endeavour should be made to make the layout comprehensive, so that afterthoughts in the form of additional accommodation and facilities should not be necessary. The engineering work, on the whole, is of a simple character, and the chief interest in its design lies in combining the various parts so that they form a single facility, properly proportioned to its important servicing work on which the efficient use of locomotive power so much depends.

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The Paper is accompanied by sixteen sheets of drawings and three photographs, from which the folding Plates, the half-tone Plates, and the Figures in the text have been prepared.

## Discussion

**The Author** introduced the Paper with the aid of a series of lantern slides and a film.

**Mr. R. J. M. Inglis** congratulated the Author on the Paper and observed that it was essential to save every possible minute owing to the shortage of engines, which would probably continue for a considerable time after the war.

The Author had concentrated on the problem of ash-disposal, and all who had anything to do with locomotive running shed operation would admit that ash-disposal was one of the most costly and dirty of the services. The wet ashpit was the best means for disposing of ashes that was known at the moment, but research might result in the development of something better. There could be no doubt that a great deal of mechanical plant would have to be installed if labour costs were stabilized at a figure considerably above the pre-war level.

The proper layout of the servicing facilities was of prime importance, because so much depended upon it and much money could be wasted by an inefficient installation.

With regard to the order of servicing, he considered that in many cases inspection should come first. In all locomotive depots there were first-class men who, if an engine was reported with a breakdown or faulty, would have it put immediately on the inspection pit and turned into the standage siding, no matter in what order the services were set out.

He would like to have the Author's views in regard to the times of movement through the various services and the standard time for the various operations under the most favourable conditions, because that would give a target at which to aim.

The layout shown in Figs. 15, Plate 2, which might be called the rising sun or three star design, contained all the facilities that could be desired. What would be the cost of the building? In the case of the general layout shown in Fig. 16, Plate 2, another turntable might be put in at the dead end, so that it would be commanded by the two crossover roads.

He hoped that in post-war planning no tender memories would cause the grim old sheds to be kept in existence. It was not fair to criticize what had been done a hundred years ago, but railway engineers could justly criticize what had been done in their own time. He was afraid that their eyes had been usually on the beautiful glistening locomotive and not so much on the dressing-rooms behind the stage; but those dressing-rooms should now receive some consideration.

**Colonel Harold Rudgard** observed that a running shed or locomotive depot was a place where engines were serviced, oiled, and got ready for traffic and the target to be aimed at was maximum availability, which meant, in the long run, fewer locomotives. Therefore it was necessary to realize what work should be done in a running shed to make it of real value to the railway.

Before the war the London, Midland and Scottish Railway had effected a good deal of modernization and mechanization by building coaling-plants and ash-shifting plants and providing machine tools; but that work had been held up by the war, and he was afraid that in many sheds, if the engines could talk, they would say: "We're designed and built with very great care, but where we reside is not very fair."

Two important points in connexion with running sheds were quick turn round and correct servicing and maintenance, so that when engines came on to the road they would be able to do their work for the maximum number of hours per day. He considered that passenger engines should go out for 16 hours per day with one preparation and goods engines for 24 hours per day with one preparation, and that no oiling or anything else should be necessary on those engines at other times.

The design of coaling-plant should be very carefully considered, because it was relied upon so much, and, in a shed where perhaps 2,000 tons of coal per week was used, if the coaling plant was out of order a considerable amount of money would have to be spent on labour. Moreover, immediately the coaling-plant got out of order the locomotive shed was thrown out of phase, because of the time taken to coal by hand—and hand-coaling of modern tenders was not an easy matter. Therefore duplicate plant should be installed. Usually two classes of coal were used at the shed, and while both plants were working one could deal with one class of coal and the other with the other class.

The L.M.S. Railway had under consideration another type of plant, namely, the underground silo, which enabled train loads of wagons to be pushed over. Those were hopper-bottom wagons, which were vacuum fitted and were worked straight from the collieries in block trains on to the coal sidings, unloaded, and sent back again. That saved the provision of accommodation in the shed yard for wagons to stand about, either loaded or empty, and the number of wagons required for locomotive coal was much smaller than in the ordinary way on loose-coupled slow-moving trains.

He had not had much experience of the wet ashpit, but he did not like it, for two reasons; firstly, owing to the use of the cage, which was a doubtful quantity, and secondly, because grabbing the ashes out of the water involved the blocking of one road. Some people considered that blocking of the road did not matter, because the crane could be used when there were no engines coming to the pit, but he regarded it as an unsatisfactory procedure. In Figs. 10, Plate 1, a wet-belt conveyor was shown in which the cage was used. The L.M.S. Company had designed a plant in which the pit bottoms were rails transversely spaced, and the parts in between were rails running longitudinally. The ashes dropped down into water and were then conveyed away. Cleanliness was essential in a running shed if the drivers and firemen were to obtain the best from the locomotive with regard to time-keeping, but in that connexion he would draw attention to *Fig. 11*, which showed three belts alongside each other —which was not very deep in comparison with the scraper type; but, whereas in the L.M.S. design it was possible to get down into the pit with the belt in and grease all the rollers, or, if anything was wrong with the belt, it could be vulcanized in situ, that would not be possible with the type shown in *Fig. 11*, because there was not sufficient room in the housing of the belt.

He considered that the lighting in the shed should be as good by night as by day to enable movements to be made equally well at all times. The inspection pits should also have good lighting, of either the bulkhead or the tubular type, together with top lighting.

He preferred round sheds to straight sheds: they might be more costly to build, but they enabled engines to be got out whenever they were wanted with the minimum of shunting and provided good access to the engines. Straight sheds should be wide and short, with not more than four engines in any road. If a distance of 1,000 or 1,200 yards had to be traversed, the cost of the man-hours involved would have to be taken into consideration. All doors in a running shed should be approach controlled, in order to make the shed a comfortable place.

Owing to the possible use of Diesel engines, all layouts should have a site for a Diesel engine shed which could be well heated and kept free from dust.

**Mr. Conrad Gribble** considered that undue modesty was shown by the Author's statement, on p. 31, *ante*, that "The engineering work, on the whole, is of a simple character." As explained in his Paper, the engineering work in a locomotive shed included coal-hoists, ash-disposal plant, water-softening plant, and very often filtration plant for the recovery of water, and appliances for lifting engines in the repair shed. Therefore the engineering work, especially when a shed had to be built on very bad foundations, was not so simple, but often constituted a very considerable problem.

Mr. Gribble agreed that the civil engineer should be consulted at the very beginning and should help in deciding where the shed should be situated and in planning the layout. Land was often restricted in the neighbourhood of a station or goods shed, where engines had to join or leave the trains, and the question arose whether it would be better to go a few miles down the line, where land could be obtained, and build a really fine depot there, or whether the light running and the possibility of having to lay additional lines for engines travelling to and from the depot would make that course prohibitive. That would involve very careful calculations. Doubtless the operating department preferred the shed to be as near as possible to the place where the engines had to join the trains, and in many cases that involved limitations in the size and convenience of available sites.

During recent years the Southern Railway had not erected any round sheds or sheds where the access to the shed was controlled by a turntable, although other companies, he believed, had done so. The danger inherent in that system was considerable, as the whole shed might be put out of commission through trouble with the table. At one very large shed in the London area, access was controlled by a table, and they had been very fortunate there, even during the war; but running sheds where the whole operation was so controlled were not without distinct disadvantages.

More than one large through shed was really used as a double terminal shed. The engines approached at both ends but they did not run through to any extent. Nevertheless such sheds were in the main to be preferred to terminal sheds.

Ash-disposal was undoubtedly the most difficult problem in laying out a modern depot, but few depots were of sufficient size to justify the very expensive deep-water wet ashpit, especially on a bad foundation, because the cost of piling for making the foundations for a structure of that size, even if room was available, would be very high.

He had heard complaints from the locomotive department about the coal breakage that occurred in the big plants. Reliability was also important. Coaling-plants had been out of use on occasions for three weeks, causing considerable expense and trouble to the operating department. A type of coaling-plant which would have been installed at one of the medium-sized depots of the Southern Railway but for the war, seemed to have much in its favour. Vertical hoists lifted tubs, hand-filled, and tipped them into the tenders. They did not require skilled operators and were therefore economical in operation.

The ordinary coal stage could be improved by the addition of a conveyor on the stage. The tenders of modern engines were so high that the stages were hardly high enough to do their work, and the addition of a coal conveyor to these had been of considerable advantage to the locomotive department.

The reclamation of water from washing-out pits was a problem in some depots where water was valuable and it was worth while to install elaborate plants for filtration and recovery of water, enabling it to be used again.

For fixing permanent way to pit walls very successful results had been obtained by laying ordinary chaired track with holding-down bolts, suspending the rails and chairs at the proper level and concreting up to the chairs. That was a simple and easy method of laying the permanent way.

**Mr. T. E. Chrimes** observed that few would disagree with the Author's concise and lucid summary of requirements, and those who had to operate locomotive depots at present might possibly envy the happier lot of those who would fill their places in days to come.

As the Author had pointed out, each individual depot constituted in fact a study in itself, and the first decision which had to be taken was that of the site, necessitating a balance between access from a traffic point of view, with possibly insufficient space for all that was required, and further distance with the increased light running involved thereby.

With regard to design, he considered that a study of the movement of personnel about the shed was worthy of some thought. The approach, for instance, to time offices and booking-on places should be situated so as to obviate the necessity for numbers of the staff to cross any running lines. That point was liable sometimes to be overlooked. Secondly, not all engine men took charge of engines in sheds, and, if at all possible, booking-on points should be situated so that men could get away to their relief points at stations, or wherever relief was generally effected, with the minimum of walking time. Administrative offices should not be placed in the centre of a depot if that could be avoided but, nevertheless, it was necessary that the running or shift foreman should have a place from which he could keep all movements in the yard under close observation, communicating as might be necessary with the administrative offices by internal telephone.

Road transport was being increasingly employed by outside firms delivering petroleum or goods for canteens, and convenient road access was a considerable advantage. Contractors also came in lorries and purchased, loaded up, and took away ashes. It was also possible that ambulances might sometimes have to approach the depot.

Lighting should receive consideration at an early stage of the design. Points, water cranes, and other facilities should be adequately lighted, whilst it was sometimes overlooked that standing engines cast shadows which tended to form obstructions if lamp standards were not strategically placed. Flood-lighting had much to commend it.

The Author had rightly drawn attention to the necessity of having an adequate number of water cranes. Too many engines taking water at too few points tended to bunch operations. Mr. Chrimes wished also to stress the importance of adequate pressure for boiler-washing operations, an essential feature from the point of view of steam power.

He thought there could be no doubt that the coaling-plant shown in the Paper was, from the point of view of speediness of operation, by far the best, but with lighter and more friable types of coal the question of crushing arose. That seemed very difficult to overcome with certain types of coal, and it might be better to sacrifice some of the bunker space. It was more or less accepted as a general principle that one day's supply was the minimum for a coal bunker, but was there anything inherently impossible in having a bunker of half the size and charging it up twice a day, say in the morning and in the evening ?

In the case of a depot which was not of the largest size, a good deal might be said for the old type of elevated stage, suitably designed and correctly proportioned, assisted by the form of conveyor mentioned by Mr. Gribble.

With certain types of coal, spraying wagons before charging into plants did not always do all that was required in the way of laying dust, and Mr. Chrimes suggested that some form of spraying might with advantage be combined with the chute.

In Figs. 15, Plate 2, where the coal stack was shown, no road was indicated through what might be the stacking ground itself, but such a road was very valuable when coal was being put down or lifted up.

With regard to ash-disposal, he considered that on the ground of expense and for other reasons, some objection existed to nearly all the existing types of plant. The wet ashpit appeared to have many points in its favour, but, if full advantage was to be taken of that method, would it not be necessary for the majority of the locomotive stock to be fitted with drop grates and drop ashpans ? The subject of ash-disposal offered wide scope for further research, if only for the sake of the smaller depot, on which such plants would be found very difficult to justify. A supplementary sand furnace near the disposal point would be useful in avoiding the necessity of fetching sand from the main furnace situated in the shed.

Something in the nature of a lobby or room of some kind for coalmen, near the coaling-plant, would also be necessary.

Shed exit facilities often provided a difficult problem, and the traffic interests concerned should be consulted at a very early stage in the design of a depot, as, in a depot which was heavily worked and where there were a number of engines leaving at approximately the same time, the greatest co-operation between the dispatchers in the locomotive yard and the receivers in the signal-box was essential. The question of telephones between signal-box and yard was also almost certain to arise.

**Mr. Harold Savage** observed that the Great Western Railway Company had built a large number of ashpits during recent years and had started to build them in concrete—one reason being that blue bricks had increased in price to 300 shillings per thousand. The Company had used mass concrete where foundation conditions were satisfactory, and reinforced concrete spanning between piles where piling was necessary. After making inquiries at certain depots where concrete surfacing to ashpits had been in existence for some years, and had stood up to the treatment it received, the Company had adopted concrete for the surfacing to ashpits, but within a very short time it had been found that the effect of hot ashes on concrete paving, probably fanned to a white heat by the prevailing wind and then generally quenched with water, led to spalling of the surface in patches about 2 feet or 3 feet in diameter and 2 inches or 3 inches deep. That had led to the conclusion that a reversion should be made to the use of blue bricks on a concrete foundation for permanent work. It had been suggested that the patches that had spalled might be repaired with a concrete composed of crushed firebrick and *ciment fondu*, but the Company had not yet tried that.

Another trouble which was experienced was that the pit drains were perpetually clogged with ashes. Attempts were being made to deal with that by putting road gratings in the side walls of the pits at intervals, which could be locked, and it was hoped that that would put a stop to the practice, which he understood was prevalent, of removing the grids which were loose in the gratings in the bottom of the ordinary pits and shovelling the ashes down the drain. The pits drained to the side, which should have the further advantage that any stationary water would stand at the side and not in the middle, where the men were working.

The Author had expressed a preference for the flat-bottom rail, carried on a flat plate and held down by clips, for the inspection and preparation pits. The Great Western Railway Company had reverted some time ago to the standard bull-head rail and chairs, because that enabled serviceable rails to be used and was therefore much less expensive, whilst it also simplified renewals, because serviceable bull-head rail was available anywhere and at any time on the system.

Mr. Savage appreciated the reason why the Author had made no reference to the costs of the various types of coal- and ash-handling plant mentioned in the Paper, but perhaps he would give his views on the size of depot which would warrant the installation of those various types of plant, indicating the size of depot in terms of the number of engines serviced in 24 hours ?

If the ashpit shown in *Figs.* 9 were taken to be 180 feet long, might it not be a better proposition to have a series of three rectangular or square pits at intervals of 60 feet to 70 feet ? That might reduce the cost, and it might also solve the problem raised by ashes accumulating at one end of the long pit.

**Mr. A. W. J. Dymond** observed that a running shed was a complicated machine which took a certain raw material, passed it through certain processes and produced a finished product, the raw material being the stale locomotive from the road and the finished product being the same locomotive in a roadworthy condition.

In the case of any such series of processes in a machine-shop, three elementary factors were required simultaneously. Firstly, the processes should be continuous and no one process should hold up continuity of operation throughout the whole series; secondly, so far as the conditions allowed the processes should be simple; and, thirdly, they should be effected with the maximum of economy. On the Great Western Railway those principles had been fully recognized as early as 1906, when a depot was opened which clearly demonstrated their acceptance; but, as was frequently the case with pioneers, the conditions obtaining at that time had had some of their bases shaken by subsequent developments—particularly developments contingent upon changed labour conditions. The two items which had been stressed by earlier speakers as of maximum importance were coaling and ash-handling.

He had no doubt that, owing to their speedy operation, relative freedom from mechanical troubles, and absence of dependence upon labour which was sometimes inadequate or of poor quality, mechanical plants would be installed in increasing numbers.

Apart from a very simple device for the mechanical handling of coal at one small depot, the Great Western Railway had no mechanical coaling-plant. In his opinion, there were three essential conditions with which mechanical coaling-plant should comply. Firstly, it should be simple and robust, giving a reliability of service equivalent to that of the machine which the coal appliance served, namely, the locomotive. Secondly, the handling which the coal underwent should be such as to reduce breakage to the minimum, although he did not consider that the question of breakage was all-important, in view of treatment that the coal received as soon as it arrived on the floor of the tender, when the fireman attacked it with a coal pick. Thirdly, the plant should offer a definite financial advantage in comparison with the manual stage. In that connexion the capacity of the overhead bunker was important.

Ash-disposal was a very serious problem. He knew of one depot which had a make of 400 tons per week. The Great Western Railway had never had any mechanical ash-handling plants. Ash should be disposed of into the wagon as soon as it appeared from the locomotive. That ruled out dumping of the ash into pits and subsequent grabbing, which would immobilize one servicing road for the period of the grabbing. Moreover, any mechanical plant for the disposal of ash should be simple and robust. The renewal of the plant could cause trouble, and the replacement or repair of a broken belt would be a very difficult matter. He did not like the Sargeant-Sauerman scraper, because a parted cable would present some difficulty. He suggested that in the case of the ashpit shown in Figs. 10, Plate 1, where there was a simple belt at the bottom of the pit, some-along thing the lines of a drag-link conveyor should be provided. The fact that no unanimity existed on the subject of ash-handling showed that it required research by engineers.

A number of sheds built on the Great Western Railway within about the last 30 years were laid out on the principles set out in the Paper, in that the engines passed the ashpit and coal stage, which was single or double sided as required, and went thence to the turntable, afterwards being berthed in the shed. A separate road from shed to outlet for outgoing engines was a standard lay-out. The sheds were either turntable sheds in single, twin, or four units, or straight-road sheds. About 50 per cent. of the sheds of the Great Western Railway had been so constructed and laid out.

**Mr. H. C. Orchard** observed that the Paper covered a very wide field and necessarily excluded consideration of the details of the various structures. In his opinion, however, it went a long way towards bridging the gap between the technical knowledge of the engineer and the requirements of the traffic officer, and for that reason it formed an important contribution to railway service. Having regard to some of the difficulties which arose in locomotive depots, he considered that the problem of subsequent maintenance might well have been stressed in the Paper. He had in mind, among other things, the damage done to coaling-plant columns by falling coal, the effect of engine fumes on concrete, particularly on the under side of the feeder floor, the removal of oil pollution from drainage, damage to concrete in floors and walls of ashpits by grab jaws, and all the troubles associated with engine-pit copings and rail fastenings.

Had the method of drainage shown in *Figs. 5* and *9* been considered for introduction at the water columns ?

With regard to water-supplies, on the southern portion of the London and North Eastern Railway it would invariably be necessary to introduce water-softening facilities.

A temporary light tunnel had been erected at Peterborough for the examination of engines under black-out conditions. The tunnel was sited at the entrance of the depot, being the first service of the sequence, as it was considered advantageous to search for faults while the locomotive was still hot. Special features were fluorescent lighting, high-quality concrete reflectors painted with Snow Cem, and the lighting cut-out arrangement when the doors were open.

In a design of engine pit which had been adopted and constructed at Whitemoor, with very satisfactory results, small concrete pockets below each chair were held down by dowel-bars, and no movement had taken place. Blue-brick facing was used, and samples of the blue bricks selected withstood heating to a cherry red colour and thereafter plunging into cold water. The bricks which exploded on test were rejected.

**Mr. J. A. Hood** agreed that design was primarily the work of the civil engineer, who should, to the requirements of the operating department and to the dimensions and particulars of the plant supplied by the mechanical department, devise the best lay-out possible in the circumstances.

Many of the older depots were very cramped. In fact it had been said that, in the old days, when a railway company had a piece of land which was too short for a siding and too narrow for a goods shed it was considered good enough for a locomotive depot or engine shed. Under the conditions in which railways operated then, those locomotive depots functioned, and they continued to function even when locomotives were increased in size. During the past 30 years, however, the increase in labour costs had caused consideration to be given to the question of mechanization as a means of labour saving, and it had resulted not only in an immediate saving of wages but also in a saving of locomotives, which became apparent only when the replacement of locomotives was considered.

In many cases which had been dealt with on the London, Midland and Scottish Railway during the past 20 years the problem had been to obtain the maximum efficiency from the existing site conditions. An increase of space was seldom possible, apart from any question of parliamentary powers. Most depots in built-up areas presented considerable difficulties in regard to expansion, and that applied to practically all depots connected with large town stations.

In his view the ideal lay-out would be to have the facilities, in whatever order was considered most desirable, in one straight line, so that the engine would pass from one facility to another without having to reverse. In practice the operations divided themselves into two, namely, those connected with arrivals and those connected with departures, separated by a break when the engine was stabled in the shed between one turn of duty and another. The straight line would present a yard which would be unduly lengthy and would militate against efficient supervision, so that a reasonable amount of compactness should be aimed at. In both of the lay-outs shown in the Paper, the engines, after passing through coaling and other stages, reversed to reach the engine shed, and he considered that such compromises were always helpful in obtaining a more compact lay-out. In the design of a lay-out careful consideration should be given to all points which tended to increase the length. It was often desired, for instance, that the facilities should be by-passed, and the question whether such by-passes were really necessary should be carefully studied. By-passing of a coal-tippler was not always necessary, for if the table were made sufficiently strong an engine with a loaded train could run over it. Again, it was suggested that every coaling road should lead to every ashpit road, but to achieve that a scissors crossing was necessary, and that occupied about

80 yards. Whilst he agreed that it was desirable that ample acceptance room should be provided before the coaling-plant, and between coaling-plant and ash-disposal plant, it was not sufficient merely to know what was the peak number of engines arriving at the shed; it was also necessary to know for how long that peak would operate and how frequently it would occur during the day, because it might not be necessary to provide in the layout sufficient standing room ahead of the plant to accommodate all the engines at the peak period; in other words, it was extravagant to provide for a capacity which would be taxed for only half an hour per day, whereas some engines could be side-tracked during that period.

With regard to the question of coal wagons on inclined roads, apart from the matter of space, if the incline was so steep that a wagon would run down to the coaling plant an accidental release of the brake might allow it to run away and cause trouble. The following system had become standard on the London, Midland and Scottish railway. When a loaded wagon was drawn from the siding it bumped the wagon already standing under the water-spray. Adjoining the water-spray was a drainage-area, and adjoining the latter a tippler. While one wagon was being tippled the recently arrived wagon was being sprayed, and the wagon already sprayed was standing on the drainage-area allowing surplus water to be run off. On the arrival of the tippler at ground-level after coal had been discharged into the bunker, the cycle was complete.

He considered that the overhead ash-bunker was the type of plant most economical in space; moreover it did not require the provision of an ash-wagon road, it was compact, and it did not need extensive underground chambers.

He was impressed with the idea of scrapers operating in shallow pits. The only drawback he could see was the space required between the pit and the road in which the ash-wagon stood. If that space could be reduced appreciably, the plant should offer the most satisfactory solution to the problem of ash-disposal.

Much had been done to modernize locomotive depots, but he was sure that in the post-war years, with the development of mechanical science, greater strides would be made in labour-saving plant and many of the present ideas might be scrapped. Great possibilities lay ahead, but he felt that the present was an opportune time to stand for a moment and take stock of the position and achievements, and the Paper was a very valuable contribution in that respect.

**Mr. L. P. Parker** observed that as the object of a locomotive depot was to service engines in the shortest possible time, so that they could be kept for the maximum time in traffic, consideration of the layout of the shed really started outside it. The period of time that it was desired to shorten was not that between the arrival of the engine at the shed inlet and its departure at the outlet, but the period from the moment when it arrived in the marshalling yard train until it worked its next train out.

That meant that the first point to be considered was whether the shed was properly accessible to the marshalling yard or to the main passenger station, or both. A great deal of trouble might be taken to save 5 minutes on the ashpit, but that was not of much use if half an hour was wasted in coming from the yard, so that a good deal could be said for separate engine roads as well as for proper layout of reception sidings. If engines were to come in from the yard in batches, there should be plenty of room behind the inlet point. They would be more likely to arrive in batches in the case of a freight depot. At a passenger depot, with engines coming in singly, it might be possible to have the first servicing operation much nearer to the inlet point.

A great deal of discussion had arisen about the ideal layout for a locomotive depot, but, even if general agreement were reached on the ideal layout, he supposed it would never be possible to put it into operation, because everything depended on the site and on the connexions to the running roads. It was possible, however, to lay down certain principles, which could be modified by the conditions existing on the site, and then try to fit them into the space available. Apart from the question of space, there was the question of traffic conditions. For example, the shed might be a terminal shed, which meant that every engine had to be turned before it went out again. Then the turntable could be put close to the inlet, and, incidentally, the turning might possibly be often done for nothing, because it would be done by the engineman on the incoming engine, whose time might not be up. If the shed were a roadside shed, with engines going out both ways, the turntable should be situated where it would be easily accessible from the outlet as well as from the inlet, because a decision might be made, after the engine was in the shed, that it was to be worked in the opposite direction. The type of traffic worked had also to be taken into consideration. In the case of a depot dealing with a heavy excursion traffic, although there might not be many engines stationed there, it was necessary to provide ample accommodation at the outlet, so that engines could be turned out at short intervals for service in the evening, when everyone wanted to go home at the same time.

The space available for mechanical attention could not be assumed as so much for a shed of so many engines. The shed might be a central depot to which engines would be brought from smaller depots for repair, or a satellite to a still larger depot, in which case it might be decided to send the engines to the parent depot for repair, so that it would not be necessary to provide so many facilities at the satellite depot.

Although, generally speaking, the ultimate aim was to place engines back into traffic as soon as possible, that was not always so. In the case of a passenger-shed, engines might enter in the evening and not have to leave again until the next morning, and it might then be better to install rather fewer facilities and deal with the engines one at a time as they came in, so long as they were ready to take their trains out in the morning.

Very often it was better not to put the turn-round engines into the shed at all. If they were dealt with at the marshalling yard and turned back again there with the minimum of facilities, with no question of inspection and repairs having to be done, the ideal was approached of having the engines on the road for 24 hours per day.

In laying out a shed it should be borne in mind that it had to be supervised and that the grouping of facilities, so far as that could be done with efficiency, helped in that respect. Fewer foremen would then be needed, or, with the same number of foremen, more efficient attention would be ensured.

It was important to have enough room. It was very convenient to be able to get a caterpillar skimmer up to the ashpits and the coal stacks. Experience during the war years had shown that the skimmer was the best machine for lifting coal. At present there was no really first-class mechanical method of turning the contents of a wagon of coal on to the stack, and that was a very expensive operation. Nor was there any really efficient machine for getting the ashes out of a pit that was not a wet ashpit and putting them into wagons.

**Mr. R. L. McIlmoyle** agreed that the lighting of inspection pits was very important, but he doubted whether the Author's idea of glazed brick with bulkhead lights would be suitable for a pit where men were working with tools and were apt to drop odd pieces of engines against the walls, and where so much oil and dirt were present that it was difficult to keep the place clean.

A pre-cast concrete pit designed for the London, Midland and Scottish Railway was in 4-foot lengths. A fluorescent tube fitting in a recess on one side threw the light underneath the engine. The adjacent unit had the light on the other side, so that a continuous strip of light showed right up into the engine. The sides of the pit could be painted with Snow Cem, or any other material. Bullhead rails and chairs were used. In his opinion that was a much more efficient unit than one in which glazed brick was used. It was likely to withstand more abuse, and it could be used as a hot ashpit if it were lined with a fire-resistant material, such as blue brick.

**The Author,** in reply, observed that the discussion had revealed a large measure of agreement with the Paper and that criticism had been on minor points, on some of which he hoped that further research and experiment would result from the Meeting.

Mr. Inglis had raised the question of the time required to complete the various servicing operations. The Author had considered that question, but had decided not to deal with it in the Paper, partly because his friends in the Locomotive Department might think he was setting a burdensome standard and also because he believed that some railway staff conditions laid down recognized times for those operations and he had no desire to come into conflict with his staff colleagues ! The time required, however, was just a summation of the time required for the individual operations plus the time required to pass to and from those operations. Two of the operations, inspection and ashing, were likely to vary considerably in time, but assuming 30 minutes for inspection and 50 minutes for ashing, he estimated that an engine should pass through the various operations in either of the layouts proposed in about 1 hour 50 minutes. The American Railway Engineers' Association estimated the average time as 1 hour 54 minutes, made up as follows :—

| | Minutes. |
|---|---|
| From terminal entrance to first facility | 5 |
| Outside inspection | 30 |
| Cleaning fires | 45 |
| Taking coal, sand, and water | 15 |
| Outside washing | 15 |
| Turning and into shed | 4 |
| | 1 hr. 54 mins. |

The cost of the shed illustrated in Figs. 15, Plate 2, would probably be about £70,000, whilst the shed shown in Fig. 16, Plate 2, might cost about £40,000.

Colonel Rudgard had spoken about goods engines going out for 24 hours per day with one preparation, which seemed to imply continuous service, but presumably 24 hours between preparation times was what he had in mind. He had also suggested that coaling-plants should be provided in duplicate to meet failures, but that seemed an expensive insurance and difficult to justify, especially as it would involve, to be logical, duplicating all plant instead of adopting other methods during the repair period, which was quite practicable in many cases, such as coaling. Colonel Rudgard had referred to underground coal silos instead of overhead bunkers. The problem was to transfer coal from the coal-wagon to the engine tender, and whatever the course of the journey, the coal had to arrive in a position above the tender and be fed into it. Storage underground was probably not much, if at all, cheaper than overhead, and elevating the coal was necessary in both cases. Clear advantages were realized in having a coal-supply stored in a position from which it could be fed to the engine by gravity and without the risk of mechanical failure involving an immediate stoppage, which would be the case with underground storage.

For wet ashpits, Colonel Rudgard disliked the travelling cage and the fact that grabbing the ashes from the pit involved blocking one road. In practice neither of those factors had been troublesome, although much of the justification for the alternative methods outlined in the Paper lay in the avoidance of such interference with the use of the pit during grabbing operations. The Author agreed that straight sheds should be wide and short in order to give reasonable selectivity, and he considered that a length equal to four engines was suitable. The general comfort of the shed would be improved by keeping the doors normally closed, but to make that practicable, power-operated doors would be essential, and those involved heavy expenditure.

Mr. Gribble had agreed that the Engineer should come in at the very beginning in the design of locomotive depots, and it should be realized that that made it obligatory on the Engineer to apply himself much more than in the past to the consideration of the depot as a single plant for carrying out a set of operations in series, rather than as a number of merely contiguous servicing facilities linked in a " higgledy-piggledy " fashion. Analysis of the operations and requirements, and then synthesis of the parts, were the obvious bases for design of the layout. Mr. Gribble seemed to think that wet ashpits were something of a luxury, justified at only a few depots, but the Author was of opinion that at not less than 100 depots throughout the country the use of wet ashpits, or some of the alternatives mentioned in the Paper, would be justifiable.

The question of friable coal raised by Mr. Chrimes had been the subject of much discussion with a view to devising some storage arrangement to prevent breakage, although it could be contended that calorific value did not vary with size. The coaling-plant shown in *Fig. 4,* was designed specially to reduce breakage, and had been found very satisfactory. To reduce the size of the bunker, as suggested by Mr. Chrimes, would reduce the crushing pressure on the coal, but would decrease the value of the plant as a storage facility. Mr. Chrimes seemed to be under the impression that to obtain full advantage from the use of wet ashpits, the majority of engines would have to be fitted with drop grates ; but that was not so and all engines without exception used them with advantage—but ashes could be discharged more easily from a drop-grate engine.

Mr. Savage and Mr. McIlmoyle had touched on the subject of concrete versus brickwork for ashpits. That had long been a matter of discussion and experiment, but the Author's experience pointed to fire brick or blue brick as the most satisfactory solution. The temptation, to which locomotive men were known to have succumbed, to shovel ashes into the pit drains by removing the loose gratings, was really an indication that the ordinary pit was not the best solution of the ashing problem. Mr. Chrimes's inquiry about the size of depot which would warrant the installation of the various types of plant discussed in the Paper set a problem in economics which involved the usual considerations raised when justifying plant or facilities. For any number of engines, either the old simple type of equipment or the modern or mechanical form would do the work, and the type to be adopted would depend upon a comparison of the annual costs involved. The old type would probably be cheaper in first cost, but much more costly in labour, whereas the modern form would, no doubt, be expensive by comparison in first cost, but cheaper to run. For any particular case, alternative schemes should be worked out to give the required output, and a comparison made of the annual charges due to the capital outlay, plus the annual running costs, to determine the most economical arrangement.

Mr. Savage's suggestion of a series of pits instead of one long pit would increase the cost and make no difference to the problem of the greater accumulation of ashes at the departure end. Engines would still move forward to the last ashing position to make way for later arrivals.

Mr. Dymond had expressed the view that ash should go direct from the locomotive to the wagon and thus save dumping into the pits and subsequent grabbing. That would mean using the wagon as a container for hot ashes, and even steel wagons would not stand that treatment very long.

In reply to Mr. Orchard, the method of drainage shown in *Figs. 5* and *9* had been first used in connexion with water-columns and, being found successful, was applied to wet ashpits where the problem was much the same.

The method of operating coal-wagons through the water-spray to the coaling-plant, as described by Mr. Hood, was the method intended in the layouts given in the Paper, and was found quite satisfactory. The space between the ashpit and the wagon road in the ash scraper proposal depended on the layout of the tracks adjoining the pit and could be made short if so desired.

Mr. Parker had very rightly stressed the importance of considering the time required for the whole servicing operation, and not just the time for some part of it. That was at the bottom of the whole question of both layout of depot and details of plant, and should be kept constantly in view.

The discussion had covered a wide range and the Author hoped that the attention given to the subject would lead to increased efficiency in future designs, especially as many of the very old depots would probably become due for renewal in the near future.

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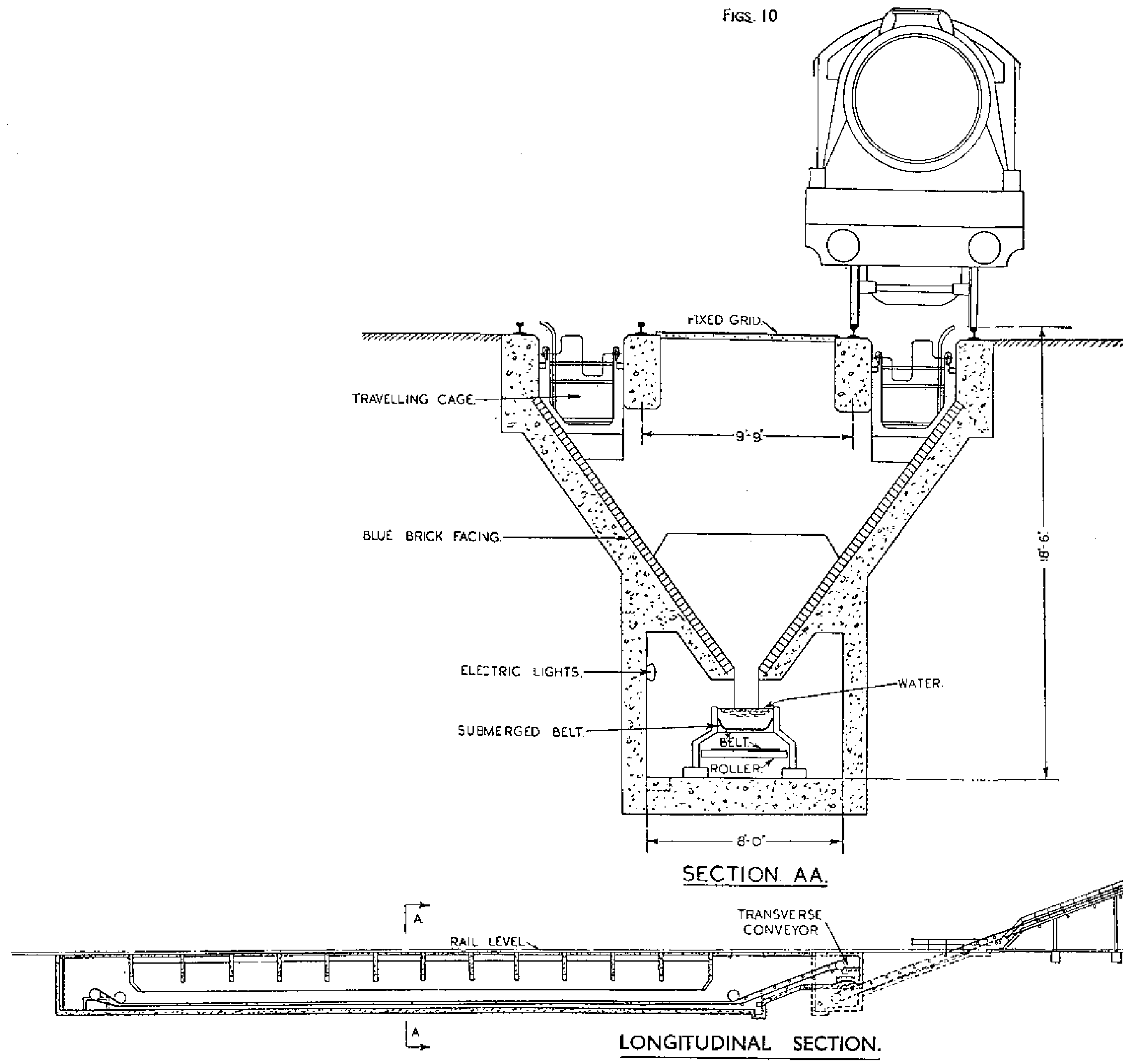
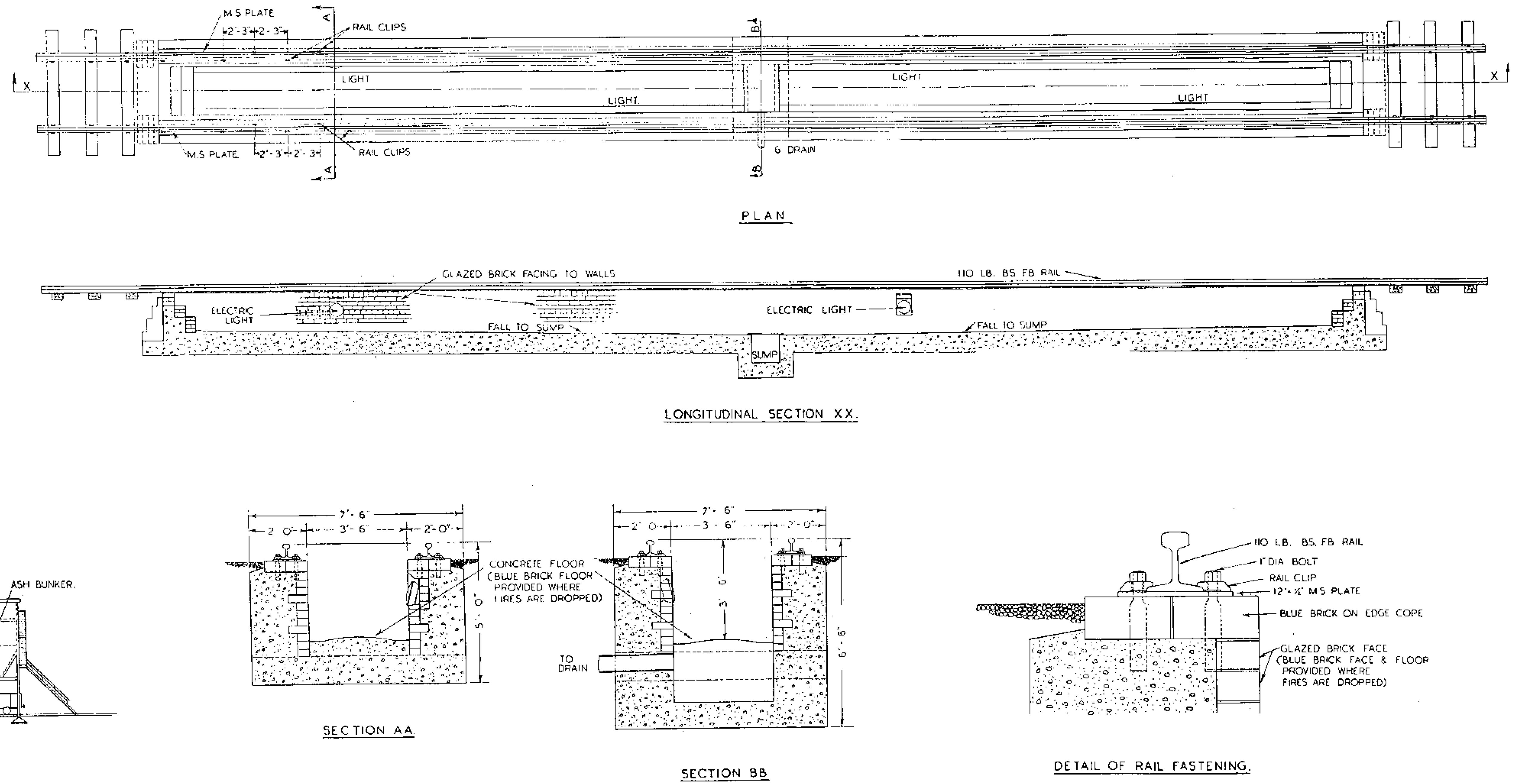
Figs. 10




WET ASHPIT USING ONE WET BELT CONVEYOR.

Figs. 13.

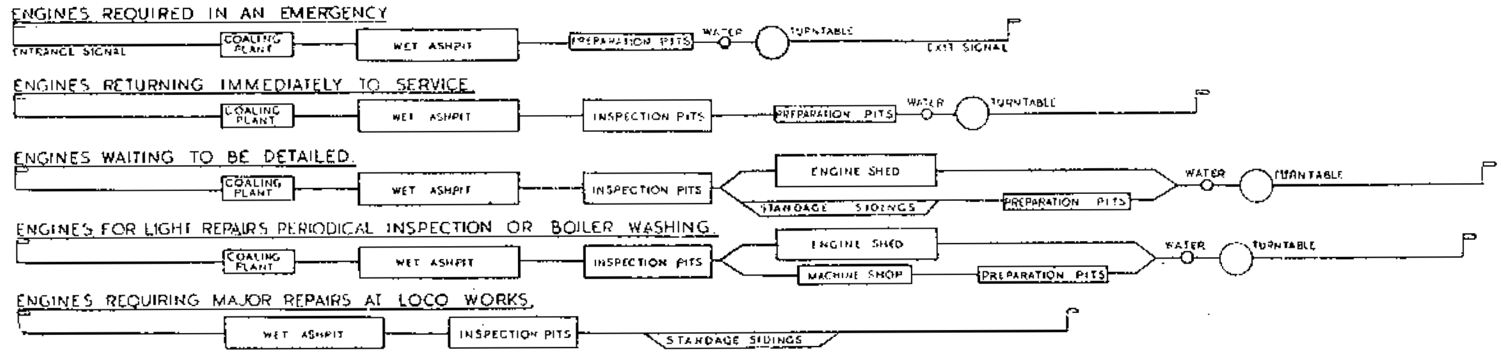



INSPECTION OR PREPARATION PIT.

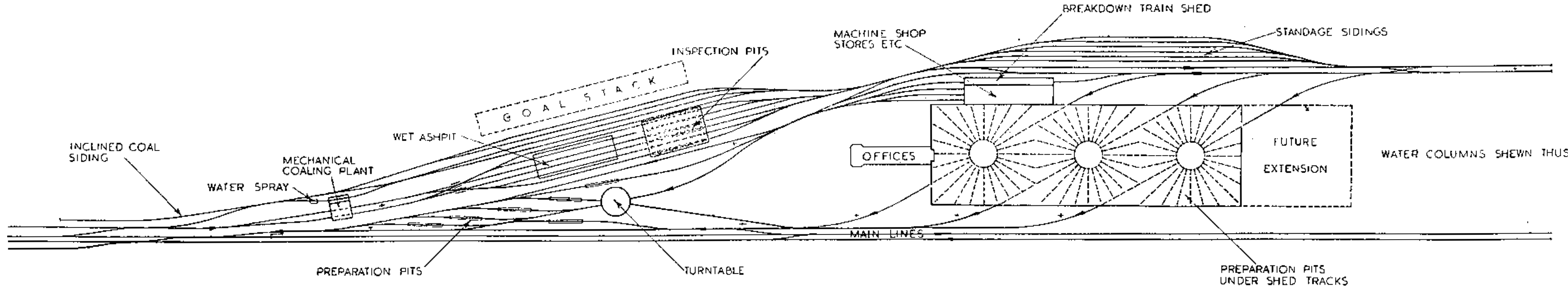
J. TAYLOR THOMPSON.

# THE LAYOUT OF LOCOMOTIVE DEPOT FACILITIES.

FIGS. 15.

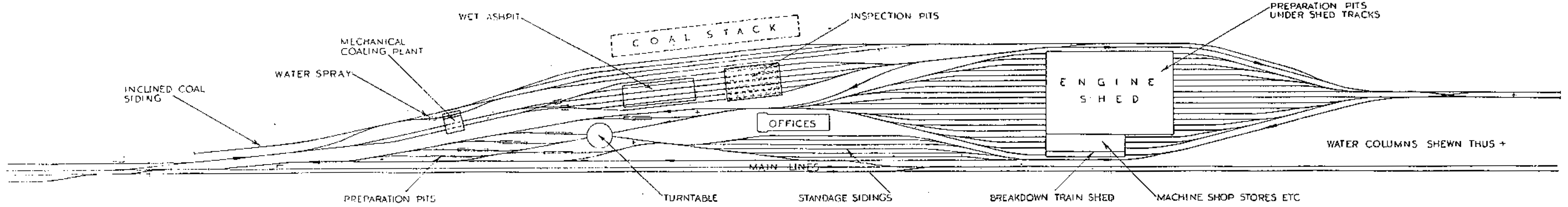



NORMAL SERIES OF SERVICING OPERATIONS.




GENERAL LAYOUT WITH ROUND HOUSE TYPE OF SHED.

FIGS. 16.




GENERAL LAYOUT WITH STRAIGHT ROAD TYPE OF SHED.



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