confinement before it passes into the open air. Sometimes openings are made through the lip or in the floor of the chamber, through which the steam escapes and so reduces the pressure within the lip chamber that the valve disk will not lift too high.

"Annular valves have the additional area located at the centre of the disk and within the outer seat. This area is excluded from the action of the steam when the valve is closed, by means of an inner seat, but is acted upon directly by the steam when the valve opens. The disk is simply a flat cover for the valve base and has two concentric seats

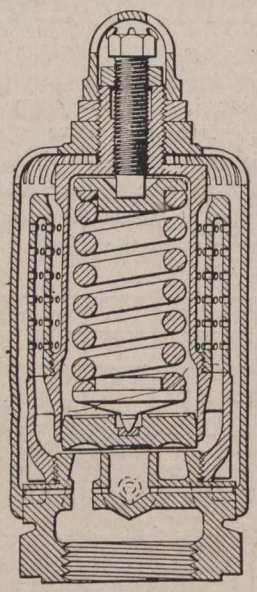


Fig. 6.—Muffled Locomotive Pop Safety Valve as Now Made.

in the same horizontal plane. The central area of the disk, which is not exposed to the steam when the valve is closed, covers a well which communicates to the outer air through four hollow arms radiating from it out through the sides of the valve body.

"When the valve opens, the steam is discharged directly across the outer flat seat, and there is also a separate additional flow over the inner seat into the central well and out through the four hollow arms. The openings through these arms are controlled by a sleeve, threaded on the valve body, so that it may be turned upward or downward as desired. If it should close the open ends of the hollow arms, preventing the escape of the steam through the central well, the reactionary effect upon the disk to lift it against the spring would be greater than if the openings from the well were unobstructed; and by locating the sleeve at intermediate points the lift of the valve can be varied.

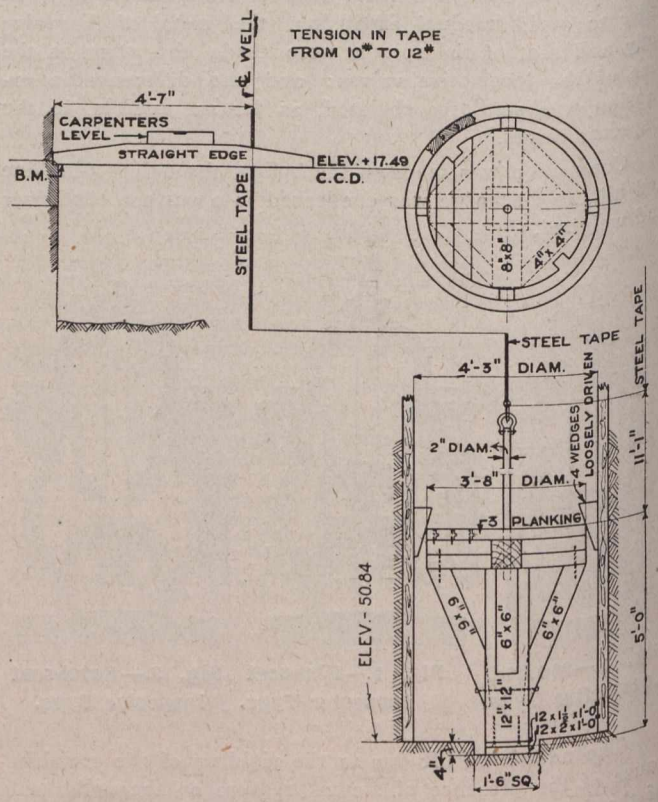
"In bevel seated valves the disk is ordinarily guided vertically so that it will return properly to its seat when the valve closes, by means of four or more radiating wings or vanes extending from the face of the disk in the steam space and bearing against the sides of the inlet or throat of the valve. But in the annular valve there are no guides or wings attached to the disk, which is simply a flat member having the truncated form of the central zone of a sphere.

"This is placed in a cylindrical chamber outside and above the steam space, and there it lifts or moves freely as acted upon by the steam against its lower face and by the opposed spring which presses upon it at its centre. The contact between the chamber and the spherical part of the disk is the least possible, which permits universal movement of the disk without possibility of cocking or sticking, and yet insures that the disk will return accurately upon its seats when the valve closes."

TESTS ON HARDPAN.

Hardpan and rock underlie the clay bed on which a large portion of the city of Chicago is located. Deep building foundations generally are carried down to one of these materials, the standard construction being wood curbed circular wells excavated down through the clay bed and filled with concrete. No tests are recorded as having been made on the bearing power of Chicago hardpan, despite its frequent use as a foundation bed, until the construction of the Cook County Hospital was undertaken. The following is an abstract of discussion before the Western Society of Engineers, by Mr. Frank A. Randall, chief engineer for Morey, Newgard & Co., who are engineers for the work.

The preliminary borings were made 6 ins. in diameter for about 30 ft. in depth and 3 ins. for the balance of the depth. These borings show below yellow clay a thick stratum of "soft sticky clay" down to about 37 ft. below ground level, with solid blue clay running into "hard clay and gravel" down to hardpan at an average of about 47 ft. below ground at the south end and 56 ft. below ground level under the main building. The main building is about 550 ft. long by 70 ft. deep, and has four pavilions, 40 ft. by 200 ft., projecting from the rear. The ground area covers



Details of Apparatus.

about 75,000 sq. ft. Rock was shown according to borings at elevations —67 and —89.5 in two cases, but the latter figure was assumed to be the more reliable. Because of the great difference in cost between caissons to hardpan and to rock and the size of the loads to be carried, it was decided to use hardpan caissons, provided the test showed a satisfactory layer of hardpan, with rock in the same relative location as in the preliminary borings. Bids were received also for pile foundations, but as the prices for these amounted to some $13,000 more than those for caissons, the latter were used. The caissons tested were carried on down after the test to determine the thickness of the hardpan stratum and the depth to rock. The hardpan was found to be from 15 to 20 ft. in depth, with hard clay