to Loch Leven by sea and landed at the wharf constructed by the company in connection with the laying down of the plant. They were then carried on an ordinary narrow gauge line by steam locomotives up to the site of the power house, where the carts were coupled to the cable of the first hauling station, situated at "B. Station." A second hauling station was installed at the intake, both equipped with a small steam plant.

The average rate of advancing during the whole erection was about 10 pipes per working day; this, taking into account the considerable length of the pipe-lines, must be considered as a very satisfactory figure.

After completion, extensive tests were carried out, every section being tested to a pressure 25 per cent. in excess of the corresponding head, and all welds, joints and packings were certified to be perfectly tight.

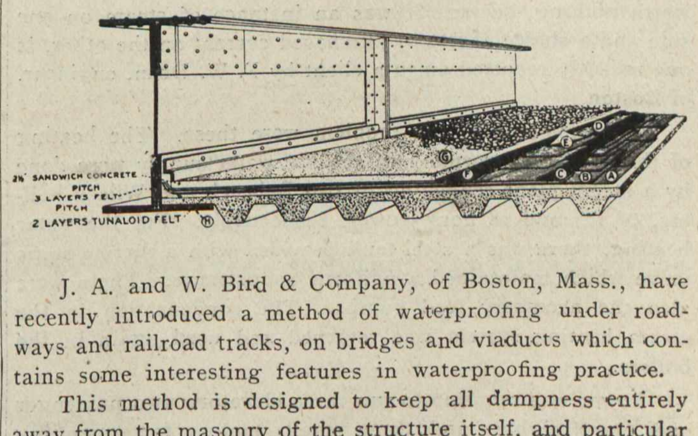
Distributing Pipes.

This forms one of the most interesting parts of the pipe-line plant. As already explained it was designed with the purpose to make it possible to feed any one of the 9 (or rather 12) turbines from any one of the six (later on eight) pipe-lines. There are two omnibus pipes running the whole length (about 400 ft. of the power-house) and which form the lower end of the future pipe-lines 4. One of the omnibus pipes is placed 4 feet lower than the other one, the whole distributing piping being accordingly arranged on the biplane system. The pipe-lines 6, 4 and 2 bend successively into the upper, and 5, 3 and 1 into the lower omnibus pipe; each turbine is connected to both omnibus pipes. The bends and T pieces are made of cast-steel, and the whole system is very safely anchored as shown by the photograph.

The complete pipe-line plant as above described was supplied to the British Aluminium Company, by Messrs. Jens Orten-Boving & Company, London, Hydraulic Engineers. The plant was started on normal working on the 26th February, 1909, and has given ever since entire satisfaction.

PROTECTION OF MASONRY AND CONCRETE BRIDGES BY WATERPROOFING.

Engineers and architects are realizing more and more the necessity of waterproofing the floors of masonry or concrete bridges before laying the top filling, street car or railroad tracks. The frequent disfiguring of otherwise handsome bridge work by the appearance of damp spots on the masonry is in itself a sufficient argument for the slightly increased cost of waterproof construction. But in climates where cold weather of any considerable severity occurs, water freezing in the masonry work may constitute a very real danger to the stability of the structure itself.



J. A. and W. Bird & Company, of Boston, Mass., have recently introduced a method of waterproofing under roadways and railroad tracks, on bridges and viaducts which contains some interesting features in waterproofing practice.

This method is designed to keep all dampness entirely away from the masonry of the structure itself, and particular attention is given to the question of preserving the waterproofing intact should there be any settling or cracking.

Their theory is to form a tough, pliable membrane over the entire surface of masonry exposed to water, and to pro-