These pipes do not contract and expand with heat, and can, if necessary be left on the surface The pipe is very rigid and not readily flattened by snow or landslides. Fig. 2 is a view of a completed pipe-line of this kind.

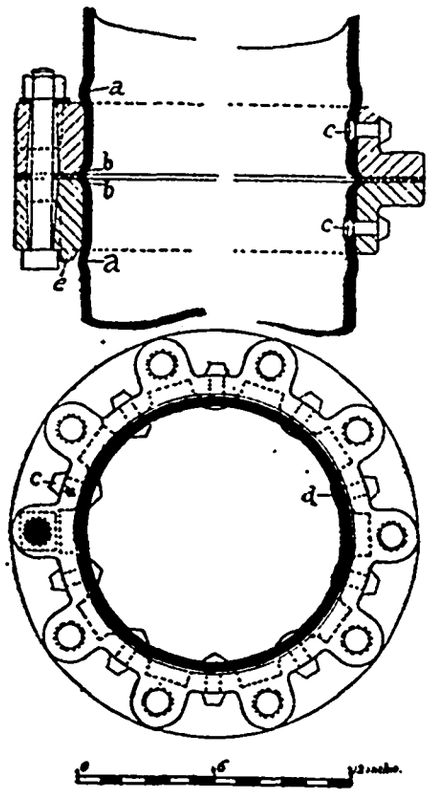

FIG. 2

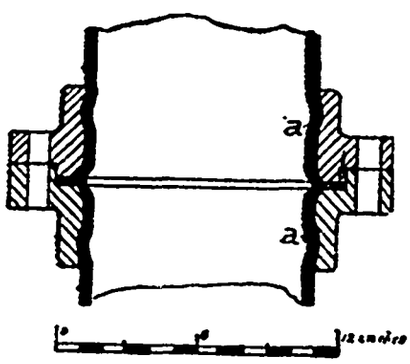

FIG. 4

Pipe Connections. Wrought iron pipes are connected principally by flanges, screwed ends and couplings, leaded or cemented sleeves, or by simply slipping the smaller end of one length into the larger end of the next. In underground work, shafts, etc., welded tubes with flanges or screwed connections are used for water, steam and air-pipes. Leaded joints are only used where a water-pipe is permanently located and not liable to be disturbed, such as pipes for water distribution. They are not suitable for pump-columns in shafts or inclines.

Flanges are the usual means of connecting pipes underground. They are commonly made of cast iron, and, in case of welded pipe, either screwed or shrunk on the ends of the tube, which, in the latter case, is expanded behind the flange, as at *a*, Fig. 3, and then headed over in front, as at *b*. Instead of expanding the pipe behind the flanges, it is preferable to have the bore of the flange recessed, and to hammer the pipe into the recess, as shown at *a*, Fig. 4. This gives a firmer hold on the flange. It is sometimes necessary to put in rivets, as at *c*, Fig. 3, in case of riveted pipe or where the pipe-line is subject to lateral disturbance. Flanges for sinking pumps, where the pumprod works inside of the pipe, should have these rivets countersunk on the inside, as at *d*, Fig. 3. In putting flanges on pipes care must be taken, in the first place, to have their faces come square with the pipe, and also to have the bolt-holes of the two flanges in line, so that the lengths of a column or pipe-line are interchangeable. In order to allow for inaccuracies in this respect, and also to provide for possibly required variations in position of elbows or other connections, the bolt-holes are sometimes made oblong, as in Fig. 5, so that one flange can be slightly rotated upon its mate. In this case a wrought-iron washer must be placed below the nut to give it an even bearing. Such a washer is an advantage also for

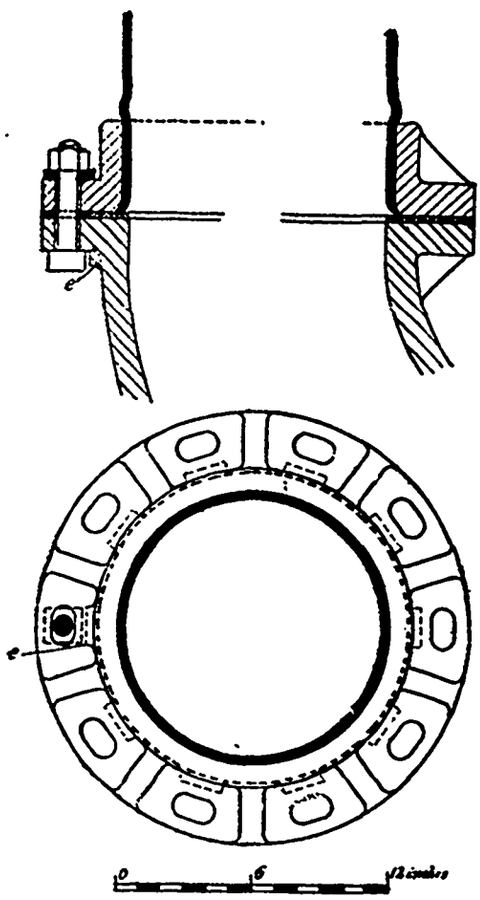

FIG. 5.

ordinary round holes, as it provides a better bearing for the nut than the rough casting. A projection *e*, Fig. 3 and Fig. 5, should be cast on one flange of each pair, to absolutely prevent the bolt from turning when the nut is screwed up. Where it is desirable to get the flanges of as small diameter as possible, bosses are carried up around the bolt-holes to the full depth of the flange, Fig. 3. In this way the bolts can be brought closer to the body of the pipe than in the form shown in Fig. 5, while the thinner metal between the bosses affords facility for riveting to the pipe. Flanges of larger diameter are, however, always required where the pipes connect to cast elbows or nozzles, so as to allow room for the bolt-heads or nuts on the back of the flange of the casting. (See Fig. 7.) Where a greater number of such connections are required, it is sometimes preferable to make all the flanges of the larger size. Such flanges should be ribbed between the bolt-holes. Nearly all flanges obtained from dealers in pipe are much too light, and have too few bolts to be suitable for pipes subjected to heavy pressure and deflecting strains, like pump-columns or high-pressure steam-mains.

The smaller sizes of pipes, and often larger ones also, have their ends threaded, and are connected together by threaded sleeve-couplings or by flanges screwed on. The flanges of large steam-pipes are often put on in this manner. This method of securing flanges is generally also necessary for pipe of extra thickness. Where a tight pipe is required