AN EFFICIENT AND ECONOMICAL LOCOMOTIVE SERVICE FOR FAST HEAVY TONNAGE.

By J. E. Muhlfeld.

During the present period, when the facilities of many railroads are being taxed to their limit to move the tonnage which is naturally forthcoming and dependent upon the railroad service to handle to its destination, to the operating, more than to the traffic department, is assigned the duty of increasing the revenue which must be derived from the handling of a ton of freight per mile of haul.

On systems where the most favorable and modern conditions exist for the train movement, the operating of the line may be termed practically automatic when compared with parallel and competing lines where the track, power, and despatching conditions are not so conducive for the realization of net earnings.

In the one case the track and despatching conditions are the best that advanced ideas and money can devise, and the capacity of the locomotives provided is limited only by the most modern design and the clearance limits. On the other hand, we have the single track line, with its naturally unfavorable road bed, light rail, short sidings, many grades and short degree curves, unfavorable water, and grade stops, more liability for casualty, and a large proportion of obsolete power, from the operating of which, and in competition with the more automatic line, is expected the handling of tonnage at dividend paying figures.

It is on these latter lines, especially, that the people employed in the operating departments must contend with the most severe conditions and the consequent annoying criticism when a failure to accomplish the expected results occurs.

Considering the subject referred to from an operating department standpoint, the first requirement by the transportation of the motive power department is locomotives of such capacity and in such condition as will move the greatest gross tonnage in one train at the fastest rate of speed that the track and despatching conditions will allow with a reasonable degree of safety.

The principal thing that a railway has to do is to get its trains from one terminal to another on time, and to the motive-power men and the operating officers this is the uppermost duty in mind.

While railroads are not operated to save fuel, or to have locomotives that it does not cost much to maintain and run, and although economy has to be considered as secondary to getting trains over the road, at the same time the tractive power required and the limits given within which to acquire this, make it now necessary that locomotives be so constructed that more work will be derived from the use of steam, and the result should be economy.

While the motive-power department people and locomotive builders are keeping abreast of the times as regards the development of power suitable for and which fulfils the requirements of the transportation and traffic departments of railroads, at the same time such advance has not been made with due consideration being given to the combination of an economical with an efficient service. The designs now having reached the clearance limits, it is necessary that a decided change be made at once, to not only provide for a further increase in the boiler capacity to supply the additional tractive power, but also for a service which will be given without the proportionate increase in the cost as the capacity of the power.

During the past few years almost entire attention has been given to the enlarging of boilers and grate areas only for the reason of fulfilling the requirements of the cylinder capacity required to produce the increased tractive power, and the proper consideration has not been given to the obtaining of this increased efficiency at a reduced operating cost.

It is not presumed that the design of locomotive referred to in this paper, or the method proposed for the operation, is without criticism, but the intention is that the special features that have been referred to will receive the due consideration of designers and builders, and that power will be provided which will remain modern for its entire period of service and produce the same efficiency at a more reduced cost than the power that has been built during the past few years.

A discontinuance of the present prosperous conditions of the country and the railways, and the continuance of some of the present wasteful methods of locomotive service, will soon result in increased losses, which would not occur had more consideration been given by the men in the mechanical departments to the attaining of an economical service in connection with an efficient one.

That the motive power department shall be asked to do a large proportion as regards the reduction in cost for operating is but fair, especially when it is considered that the average cost for the fuel alone for the locomotive service amounts to from 14 to 16%, and the cost for the renewals, maintenance and the operation of the power figures from 18 to 25% of the total operating expenses, depending upon the locality and the conditions.

While it is a fact that electro-motive force is in many instances superseding steam power for the handling of suburban passenger traffic, and that it may shortly displace the latter for through passenger service; it will, however, be some time before electrical energy will supplant steam motive force for the handling of heavy tonnage.

Therefore, in preparing the design for a type of tonnage locomotive for to-day, such construction must be adhered to as will not only fulfil the present heavy tonnage requirements, but which will also remain modern for several years to come, and combined in the constructive features must be the design of a boiler and a motion gear which will insure the most conversion into energy, per unit of heat contained in the fuel to be consumed, and which will result in the most econony, both as regards the cost for maintenance and operation.

The features for a modern locomotive may be summed as follows:—A reasonable first cost, maximum capacity for the service, and within the track weight and clearance requirements, capacity to handle the heaviest gross tonnage practicable at the highest permissible speed, economical as regards fuel and water consumption and maintenance for repairs, a construction of the least number of parts, and a capacity to perform continuous mileage without failure.

The modern American types of locomotives fulfil quite satisfactorily all of these requirements, with the exception of the wastefulness in fuel and water consumption; and in the type of locomotive that is submitted, the most careful consideration has been given this subject, while a design has also been adhered to which will embody the other necessary, and which may be, practicable features.

All mechanics interested in locomotive design and construction realize the fact that we have reached almost the limit, and that only by brute force, as regards increasing the steam-making capacity of the present American type of locomotive boiler, with its stoking and feeding appliances, and in maintaining the present clearance limits. A new type of boiler and its attachments must be designed which can be readily adapted to the present arrangement of cylinders, frames, and the carrying and motion gear, and to further increase the capacity and mainly the efficiency, it must be of such design as will convert into work more of the energy now contained in the fuel, and which is being lost to such a serious extent. This efficiency must be increased from two to three fold, and for an almost equivalent weight.

Such a boiler must be of a simple and durable construction to be able to withstand the grief that will result from the high steam pressure, excessive expansion and contraction, persistent forcing, bad water, weather and track conditions, and neglect of attention in the way of boiler repairs, inspections, tests and washing out, which are quite liable to occur during a time when the power is hard run in order to handle a heavy business, and when the weather conditions especially are decidedly severe. Such a boiler must be easily accessible to facilitate repairs and removal of parts, and must be drafted so that even under the most adverse conditions which will result from the use of an inferior quality of fuel during severe atmospheric conditions, the failures to steam, which cause much expense, to say nothing of the delay to train movements, will be reduced to the minimum.

With this recommendation for the design of a boiler which will more nearly fulfil the requirements of locomotive service than the present type, have also been embodied other features which will better meet the general requirements, and which will give results to the company, engineers, firemen and shop men who must do service about them.

The type of locomotive that has been made the subject for this proposition is the most undesirable with which to associate the new features and keep within the overhead clearance requirements of 15 ft. 2 in., from the fact that the driver wheels being 63 inches in diameter over the tires, leaves but little margin for the boiler and its attachments, and for a depth of firebox between the top of the foundation ring and the lowest position of the combustion flues. It will be noted that these features can be more readily applied to some of the other types of locomotives, but which would not be so favorably adapted for the service to be performed.

Referring to the drawings which give the general arrangement only and which are printed separately as an inset opposite page 24.

Fig. 1 shows a left elevation of the locomotive.
Fig. 2 shows a longitudinal section of the locomotive.
Fig. 3 shows a top plan of the locomotive.
Fig. 4 shows a right elevation of the engine.
Fig. 5 shows a front elevation and section through the combustion chamber.
Fig. 6 shows a front end elevation of the engine.
Fig. 7 shows a rear end elevation of the engine.
Fig. 8 shows a cross section through the firebox and stokers.
Fig. 9 shows a rear end elevation of the tender.
Fig. 10 shows a section of the tank on line A.B.
Fig. 11 shows a section of the tank on line Y.Z.
Fig. 12 shows a section of the tank on line C.X.
Fig. 13 shows a cross section of the stokers.
Fig. 14 shows a longitudinal section of the stokers.
Fig. 15 shows a longitudinal section of the combustion chamber.
Fig. 16 shows a section plan of the combustion chamber.
Fig. 17 shows a front elevation of the combustion chamber.
Fig. 18 shows the method for attaching the combustion flues to the flue sheets.