

bottom to the water line, and back from the head from twelve to twenty inches with scale and mud so compact that the hand-hole plate is with difficulty removed.

The engineer (?) usually in charge is very loud in his denunciation of the "old tea-kettle" that "won't heat water hot enough to scald a hog." If by chisel and scraper, and the cultivation of the reputable virtue of which Job was so celebrated, a portion of the hard-burned accumulation—a monumental testimony to the skill of the engineer—is removed from the tubes and head, and a communication opened to the water in the boiler, it is usually found that the tubes are ruined and leaky. It is then that the evils arising from the neglect to keep the boiler clean is made apparent. For if the engineer cannot remedy the evil by driving an iron plug in to expand the tubes and "thimbles" the next make-shift is equally abortive, and a machinist is called to repair the leaks; then of course, the cause of the trouble comes out, and also the fact that the tubes must be replaced by new ones, as the ends are burned and therefore worthless.

The water leg of the locomotive type, especially that portion that extends below the grates and under the ash pit, is very susceptible to deposits of mud and slush.

The evil of this is not so much the difficulty of converting mud into steam—for that portion of the boiler generates but little steam—as the difficulty of keeping a portion of the mud from mingling with the water in other parts, where the heat is more effective, when, if a surface blow-off is not used daily, a considerable portion is carried over with the steam into the engine, much to its detriment. The mud also does its destructive work when the boiler is supposed to be empty and idle, for the mud will not run out but lies soggy and wet in the bottom, rusting and eating when all the rest is dry.

It is the practice of some engineers to blow the water out of the boiler at almost any pressure from ten to fifty or sixty pounds, and this is about all the cleaning such engineers give their boiler. They err in thinking the deposits can be removed. A small part immediately around the blow-off will be discharged, and the same results could be had by letting the water out with no pressure, while the harm that is done to the tubes, sheet joints and rivets from the heat to which they will be subjected, when no water or steam remains to guard them, is very great.

Between this method of cleaning and no cleaning, there is in truth a large balance in favor of the latter, for while the results from either course are equally certain, the latter will most certainly clog and fill the boiler with scale and slush, eventually rendering new tubes imperative, the former will also do it—for blowing out does not clean—and in addition will ultimately ruin the shell joints from the great heat and expansion to which it is so exposed.

As a rule, the blow-off cock should be placed in the lowest portion of the boiler—or at least the coolest—which is generally the lowest for the reasons that if it is at the lowest part it will drain all the water out, and sediment collects in the lowest places and can be removed daily quite effectually by blowing out for a few seconds. The writer does not indorse the practice of opening the blow-off suddenly and wide for this purpose. The steam pressure has

been seen to drop ten pounds in half a minute from this cause and the belief that the course is injurious is reasonable. The cock should be opened but a limited part of its capacity and remain so for a longer period. Thus no bad results follow, the pressure does not fall perceptibly, and the small opening longer continued creates a more extensive movement of the water towards the cock, and thus necessarily carries out a much larger per cent. of sediment than the short, hard blow, which blows out one-tenth of the water perhaps, without giving that at a distance time to flow to and discharge its load. To assist the blow-off at the bottom of the boiler in maintaining pure water and freedom from foaming, there should also be one at the water line, a surface blow-off.

When the water is very impure, and a scum rises in boiling, a surface blow-off is very essential. It should also be placed in the cooler part of the boiler, as the scum bubbles up where the water is most, and seeks the smoothest place to rest. It may be introduced at any convenient place, and a pipe extended to the place of receiving. When it is possible much advantage is gained by having the receiver made funnel-shaped and quite large, the rim at the water-line or a little below.

The advantage gained by the funnel receiver is principally due to the fact that the water boils up fiercely at its edges, and that within it the water is comparatively still, and so gathers the scum at the very place where the blowing-off must take it, and largely to the wide rim of the receiver which takes from a large area. The value of the surface blow-off to the engine is very noticeable when the feed water contains a large percentage of lime and is used without a purifier. Much of the lime, resembling magnesia, is very light, and when precipitated by the heat, floats upon the top of the water, and is carried over by the steam into the cylinder. Its presence there is readily detected by the indifferent performance of the engine, and the increased amount of cylinder oil necessary to keep the valves and piston working smoothly.

The engineer, if observant, will soon discover how often the boiler should be cleaned, and if prudent will make thorough work of it, knowing that anything slighted will demand correspondingly greater labor the next time. Various forms of scrapers are essential and should be devised to suit the work. Often it is impossible to use scrapers by reason of the indifferent means of access provided, and frequently from the intricacy of the tubing. In most cases a force pump, hose and nozzle will reach the places and do the work much better. Indeed, if two nozzles are affixed to a small gas pipe, one in line and the other at right angles with its length, an implement of great value is had, with which the boiler may be washed much cleaner than it can be scraped. It is understood that the gas pipe, to which the nozzles are attached, is employed, that the nozzles may be manipulated any distance in the boiler far or near, and flexible connection made between it and pump with hose.

A GOOD CEMENT.—For a glass-metal cement insoluble in carbon bi-sulphide, alcohol, water etc., dissolve gelatine in water, add a small percentage of glycerine, and also a small quantity of potassic bichromate.