instances, the sprinklers yielded elsewhere than at the soldered joint. One of the three sprinklers was a Parmelee, and the other two Burritt sealed sprinklers.

This shearing strength per square inch amounted to 2,449 pounds in the Parmelee, and 4,534 and 7,254 in the Burritt sprinklers. Sensitive sprinklers, with any considerable elements of elasticity in their construction, become tight after leaking down to a point at which the elasticity of the sprinkler equalled the water pressure.

These results show that the solder does not weaken on account of age or pressure. An examination of sprinklers which have opened at ordinary temperatures warrants the opinion that such instances have been produced by imperfect soldering, freezing, excessive strains caused by screwing a valve to its seat, or by expansion of the sprinkler with rise in temperature.

In some sensitive sprinklers the elastic springs, or the flexibility of some of its members, limit the stress on the solder to the force which can be transmitted by the spring; and sprinklers of this form have not given trouble by reason of yielding of the soldered joint from this cause.

The methods of applying the fusible alloy by sealing caps over automatic sprinklers, and thus producing a joint exposed to contact with the water, were not used until after numerous attempts to produce sprinklers containing a valve secured to its seat by a rigid arrangement of parts, with the soldered joint away from contact with the water, had resulted in failure.

Subsequently, Mr. Frederick Grinnell solved this problem by placing the valve in the centre of a flexible diaphragm. As a result of this construction, the water pressure upon the diaphragm tends to keep the valve tight, as long as the levers remain in place; when the resistance against the water pressure is removed by the fusion of the solder, then this same water pressure opens the valve. This new mechanical movement, using the same element of hydrostatic pressure to keep the sprinkler open or shut, as needed, and also to relieve the inelastic solder from strains due to water hammer, is comparable in simplicity and importance to the celebrated invention of Elias Howe which pierced the sewing machine needle near the point.

In the Grinnell sprinkler, the joint is reinforced by a wire bent at right angles, and soldered against the joint, making a compound soldered joint lying in three planes. In the Brown sensitive sprinkler, the thrust of the spring against the yoke is taken by a pin driven through the yoke, and there is no direct stress upon the solder until it melts and allows the parts to slide laterally. The Walworth sensitive sprinkler differs from others in the use of an oval link instead of a soldered joint. The system of levers is such that a water pressure of one pound to the square inch exerts a force of one-fortieth of a pound on this link. The area of cross-section of one of these links is one-fortieth of a square inch. The yielding of the lever at the side limits the tension which is placed upon the link.

At this date we have not the benefits of experience respecting the endurance of this link; but one of these sprinklers, with the tension on the link as great as the stiffness of the side rod would permit it, has been in my possession for three months without any indication of the solder yielding.

OPENING TEMPERATURE OF SPRINKLERS.

The temperature at which sprinklers opened was ascertained by connecting the sprinkler to fifteen pounds' water pressure, and placing it in the middle of a large steam kettle. The water was agitated with a dasher, and heated so slowly that fifteen to thirty-five minutes were required to melt the sprinkler-joint, and the temperature could be noted to an accuracy of about one-quarter of a degree.

Sprinklers with hard solders were melted in a similar manner in a kettle of oil. When a sprinkler opens, the solder is not fluid, but either in the granular state that precedes fusion, or in a thick viscous condition, the form varying according to the solder and the pressure applied.

Therefore it is important that the parts forming a joint should slide easily on each other. These sprinklers, where the joint is formed by a conical sleeve must open with more difficulty, because the two surfaces of the joint must be separated as the joint opens, requiring greater force than mere sliding, or the opening of the sprinkler delayed until the temperature increases to a higher point, and renders the solder perfectly fluid.

Those engaged in the manufacture of the earlier Parmelee sprinklers used rather harder solder than is the present practice. The very first sprinklers were sealed with the more fusible solder, and later "212" and "250" (so-called) solder were used. Two lots of sprinklers, as given in the table,—one in present condition since 1879, and a portion of another lot which had been in use since 1872,—gave as their opening temperatures 163 and 168. On comparison with the results given for later sprinklers, it will be seen that the solders have retained their low-melting points. There were but a few of the earlier sprinklers introduced into the mills, and so many of them have been changed that it is not an easy matter to obtain a full supply of them for these experiments.

The alloy which melts at about 150 is not considered strong enough for use in sprinklers, and there cannot be considered to be a demand for such a sodder, while those now in use prove to answer the requirements of such work over highly combustible material. The operation of the automatic sprinkler, of the valve, or "sensitive" type, is interfered with or wholly prevented if the sprinkler is severely corroded; and it is suggested that such moving or sliding portions of sprinklers be protected with some of the heavier petroleum oils, which would prevent rust without cementing the sprinkler. It is essential that no mixture containing an animal or vegetable oil be used.

N.B.—This paper was accompanied by Valuable Tables of the results of tests, &c.

WOODEN WATER PIPE.—At a Meeting of the Engineer's Club of Philadelphia, it was stated respecting a Wooden Water-Pipe that:—The section of spruce was originally about 14 inches in diameter at the large end and somewhat smaller at the other, having a wrought-iron band about 1½ in. wide, 3-8 in. thick at one side and tapering to a thin edge at the other, so that it could be driven on or into the end of the log near the outer circumference. A piece of iron pipe 4 in. internal diameter and about 12 inches long, tapered to a thin edge at each end, served to connect the ends of the two adjoining logs, which were driven over it end to end, and prevented from splitting by the iron bands around the ends of the logs. In some cases no interior iron coupling pin was used; one log was tapered at one end and driven into the next one, which was prevented from splitting by the exterior iron band. The 4-in. pipes, so far found, were of yellow pine, spruce and oak, of about 12 feet lengths, and from 12 to 24 ft. in diameter and supposed to have been laid between 1795 and 1805; the depths at which they were found varied from 2 to 8 feet below the surface of the street. The outer bark and heart wood of the spruce logs were generally sound, while the inner bark and sapwood were decayed, except where the soil was dry, gravelly or porous, when the greater part of the wood was decayed and the iron badly corroded. A specimen of red oak from a log adjoining the spruce one was decayed on the under side, but other portions looked nearly as fresh as if recently laid.

This is very useful information, and those interested should make a note of it.