to accumulate would eventually clog up the tubes to the passage of the gases. This would reduce the conductivity of the tube in the same manner that the boiler scale reduces the boiler efficiency. This difficulty of clogged pipes has been overcome in the same way as that employed in marine practice. Through the small opening in the bricked-up door, a small shovel filled with sand is introduced. The draft is strong enough to pick up the particles of sand and draw them through the tubes, the sharp edges of the sand cutting away the caked carbon, thoroughly cleaning the insides of all the tubes. This cleaning is done about twice a day, and is being found sufficient to keep the tubes in good shape.

The combustion of oil is always regulated in oil-burning plants by the color of the gases escaping up the stack. This being difficult of accomplishment under ordinary conditions in a car of this type, without going outside the car to make observations, an ingenious provision has been made so that no difficulty will be experienced in making this inspection of the escaping gases. A small window, which may be observed beside the stack in fig. 1, in combination with a couple of mirrors conveniently located inside the engine room, makes an observation of the escaping gases at all times possible to the engineer.

This car, together with the other two cars previously mentioned, are housed in a 3-stall section to the roundhouse at Fort Erie. Each stall has a pit its full length under the cars. These pits each have air, water and oil connections. The oil is brought in through a 1½-in. hose and pipe connection under 5 lbs. of air pressure, from three 7-ft. diam. and 7-ft. high tanks located in an underground chamber 15 ft. long, 10 ft. wide and 10 ft. deep, made of concrete. This chamber has four vent holes in its roof. The tanks are piped to operate independently, so that two may be filling by gravity from tank cars alongside, while the third is being used to fill the car tank. Beside the connections in the building, there are similar attachments to an outside track.

No tests have been made to determine the ultimate velocity attainable with this car, but over 40 miles an hour can be made and held for considerable periods. The 20-mile run between Black Rock and Port Colborne was made during the last summer season in the scheduled time of one hour, which included 10 stops, or at the average speed of 20 miles an hour. The car comes up to speed more rapidly than would a full train.

As might be supposed, from a fuel standpoint, this car is more expensive to operate than its coalfiring twin, for the price of oil is high as compared to coal. The fact that a fireman can be dispensed with, makes the net cost of operation less than the other. Not only that, but the service is more popular from the fact that the car is cleaner, and many of the objectionable features of coal-burning are done away with.

The writer is indebted to the G.T.R. Motive Power Department for the details of construction and the features of operation.

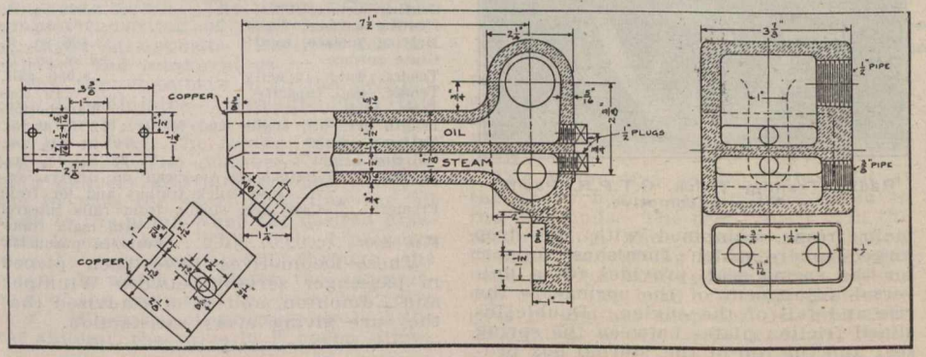

Fig. 4. Design of Nozzle for Injecting Oil into the Firebox.

Lubrication of Superheated Steam Locomotives.

At the annual meeting of the Travelling Engineers' Association in Chicago recently, the committee on "Lubrication of Locomotives using Superheated Steam," of which M. H. Haig was Chairman, presented a report containing the results of observations on 14 of the 30 roads having locomotives equipped with superheaters, which is abstracted as follows:—

The effect of superheat on lubrication, depends upon the temperature of the superheated steam. Smoke-box superheaters give the lowest degree of superheat, none of those reported exceeding 490 degrees F.; this was obtained with a drum type in service on the Santa Fe. The Baldwin superheater has a temperature of 430 degrees F. for the highest. At the temperatures obtained with smoke-box superheaters, little trouble has been experienced from the use of the same methods of lubrication employed on saturated steam locomotives, and practically no changes have been made. Oil is being delivered to the centre of the steam-chest for slide valves and inside-admission piston valves; while for outside-admission piston valves, the oil is introduced into the ends of the valve chamber. In some cases, the cylinders have been tapped to receive direct lubrication at a point in the middle of the bore, and near the top. Experience with this method leads to the belief that equally good results can be obtained by the usual methods of feeding the oil to the steam-chest.

All roads reporting have found it unnecessary to change the quality of the oil with low-degree superheat; and the increased quantity consumed is but slight. Oil with a flash point of about 520 degrees F. is the kind used. Mileage reports per pint vary widely, depending upon locomotive size; the figures range from 35 to 75.

Little data were received relative to the wear of valve and cylinder packing with a low degree of superheat although in some cases, the wear appears to be a little more rapid. No case is cited of any change of material being made, nor was the rod packing changed.

Eight railways reported the use of smoke-tube superheaters. The superheat obtained varies from 100 to 200 degrees with corresponding steam temperatures of from 490 to 580 degrees F.

Differences in boiler pressure were found to have no influence in the proper lubrication of valves and cylinders of locomotives using superheated steam. The only effect discernable, both with saturated and superheated steam, was that the quantity of oil consumed was increased. Some railways feed directly to the cylinder, while others feed in the usual manner to the steam chest. Satisfactory results are obtained by the following methods of feeding oil to the steam chest, all cases applying to piston valves, as no cases were known of superheated steam being applied with slide valves:

(a) Two feeds per steam chest, with a delivery near each admission port, preferably a little toward the centre of the steam chest;

(b) The customary one feed per steam chest, introducing the oil into the centre of the steam chamber;

(c) One feed per steam chest, introducing oil into the steam channel at a point near the steam chest; and

(d) Three feeds per steam chest, one in centre of steam chamber, and one at each end near the admission ports, each port of delivery having an individual lubrication feed.

To insure proper lubrication at all times, it is recommended by some that steam be admitted to the cylinders when drifting; it has been found that even though proper lubrication is obtained while working steam, the valves and cylinder walls become dry after drifting for some time. A drifting valve will let sufficient steam into the valve chambers and cylinder if properly handled by the engineer. These results were obtained from direct observation of two roads equipped with and without means of admitting steam while drifting. By proper care on the part of the engineer in always opening the drifting valve before closing the throttle, it is possible to obtain material increase in the life of packing rings.

The use of mechanical feed lubricators is reported on as being unsatisfactory, the hydrostatic type proving superior. The mechanical lubricators failed from mechanical defects, greater liability of failure, and higher cost of maintenance.

Several different grades of valve oil are used on locomotives equipped with high degree superheaters. Flash points of from 550 to 600 degrees F. were reported, in most cases the same oil as that provided for saturated steam locomotives. The oil as used by the Canadian Pacific Ry. has a flash point of 600 degrees F. for use with steam having a minimum temperature of 590 degrees F. The successful use of an arrangement of oil piping, whereby valve oil is passed through the smoke box before entering the steam chest, indicates that high temperature has no permanent effect upon its lubricating qualities when protected by steam. This should not be considered as proof, however, that oil possesses any lubricating qualities while subjected to excessive temperature, as the temperature in the steam chests and cylinders is comparatively low.

High superheat has increased the quantity of oil used in valves and cylinders, varying in different cases from 10 to 100%. The larger percentages are due to the delivery of oil directly to the cylinders without a reduction in the quantity fed to the steam chest. One road, however, reports that the reduction of water carried to the cylinders by foaming, which has been effected by the application of superheat, has enabled the locomotive to be operated with no increase in the oil allowance.

The wear of cylinder packing rings is increased by the use of highly superheated steam, and the direct introduction of oil into the cylinders has not overcome the trouble. On the other hand, the wear of piston-rod packing is but slightly affected. The C.P.R. reports that in the case of cylinder packing rings, the life was from 1 to 18 months