

cement. Conduits are placed on a bed of crushed rock or gravel, approximately 6 in. deep, and this is extended upward to about the center line of the conduit when trench is backfilled. Underdrains leading to points of free discharge are placed in the gravel or crushed rock beds.

Wooden Conduit.—Each pipe is enclosed in a tin-lined wooden casing. Sufficient space is allowed between the pipe and the casing to provide for the insertion of pipe guides or rollers which rest on the bottom of the casing. The casings are bedded in gravel or broken stone and one or more tile underdrains are laid beneath them.

CHAPTER XIV

PIPE

IN the present era of large-scale developments accompanied by intensive application of engineering principles in many of the basic industries, it has become increasingly important to give more study to the characteristics and properties of the materials entering into the structure and maintenance of their various contributing units. This is particularly true of pipe lines which often bear an important relation to efficient and economical operation.

STEEL PIPE

During the past 20 years in particular there has been a remarkable development in the wrought tubular industry, including the tonnage used, the capacity of mills, diversity of pipe service, and improvements in the material itself.

The factors which control the characteristics and properties, and thus produce the wonderful improvement in various tubular materials, are the facilities of the manufacturer; the special processes supplementing the fundamental ones; the availability and quality of raw materials; the ideals and skill of the men in the organization—their capacity for genuine accomplishment. Among the many evidences of this trend are: the improvements effected in the quality of the material, production of certain sizes of pipe up to 40 ft. lengths, diameters up to 96 in., a complete line of tubular products, full standard weight pipe, and marking with the name, are representative of the progressive attitude taken in the manufacture of wrought pipe. The increasing demands of the oil industry, which consumes nearly one-half of the pipe made, has been a stimulating factor in respect to improved quality.

Among the improvements none have received greater attention than the efforts to produce a uniform quality of steel. To secure and maintain uniformity, necessitates complete control of all materials and manufacturing operations—from ore to finished product. This practice of producing uniform pipe and steel and its fabrication into finished tubular products is supplemented by a mechanical process of roll-knobbling, to make the metal more uniformly dense when there is any tendency to physical irregularity in this respect.

Another condition which gives rise to electrolytic centers and pitting is the presence of irregular areas of heavy welding-scale on the surface of the finished product, caused by oxidation at the high temperature of

Material for this section was prepared especially for THE GUIDE, the part on Steel Pipe being contributed by F. N. Speller, Pittsburgh, that on Wrought Iron Pipe being the work of N. Bowland, Pittsburgh, and that on Copper and Brass Pipe being compiled by J. F. Gowen, W. A. Willis, W. G. Schneider, and H. H. R. Spofford, of the Copper and Brass Research Association, New York.