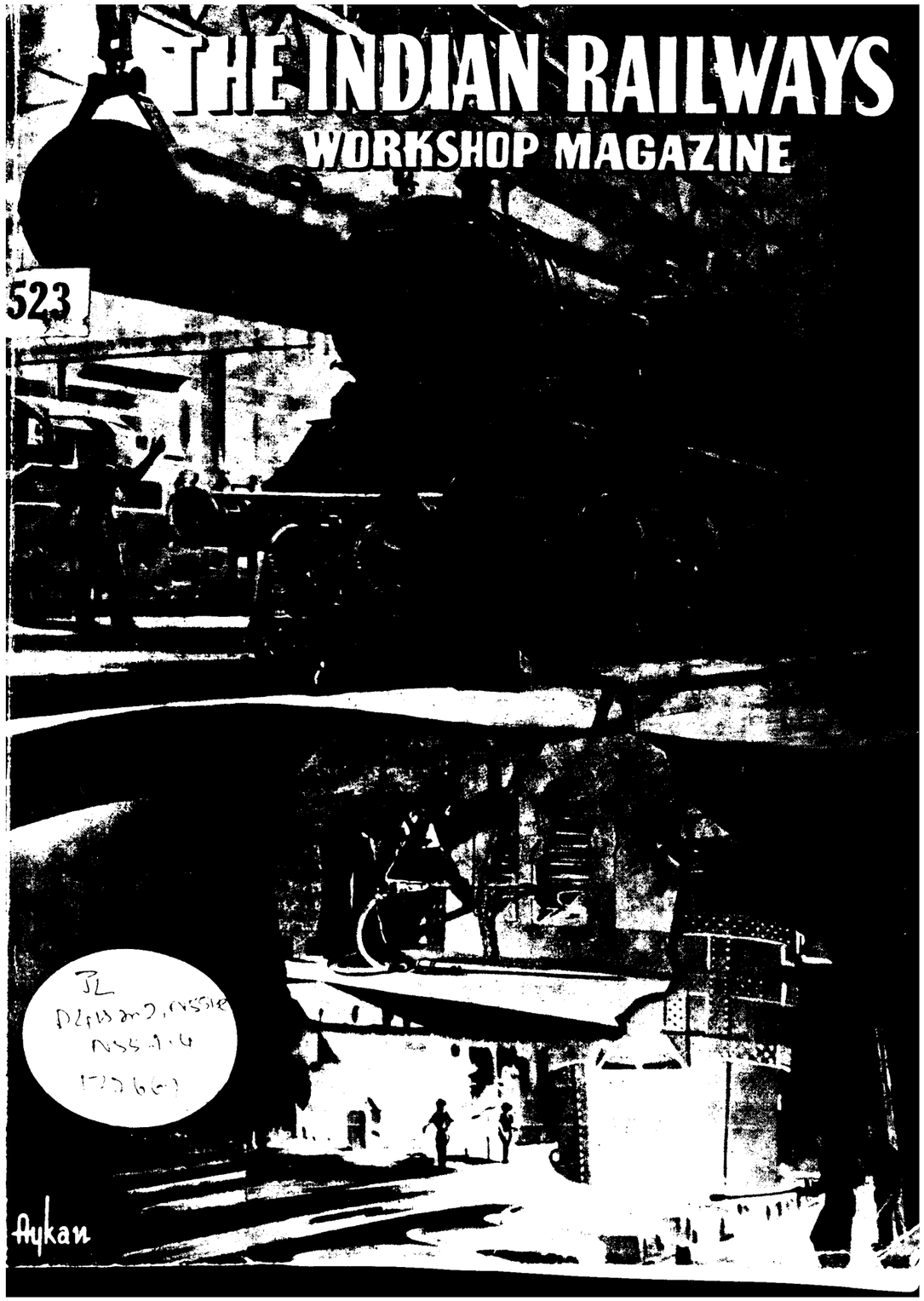
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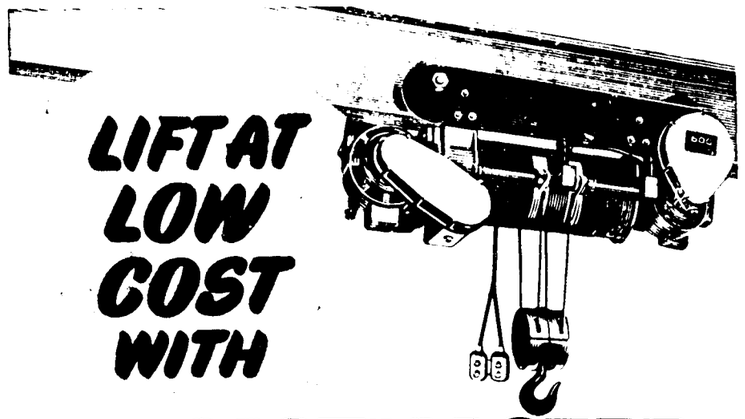

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Editorial Notice

The Editor invites contributions from the Engineers and Works Managers of Railway Workshops as well as company-managed Engineering Workshops in the form of original articles, research write-up, production techniques etc. relating to Workshop practices in India and abroad. Besides, suggestions for the technical improvement of various aspects of Railway Workshop practice are also invited with suitable write-ups accompanied by photographs wherever possible.

Contributions are accepted on the distinct understanding that they are sent solely to "THE INDIAN RAILWAYS WORKSHOP MAGAZINE". The Editor accepts no responsibility for the views and statements of the contributors.

All contributions intended for publication in any particular issue should reach the Editor at least 30 days prior to the scheduled date of publication. This Journal is issued quarterly i.e. February, May, August, November.

All published contributions are paid for at our usual rates.

Editor

provided with dustless floors. All the services, such as, compressed air, electricity and water supply are taken underground [illegible] and this [illegible] the general [illegible] the work. The roads [illegible] concreted to prevent dust, and the general [illegible] by [illegible]

[illegible] has been so planned that raw [illegible] will be received and processed through the Factory in a uniflow direction. The Coach Shell will be finished by the time it reaches the other end of the Factory and from this end one Coach will roll out every six working hours.

The type of the Coach that would be manufactured in the Factory is the most modern design of the integral type which has been accepted as a standard in most of the European countries. Being the latest in the field, the coach combines the three major factors contributing towards the comfort and safety of the travelling public, namely, smooth running, light-weight and strength. The integral character of the coach forms a structure of great strength along its axis. The design incorporates all welded trough floor system integral with the body and permits the forces sustained by the body to be borne by the entire body including the skin. It is this future of the coach that gives it the name 'Integral' and serves to reduce the weight of the coach to 35 tons as compared with 42 tons which is the weight of the conventional coach. This coach is mounted on roller bearings instead of the conventional lined bearings and this feature enables trouble free maintenance in service. Another advantage of this type of coach is that it incorporates anti-telescopic devices in construction. The carriage is also designed for improved riding qualities by the provision of shock absorbers and coiled spring axle box suspension.

The latest types of machinery capable of [illegible] 600 in numb[illegible]ing installed, 643 of these [illegible]dered abroad after inviting global [illegible] and 59 have been obtained from in[illegible] big gunmetal [illegible] rolling and straightening machines, one hydraulic press of 1,000 ton capacity and double acting swage hammers. Most modern welding machines including spot welding, flash welding, submerged arc and foil welding machines are also under order.

The Factory has been equipped with modern handling facilities which include fork lift trucks and Lister trucks. Sheet metal will be conveyed to the various machines on ball transfers suitably located in the shops. 4 twenty-ton cranes and 20 five-ton cranes and 3 gantry cranes are provided in the various shops and the Assembly Shops are provided with 2 seventy-five ton traversers.

Jigs and fixtures are used to the greatest possible extent to ensure inter-changeability of the various components and to facilitate correct assembly.

The total workshops of the Integral Coach Factory is ten. They are divisible in three groups, namely, Body Assembly and Finishing Shops, Manufacturing Shops and Storage Sheds. They lay-out of the shops in relation to each other, has been so planned, as to achieve uniflow of work within the factory and to avoid wasteful and unnecessary cross movements.

The rail entry for raw materials for the factory is at the west-end from Villivakkam Station and the general movement of the work is planned from west to east, the finished coach to come out of the other paint shop at the east-end. The third group consisting of stores buildings is situated at the west end of the factory and these buildings receive the raw materials for storing and issue to work. These stores

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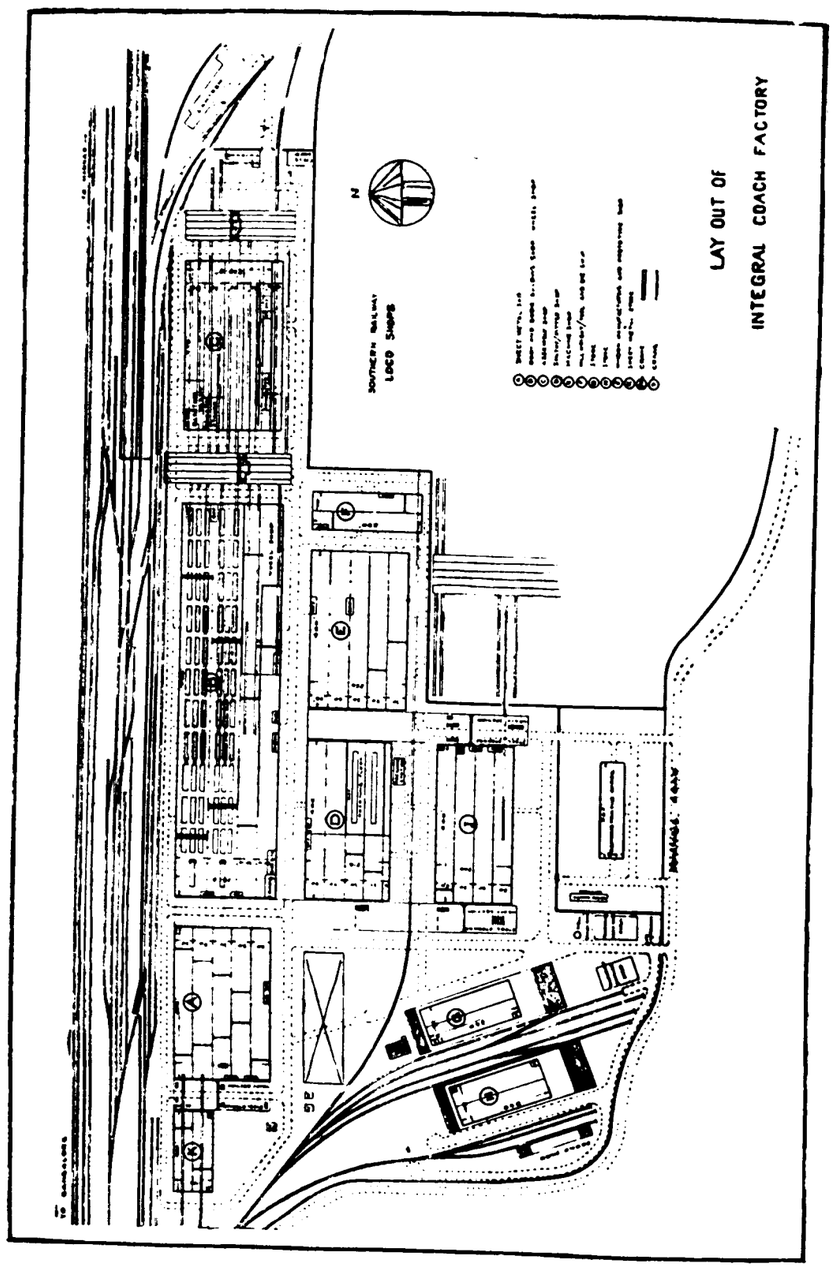


buildings are served by rail and roadways to enable materials being unloaded direct from wagons into the stores and subsequent issue to the shops by Lister trucks, fork-lift trucks and lorries by road. The first group consisting of body assembly and finishing shops are situated in a line, next to each other from west to east, to enable the body assembling and finishing operations being done on a belt system of operations. The second group consisting of manufacturing shops are situated to the south of the assembly and finishing shops, so that the finished parts and sub-assemblies from these manufacturing shops may be led to the Assembly Shop conveniently. Out of groups one and two, the important shop is the Main Assembly Shop and has been sited centrally, with all the rest of the Shops in the group sited around it to facilitate easy flow of work and materials with minimum of transport and handling.

The process of manufacture is as follows: The Mild Steel plates and sheets required for the coaches are received and stored in Shop K (see Lay-out of Integral Coach Factory on page 8) from where they are issued to Shop A where the sheet is processed by being cut and pressed to shape and welded into convenient units for being assembled in Shop B. The other raw materials for the coaches are stored in Shops G and H, from where they are issued to Shops J. D. E and F, where the Sub-Assemblies and finished articles, such as doors, windows and axle boxes are manufactured. These after manufacture, are fed to the Main Assembly Shop (Shop B.). At the Main Assembly Shop, in the two northern 80′ bays, there are six belts or assembly lines where the coach shell is progressively assembled and welded together on heavy jigs and blocks, with the processed materials received from Shops A, D, E, F and J. The assembly lines commence at the west end of the Shops and the completed coach shell comes out at the east end. Simultaneously, in the two southern 50′ bays, the wheels and bogies for the coach are manufactured and come out of the shop at the east end. This coach shell and the bogies required for it are then transferred to the Paint Shop for the finishing operations of grit blasting, painting, asbestos, spraying of the coach interior for heat insulation. When the coach shell has thus been completed, the bogies are slipped under it and the finished coach comes out of this Shop.

The Main Assembly Shop is the biggest shop, being 1,000′ long and 260′ wide, consisting of two bays each of 80′ width and two bays of 50′ width each. The roof of this shop rises to 42′–3″ from floor level to underside of roof trusses. All the other shops have standard bay widths of 50′. The spacing of columns in all shops are 40′ in the inter-shop area and 20′ along the outer walls. This proportion of bay width and column spacing gives a neat inter-shop area and a maximum of unobstructed working space.

Inside each shop, an extensive system of trenches, below the floor level, has been made to take the compressed air mains, and other services such as electricity, raw and filtered water supply, cooling water to machines and telephone cables. These trenches are covered with mild steel chequered plates flush with the floor level. For handling materials inside shops, extensive cranage in the form of electrical overhead cranes have been provided in all the shops except two. All the shops inside the workshop area are connected by a well laid-out system of concrete roads. The entire shop area is well served by a net work of underground storm sewers and sanitary sewers. It is also well served by water supply. To meet the needs of the Factory and the township it is proposed to pump water from a source 11 miles away, near Ennore on the Calcutta main line of the Southern Railway. A large Canteen has been constructed to cater to the needs of the 4,000 workmen to be employed in the Factory. It is equipped on modern lines and will be run as a Cafetaria.

For the essential staff, a self-contained colony of 400 houses has been built and it is provided with a children's Park and a play-ground with suitable lawns and flower beds.

A club building with an auditorium and rooms for indoor games caters to the cultural and social needs of the residents of the township. The Administrative Office for the Factory is a modern building with three floors with provision for adding a fourth floor in the years to come.

A Technical School to train skilled men required for the Factory was opened in March, 1954. After training about 600 men annually during the initial four years, the School will switch over to training apprentices on regular scheme of 3½ years, the number being reduced to approximately 150 a year.

PRODUCTION PLAN

The production work will be inaugurated by the Prime Minister of India, Mr. Jawaharlal Nehru on October 2, 1955. The production schedule is as follows: 20 coaches in the first year, 100 in the second, 200 in the third, 300 in the fourth year and 350 in the fifth year. The first 20 coaches would be from assembled components. Other units in the factory would be busy producing components for a portion of the outturn during the second year. The factory will be giving an outturn of 5 crores of rupees a year of which 3 crores will be spent on labour and general administration and 1½ to 2 crores of rupees on material. It is hoped that the cost of the coach produced in the Factory will be less than that of an imported coach. The main aim of the Integral Coach Factory is to promote indigenous capacity for the manufacture of components required for the Railway coaches.

The nice team spirit amongst the officers and the staff under the leadership of Mr. K. Sadagopan, Chief Administrative Officer accounts for the quick progress of the work at the Integral Coach Factory. The Perambur Coach Factory being one of the biggest factories in the East will not only supply India's requirements in Railway equipment but also those of South East Asia.

The Integral Coach Factory has been visited by some of the distinguished men in India and abroad. Recording his impressions of his visit to the Factory, Marshall Tito writes: "I am very much impressed with this big enterprise which represents one of the premier industries in India's industrialisation". Another visitor Mr. S. N. Ghosh has written: "Matching the magnitude of the project has been its execution. Nothing but the best both in men and material has been harnassed to service. The design and execution of all the civil engineering works of this project, which covers every field of civil engineering such as structural works, auxiliary services, water supply, drainage and roads have been done by Indian engineers. The sponsors take justifiable pride in stressing the fact that in the past when the country was under foreign rule, the designing and the planning of works of this magnitude were entrusted to British firms of consulting engineers. In designing and executing all civil engineering works of the Integral Coach Factory, our engineers have more than proved that, given the opportunity, they are capable of shouldering responsibilities in putting up large production units required for the rapid industrialisation of our country. I met two of them, Messrs. Murthi and Swarup and the pair between them had done a job which can bear comparison with the very best of its type, in any other country.

Going round the factory, where a steel city is taking shape we saw the Swiss made model of the Integral Coach Wagon which will be multiplied here. Streamlined, light

(Continued on page 11)

PERAMBUR COACH FACTORY TAKES SHAPE
Towards Self-sufficiency in Railway Coaches

By Sri K. Sadagopan
Chief Administrative Officer, Integral Coach Factory, Perambur

SINCE the attainment of independence, the Railway Ministry have been following a vigorous policy of attaining self-sufficiency at the earliest possible date in the matter of railway equipment, with a view to cutting out dependence on foreign countries.

So far as locomotives are concerned, the establishment of the Chittaranjan Locomotive Works and the Tata Locomotive Engineering Co. will enable us almost fully to meet requirements of locomotives not only for replacing old and worn-out locomotives, but also for providing the Indian Railways with additional locomotives, so that, with the increasing economic development of the country, in all spheres of production and distribution, the railway transport system may fulfil its role and efficiently discharge its responsibilities.

So far as goods wagons are concerned, Government's policy has been that the development of the requisite production capacity should be planned in the private sector. The present capacity in the private sector for the manufacture of wagons is about 12,000 to 15,000 wagons a year. Government are constantly exploring sources in the private sector to build up a higher wagon building capacity.

As regards the various other items of railway equipment which at present are being imported, Government have constituted a high-power committee to suggest the steps to be taken to achieve self-sufficiency to the maximum extent possible.

So far as passenger coaches are concerned, the position at the time of independence was that, while on the one hand we were left with a badly depleted and deteriorated coaching stock as compared with the position in 1939, on the other we had taken on the responsibility for moving passenger traffic which, during the war and post-war periods, had registered an enormous increase of over the 1939 level of traffic, with the inevitable consequences of poor performance and overcrowding on an unprecedented scale.

With a view to meeting this serious situation and affording the maximum relief possible, Government had to follow a policy of large-scale import of passenger coaches from abroad. It also became absolutely manifest that, taking into account all available sources of indigenous capacity for the manufacture of coaches, a large separate manufacturing unit similar to Chittaranjan Locomotive Works, for meeting our requirements of coaches, was inescapable. Accordingly,

(Continued from page 10)

and at the same time sturdy, spacious and comfortable, these coaches are equipped with up-to-date travel amenities. Luggage space has been cleverly designed.

The township that is growing round the factory is a planned affair, with a staff and workers quarters, beautifully but economically designed.

The little we saw of the men and the material was enough to convince us that along with Chittaranjan where Asia's biggest locomotive workshop has already grown up, the Coach building factory at Perambur is destined to play a vital role in not only equipping the Indian Railways but also in playing a new and old trail in the industrial development and self-sufficiency of the Asian continent.

Sri K. Sadagopan, M. A.
Chief Administrative Officer, Integral Coach Factory, Perambur.

in 1948, a decision was taken by the late Shri N. Gopalaswami Ayengar, the then Minister for Transport and Railways, that a separate factory for the production of broad gauge coaches should be established in the country.

B. G STANDARD COACH OF FUTURE

The next question was the type of passenger coach that should be adopted as the standard. Several types of coaches were examined by the railway technical chiefs and the decision was taken that the light-weight, all metal integral and tubular design would be the best, and should be adopted as the standard. This design, which was offered by a Swiss Coach-building firm, Messrs. Swiss Car & Elevator Manufacturing Corporation, Ltd., Schlieren, Zurich, Switzerland, was accordingly accepted by Government.

ADVANTAGES OF INTEGRAL COACH

The advantages of the type of coach to be built in the factory at Perambur, are :

(i) The design incorporates the principles of integral tubular construction which enables the forces sustained by the coach to be borne by the entire body including the skin. This design, therefore, results in the maximum economy of material for a desired strength and is therefore about seven tons lighter than the conventional design, weighing only 35 tons as against 42 tons of the present all-steel coach of the conventional type.

(ii) The design incorporates anti-telescopic end construction. This design, combined with the fact that the carriage will be of all-steel welded construction, would reduce the possibility of the carriages telescoping in the event of an accident.

(iii) The carriage is designed for improved riding by the provision of shock absorbers and coiled spring axle box suspension. The bogie trucks are of the latest all-welded Swiss design. The axle boxes are fitted with S. K. F. roller bearings, making for smoother movement.

(iv) The coach will be sprayed with Limpet asbestos as an insulation against heat and noice.

LOCATION OF FACTORY

As regards the location of this large manufacturing unit, several alternative sites including Bangalore were considered, and it was eventually decided that this factory should be located at Perambur, Madras. Perambur is already a big railway workshop centre, and sufficient railway land was readily available for going ahead with the construction of the factory. Railway facilities for the transport of material, etc. were available on the spot. With the location of the factory in Madras, there was also no compelling need for establishing immediately a large colony for housing every worker, and consequently it was felt that the finances made available to the Railway Ministry could be put to the maximum productive use by way of the establishment of the factory proper.

The factory consists of ten shops with a total covered area of 8,48,600 sq. ft. and has been laid out on the most modern lines. The planning of the factory has been such that the raw materials is received at one end of the shops and processed through the factory in a uniflow direction and the finished coach shell rolls out at the other end.

PLANT AND MACHINERY

The question of equipping the factory with the most modern plant and machinery was taken up in time so that there might be no time-lag between the completion of the civil engineering works and the installation of plant and machinery.

As far as possible, machines of indigenous manufacture were ordered. But the machine tool manufacturing capacity in the country not yet having fully developed, it became inevitable to import the vast bulk of our machinery requirements from abroad. Accordingly, global tenders were called for in November 1953, and the tenders were received and finalised by March–April 1954.

It is indeed a matter for special gratification that it has been possible to obtain very competitive and favourable prices and very early deliveries. The following figures give the rough break-up of the orders in West Germany, U. K., Switzerland and other countries :

Country	*No. of contracts*	*No. of machines*
Germany	78	152
Switzerland	31	312 (includes 260 welding sets)
England	23	68 (includes 25 welding outfits)
Sweden	3	3
Czechoslavakia	3	6
France	1	1
Belgium	1	1
Italy	1	1
Total	141	544

RAW MATERIAL PROCUREMENT

Simultaneously with the procurement of plant and machinery, action was initiated for the procurement of numerous items of raw material required for the production of the coach, both from abroad and from indigenous sources. The bulk of our steel requirements has had to be imported in the first instance, but care has been taken to ensure that with the new steel plants coming into production, our entire requirements of steel are obtained from these steel rolling mills.

TECHNICAL TRAINING

The most urgent problem calling for attention in the context of the second Five Year Plan, is one of making nation wide arrangements for the training of technical personnel at all levels, so that we may have technical man power on a scale sufficient to meet the demands for the implementation of the Plan. The need for properly trained skilled workers in the various technical categories was foreseen at the very early stages of this project.

In March 1954, a Technical Training School was started, and the inauguration of this School was performed by Shri O. V. Alagesan, Deputy Minister for Transport and Railways. Boys who have already received basic industrial training have been recruited and given an extensive course in the particular trade for which they are most suitable, both in the school and on the shop floor. Thus, the timely starting of the technical training school has enabled us to find the nucleus of skilled craftsmen to help in the starting of production in the factory, as originally planned. No pains have been spared to make the training school a model institution and to give the boys the best possible technical education.

The training methods have been planned with the utmost care, and due emphasis has been given to the correct practical training of the boys. For each department of training, viz. welding, fitting and machining, a special Swiss instructor is attached to give his whole-time attention to the training of the apprentices in his charge. It is a matter for gratification that our Swiss collaborators are very satisfied with the willingness and the capacity of the boys to pick up technical knowledge and skill, and there is every reason to hope that in so far as technical skill is concerned, the boys turned out of this school will compare favourably with craftsmen in the industrially advanced countries.

In establishing production of this new type of railway passenger coach, the importance of having a sufficient number of experienced men trained abroad in the detailed processes of production need heardly be stressed. Accordingly, action was taken at an early enough stage of the project for the selection of suitable men in the rank of supervisors and also in the rank of skilled workers from the workshops of the Indian Railways, and for their deputation to Switzerland for practical training, for periods varying from six to twelve months in the works of our collaborators, Messrs. Swiss Car & Elevator Manufacturing Corporation Ltd. Schlieren, Zurich. So far, 40 such men have received their training and returned to India, and have assumed their respective positions in the production organisation. Another 19 men are at the moment undergoing training in Switzerland.

TECHNICAL COLLABORATION

The integral coach being a new design of coach in the manufacture of which our Indian mechanical engineers have no previous experience, it was essential that for the successful establishment of the production we should acquire the 'know-how' from engineering firms who have considerable experience and have built up a reputation for the production of this type of coach. Accordingly, a technical aid agreement was entered into with a Swiss engineering firm—Messrs. Swiss Car & Elevator Manufacturing Corporation Ltd. Schlieren, Zurich.

The main provisions of this agreement are : (i) The firm accept their full share of technical and executive responsibility for establishing the manufacture of the integral type of coach in the factory ; (ii) The firm agree to supply workshop drawings and specifications for machinery and plant in connection with the construction and equipping of this factory for the manufacture of coaches upto the agreed production targets ; (iii) The firm agree to supply technical assistance to Government by receiving in their factory in Switzerland such technicians and engineers as may be mutually agreed between the firm and the Government for the purpose of training them in the offices, laboratories, workshops, inspection and other departments of the firms ; and (iv) The firm agree to supply whole-time technical personnel for employment in the factory for such period or periods as may be agreed between Government and the firm.

The payment of basic fees by Government to the firm for their technical collaboration has been made contingent on the firm establishing production and achieving the production targets, from year to year, as embodied in the Agreement.

PRODUCTION TARGETS

The following production targets have been agreed between Government and the firm :

Target	*No. of unfinished coaches*
1st year of production	20
2nd year of production	100
3rd year of production	200
4th year of production	300
5th year of production	350

Of the above numbers, the Agreement contemplates a progressive increase, vide details below, in the number of coaches to be turned out by using indigenously made parts excepting for wheels and axles and proprietary items.

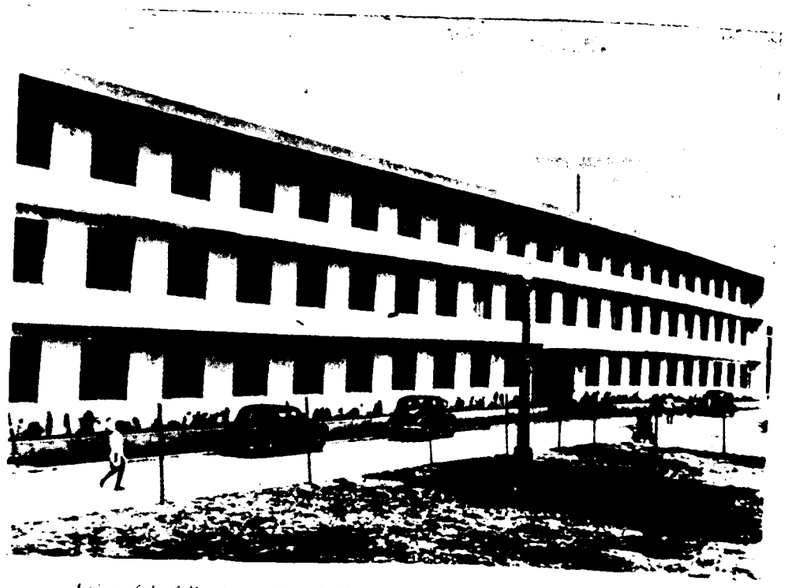
Target	*No. of indigenously manufactured coaches*
2nd year of production	20
3rd year of production	120
4th year of production	280
5th year of production and thereafter	350

The writer has had the rare opportunity of having been associated in the conclusion of the present technical aid agreement with Messrs. Swiss Car and Elevator Manufacturing Corporation Ltd. and on the conclusion of this agreement of being entrusted with the responsibility of working the technical collaboration smoothly and successfully.

SALIENT DATA

Given below are the salient facts pertaining to this project :

(i) Covered area in the shops	8,48,600 S. ft.
(ii) No. of sheds	10
(iii) Tonnage of steel for the project	9,500 tons
(iv) Length of railway lines	12 miles
(v) Roads inside shops	3·4 miles
(vi) Roads in colony	3 miles
(vii) Houses	400 units
(viii) Water supply pipes	16 miles
(ix) Consumption of cement	19,500 tons
(x) No. of machines in the Factory including welding sets :	
(a) General purposes	549
(b) Special purposes	60
(xi) Jigs and fixtures	750
(xii) Pipe lines (Cooling water ; Oil ; compressed air)	8.4 miles
(xiii) Compressors	8,250 Cft/Min.
(xiv) No. of cranes/traversers :	
(a) 20-ton overhead cranes	4
(b) 5-ton overhead cranes	26
(c) 75-ton traversers	2
(xv) No. of workmen to be employed	4,000
(xvi) Annual output in single shift	350 (unfurnished coaches)
(xvii) Total consumption of electrical units per annum	6 million units
(xviii) Total cost of the project	Rs. 7.35 crores



A view of the fully air-conditioned Administrative Office of the Integral Coach Factory.

TEAM SPIRIT

The successful and timely execution of a major project of national significance is possible only when there is the most cordial team spirit, and a missionary zeal to accomplish the allotted task on the part of all concerned, viz. the officers and staff of the project at all levels, the steel producers, the raw material suppliers, the fabricating and building contractors, and the plant and machinery suppliers. If, on this project, it has been possible to inaugurate production according to Schedule, this is due entirely to the effective contribution made by all the parties concerned in building up this project and their cheerful and enthusiastic co-operation.

Modern "Integral Design" Railway Coaches

By W. Braem
Chief Technical Manager, Integral Coach Factory

MANY IMPROVEMENTS OVER CONVENTIONAL TYPE

IN the last two decades, the construction of railway passenger coaches has undergone a revolutionary change. It was not only a question of seeking means for greater economy in Railway rolling stock operation but in particular also of providing for greater riding comfort of the passengers so that railway travel may be more agreeable and be actually an attraction for the travelling public.

New developments in manufacturing processes, availability of the correct raw materials produced to specifications drawn up to meet the various requirements and above all, the introduction of the electric arc and spot welding technique which, in Europe, dates back from 1930, opened new vistas in the coach building industry. As a result of these advancements, the old customary principles of construction were completely abandoned and new methods adopted.

Under this influence, in Europe, a specific new development of an all-steel coach design became popular which distinguished itself particularly by virtue of its considerably lighter weight when compared to the coaches of earlier manufacture, at the same time improving the running qualities of the coach and also ensuring greater safety of the passenger by the so-called "integrated design".

BIRTH IN SWITZERLAND

The new method of construction had its birth in Switzerland, the first execution of which dates back to 1933, when M s. Swiss Car & Elevator Manufacturing Corporation

Mr. W. Braem.

Ltd., Schlieren, Zurich, in co-operation with the Swiss Federal Railways, built an experimental coach of the "integrated design". The final tests and the concluding trial runs were so promising that, with this new coach, the foundation stone for a new epoch in railway coach building industry was laid.

With the good practical experience gained in the meantime, this new type was declared as the standard type by the Swiss Federal Railways as far back as 1937. To-day this mode of construction has already been adopted by most of the European railway administrations as an ideal design of modern coach building.

SPECIAL FEATURE

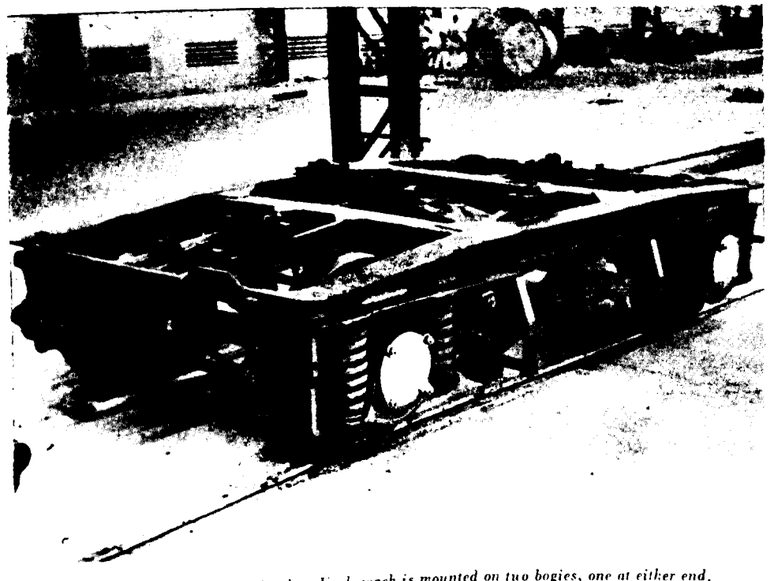
The apparent characteristic feature of this new construction lies in the unique constructional design of the coach shell. According to the old principle, the walls with the roof were built as a superstructure on the underframe which, by itself, only had to serve as a carrying unit or a supporting bridge resting on the running gears or bogies at both ends. The superstructure served only as a protecting hood to offer passengers, the seating and other comforts and protection from the elements and did not subscribe to the strength of the coach.

In the new construction, this "protecting hood" is so designed as to form part of the supporting construction itself. The undercarriage, the side and end walls and roof together constitute an integrated structural body which can, in a certain sense, be compared to a quadriliteral girder construction; consequently, the entire coach shell which, for simplicity, can also be imagined as a large hollow tube, constitutes a carrying unit thus serving a duel purpose.

By employing intelligent methods of construction, especially by the exclusive employment of the modern electrical welding technique, it was also possible to include the relatively thin side wall and roof covering plates of steel sheets of 1/16" to 3/32" thickness as the so called "skin stressed members" in the computations for the carrying capacity. By this, a further reduction in weight has been made possible without, in any way, decreasing the carrying capacity or the stability of the coach body. This type of coach has, therefore, been rightly termed as an "all welded light-weight steel coach".

SEVEN TONS SAVING PER COACH

With this type of construction, savings in weight upto 30 per cent can be achieved. In the case of the new light-weight passenger stock designed for the Indian Railways, seven



A bogie of the Schlieren Coach. Each coach is mounted on two bogies, one at either end.

tons of steel will be saved for every individual coach, the new third class coaches weighing 35 tons only against 42 tons for coaches of the old design. For the entire coach body "low carbon mild steel sheets" with commercially specified standard values for tensile strength and other physical properties will be exclusively employed.

Since the entire construction is based on electrical spot and seam welding, it is absolutely necessary that the steel employed, has all the properties for sound "weldability". When the new Governmental steel plants start functioning, India will be able to supply the raw materials of the required quality for these coaches from the country's own resources.

The under-carriage incorporates a steel plate corrugated welded floor, running throughout the entire length and so designed as to absorb in particular, the various tractional forces and the buffing shocks. The end constructions are heavily reinforced so as to resist every kind of telescopic action in the event of a collision.

The Louver and glass windows have light metal frames manufactured from extrusions and for ensuring better sealing against dust, light metal guides with felt linings are provided. The entrance doors have special hinges with ball bearing arrangement and are further provided with protective guides so that any possibility of injury to the passengers by jamming of fingers or having parts of their dress caught etc., are positively eliminated.

As a protection against the danger of rusting of the sheet steel body shell, the complete interior receives a 3-fold coating of special bituminous paint. Further, the walls and the roof are also inlaid with an asbestos insulation layer as protection against the conduction of heat into the coach interior and also as an anti-reverberating medium.

The design of the coach enables the entire construction to be processed continuously; commencing from the manufacturing of details, sub-assemblies, right up to the finished stages, ensuring smooth flow of work on the various assembly lines.

RIDING QUALITY

In developing this new integral all-welded light-weight steel coach design, attempts have been made to improve on the previous design of running gears also. It would be superfluous to emphasise that the bogies are the most vital parts of a railway coach. The riding quality depends almost exclusively on a good bogie construction. The bogie is the part which is most liable to wear and tear. Its behaviour in actual service contributes towards the efficiency factor of a coach. Therefore, it has to be so constructed that it can withstand the heavy wear and tear and thus ensure long, uninterrupted, maintenance-free service.

The "Schlieren" bogie that has been adapted by the Indian Railways, incorporates several new features. Taking advantages of the new processing methods, welding techniques etc., it had been possible to reduce its weight by 23 per cent as against the other I. R. bogies in use. As explained elsewhere, this reduction in weight had been achieved by resorting to a reliable welded construction throughout the bogie frame and bogie bolster.

CUSHIONING EFFECT IN RIDING

The axle-boxes which play an important role, are fitted with spherical roller bearings. The old jerky axle-box guides have been eliminated and are replaced by an entirely new arrangement of guides working in an oil bath sealed against dust and water which in turn, ensures a smooth working with practically no wear and tear of moving parts. The axle-box helical springs are controlled by shock absorbers. The laminated bolster springs arranged longitudinally have a special spring

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POWER DISTRIBUTION AND LIGHTING

By Shri G. N. Upadhyay, B.Sc. (Engg.)
District Electrical Engineer, Integral Coach Factory.

BIG JOB DONE AT INTEGRAL COACH FACTORY

THANKS to the rapid strides made in the development and application of electricity in recent years, electric motive power has come to be regarded as the vital backbone of industry. Availability of adequate, reliable and cheap power supply is, therefore, of primary consideration in deciding the location of any large scale industry, and this criterion, no doubt, influenced the choice of Perambur for the location of this important manufacturing project.

With the Basin Bridge Thermal Power station of the Government of Madras nearby and the proximity of their Korattur 110-66/33 11 K.V. tie station which links up the former with the Mettur, Moyar and Pykara hydro-electric stations into a "grid" permitting interchange of block power between the hydel and thermal systems and assuring, therefore, reliability of continuous adequate power supply right round the year, Perambur has, indeed, been a most suitable choice.

The factory has the initial target of manufacturing 250 Broad Gauge passenger coaches in the first stage, and 350 B. G. coaches when the second and final stage is reached. For the first stage production target, 572 electrical machines, including 260 portable D. C. arc welding sets and aggregating to about 10,000 H. P. connected load have been installed. When the final target of 350 coaches per year is attained, it is anticipated to have in all 932 electrical machines, including 480 welding sets, with a total connected load of about 15,000 H. P.

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leaf design which ensures better lubrication between the leaves on a long run. This improvement of the spring provides for better shock absorbing capacity which consequently produces a softer cushioning effect in the riding of a coach. These springs are suspended by swivelling hangers to the bogie frame thus taking up the lateral shocks as well as the side swinging of the running gear thus isolating such movements from the coach body.

An absolutely play-free connection between the body bolster and the bogie frame by means of two anchor links, longitudinally arranged, diminishes additional jerking while the coach is running. The brake rigging in the bogie has an improved arrangement so that the centre pivot is entirely relieved of the heavy pulls of several tons applied through the brake rod. The brake blocks are designed as two parts, consisting of the brake shoe and the brake shoe holder, with the result that the relatively cheap brake shoe as wearing part has only to be replaced when worn and brakes have to be reset.

COACH SEATS 80 PASSENGERS

The new third class all-steel coach will seat 80 passengers. It has four lavatories and four doors per side. The length of the coach body is 70 feet, while its width is ten feet eight inches. The width of the compartment is five feet seven inches, while the space between seats is one foot and nine inches.

The seats are made in wooden strips placed transversely to the length of the coach. Above the bunks are luggage racks which can be utilised as upper berths.

The maximum power demand for the ultimate target of 350 coaches per year is expected to be 2,000 K. Ws. with a total connected load of about 15,000 H. P.

INTERIOR SHOP LIGHTING

The illumination of large modern industrial workshops presents problems both psychological and technical. With the

Sri G. N. Upadhyay.

increasing realisation of the importance of visual comfort in stepping up the out-turn of modern workshops, the psychological aspect has been assuming more and more importance than the technical which is more or less a simple and straightforward affair. This factor along with economy of operation and maintenance have been taken into account in designing the shop illumination.

To enable maintenance, repair and overhaul of the electrical equipment of shop machinery and the various H. T. and L. T. electrical equipment, a full-fledged electrical repair shop with a floor area of 11,000 sq. ft. has been set up.

The general electrification outside the factory mainly consists of: administrative building (air conditioning and lighting), technical training school, I. C. F. colony and officer's flats and amenity buildings and other ancillaries.

AIR CONDITIONING TO INCREASE EFFICIENCY

Owing to local weather conditions and availability of limited floor space, it has been found both desirable and necessary to air condition the entire three-storeyed Administrative Office building except the corridors, staircases, entrance foyers, and canteen rooms, so as to provide comfort and incentive for the most efficient working of the organisation. The 195 ton air conditioning system serves a total floor area of 45,100 sq. ft. covering a total air conditioned space of 473,900 cu. ft.

The three-storeyed Administrative Office building is provided with modern concealed conduit wiring type electrical installation to cater for an illumination of 8–10 foot candles by means of decorative multi-tube fluorescent fittings, ranging from 2 ft. to 4 ft. lengths, with special directional type fittings in locations like drawing office, laboratory, museum hall, etc. The large neon-sign bearing the name of the factory to be provided on top of this building makes the factory easily a significant land-mark over a large area around.

SCHOOL AND COLONY

The Technical Training School attached to the factory for training of mechanical apprentices commenced functioning in March, 1954, with a modest workshop and its electrical load requirement was met initially from the Southern Railway temporary L. T. supply. Owing, however, to the rapid development of the institution, a temporary

Photo shows a nine-panel 11 K. V. Switch Board at the Integral Coach Factory Receiving Station.

150 KVA 11 KV/400. V. out-door Substation was specially installed behind the School building in April, 1955 and supply was switched over to the permanent 500 KVA Technical Training School Substation later this year. The School Workshop loads comprise portable arc welding sets, lathes, grinders and other Workshop machines, one 60 H P. air compressor, etc., aggregating to over 500 H. P.

In the housing colony all quarters including those meant for Class IV staff have been electrified. Besides lights, ceiling fans and convenience plugs have been provided in certain types of quarters as per the prescribed Railway standard in this regard. I. C. F. officers' flats at Perambur have been electrified.

The colony roads are adequately lit with street lights and the children's park with mercury vapour lamps mounted on R. C. C. lamp posts. Utility combined with a decent degree of comfort has been the keynote regard to the lighting of the residential colony.

An adequate number of electric water coolers located at convenient points in the offices, workshops and service buildings provide cool drinking water to the staff. Bracket and pedestal type air circulators are being installed in the shops to afford comfort to the working staff and improve the efficiency of their turn-over. Announcing equipment to transmit messages, instructions and lunch time music as well has been provided in the shops.

INDIAN PERSONNEL

The electrical organisation of the factory comprises Indian personnel, and all basic

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Construction of A Giant Factory

By Sri O. S. Murthy, B.A., B.E. (Hons.), A.M.I. Struct. E.,
Indian Railway Service of Engineers, Engineer-in-charge, Integral Coach Factory, Perambur.

MANY NEW FEATURES

TO an engineer, recounting the story of the construction of a project of the magnitude of the Integral Coach Factory is very facinating. For, in doing so, he lives once again through the early days of planning and design, through the days of intense activity when thousands of workers bent all their energies towards a common purpose, through the anxious time when the work was held up due to shortage of material or due to other impediments, and finally through the exhilarating period when a giant factory takes its final form to fulfil the purpose for which it was designed.

With the decision of the Ministry of Railways to locate the Integral Coach Factory at Perambur, a team of engineers under the able leadership of Sri M. Ganapati of the Chittaranjan reputation, took the field in May 1951 for site investigations and preparing designs and drawings.

Sri O. S. Murthy.

FOUNDATION PROBLEMS

The first task of the investigating team was to make a thorough study of the soil conditions at site, both by direct loading tests and by the principles of soil mechanics. Undisturbed samples of soil up to a depth of 40 ft. were taken and several bore holes up to a depth of 60 ft. put down to ascertain the nature of the strata.

These investigations revealed that this soil was highly compressible and was made up of overlaying silt. It was, therefore, decided that the foundations for all the columns would have to be on groups of piles with R. C. C. caps. Reinforced concrete raft foundations were ruled out, because of the fact that the sizes of these rafts would interfere with the machine layout and would restrict working space between the columns.

TEN SHOPS

The general arrangement of the shops follows the work-flow. Designs had to be made for 10 shops, and before undertaking the work, the requirements of the mechanical engineers were ascertained in respect of several details, such as width of bays, heights of crane operation, sizes of openings, etc.

In the rational design of a factory, the civil engineer can contribute towards the efficiency of production. With bad planning and unsatisfactory detailing, the civil engineers' work can be a great hindrance and impediment to the flow of production in the years to come, while by forethought and good planning, he can directly assist in increasing the efficiency of production.

The lighting and ventilation of the shops were carefully planned, and after careful consideration, the percentage of glass in the roof was decided at 30 per cent. In deciding the width of bays, the experience gained at Chittaranjan, where the bays are 40 ft. in width, was of great assistance. It was found that with a 40 ft. wide bay, it was difficult to arrange three rows of machines, while it was too wide for two rows of machines. Therefore, a 50 ft. wide bay has been standardised for the Integral Coach Factory in order that a third row of machines could be installed if future demand arises.

(Continued from page 23)

preparatory work like survey, design and planning of the electrical works have been done locally.

Except air conditioning and house wiring jobs, all the electrical works have been executed departmentally with the aid of unskilled, skilled and supervisory staff of the electrical organisation of the project.

Owing to the dearth of well-experienced technical hands all-round, efforts have been made, right from the commencement of the electrical works, to recruit trained and experienced technical men and give them the benefit of further experience by engaging them on the different construction works so as to have a nucleus of thoroughly trained and competent technical staff. The men who thus acquire intimate knowledge and experience of the intricate details of the equipment and installations, become fit to shoulder the responsibilities of trouble-free operation, repairs and maintenance, when the construction phase is over and the factory strides into production activity.

Heavy foundations for the Beche Smithy Hammers being prepared under difficult sub-soil conditions. The foundations were raised on groups of 25 piles.

One noteworthy feature of the general lay-out is that there are three overhead gantry cranes 80 ft. nominal span, covering the space between the shops. The handling of the raw material stored under these gantries as also the movement of components and sub-assemblies from one shop to another, is made easy, thus minimising manual effort.

STEEL WORKS

As soon as the layouts of the main designs of the structures were completed, orders for the steel work were placed with structural fabricators in various parts of the country, viz. Madras, Bombay and Calcutta. Simultaneously, action was taken for collecting the large quantity of stores, such as 14,17,000 sq. ft. of asbestos cement sheets, 2,71,000 sq. ft. of glazing for the roof, 19,500 tons of cement, 200 tons of site rivets, bolts, nuts and galvanised fittings, 9,500 tons of rolled steel, and a host of other building material.

The total quantity of fabricated steel required was of the order of 6,400 tons. In our country, where steel is in great shortage, the rolling programme of a particular section has to be arranged and co-ordinated with the total outstandings of that section with the producers. The outright import of completely fabricated steel, as has been done in the case of some of the industrial enterprises, such as Trombay, would have meant loss work to Indian fabricators and spending of foreign currency. In the construction of the Integral Coach Factory, it has been the policy to harness as much of indigenous talent and enterprise as possible.

The chasing and programming of rolling of steel, its movement from the steel producers

to the fabricators yards, the processing of the steel through the fabricators workshops and its final despatch to site of work, has had to receive the constant and anxious attention of the engineers at site.

The unfortunate lock-out in 1953 in the steel works at Burnpur caused a delay of nearly six months in the collection of the sections required. Even so, with the arrival of steel work at site, the erection was organised vigorously and at one stage as much as 700 tons per month were being erected.

While this steel was being fabricated in the various workshops in the country, the site was got ready to receive the huge columns of the structures. The first pile was driven in September 1952, and commencing from that date, 2460 numbers of 16" dia. of R. C. C. piles cast in site, have been driven to a depth of about 40 ft.

ENGINEERING FEATURES

Of the 6,500 tons of fabricated steel, 2,550 tons is of welded construction. Steel work in the whole of the main assembly and sheet metal shops belongs to the latter category.

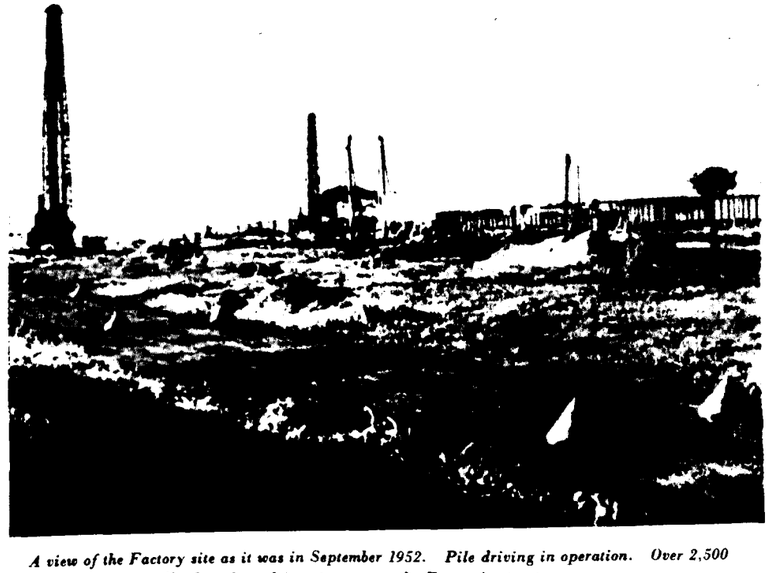
The main assembly shop, which is 1,000 ft. long and 260 ft. wide with a height of 55 ft. to the ridge, is a magnificent structure which may truly be termed an "Industrial Cathedral". Four 20-ton cranes at a height of 33 ft. and several 5-ton cranes assist in the manufacture operations. This shop has been planned with two 80 ft. bays and two 50 ft. bays,running the full length of 1,000 ft.

The method of fabrication adopted in the case of the main assembly shop and the sheet metal shop, is somewhat unusual in our country. At any rate, it is presumed, that these two shops comprise the biggest single job where a combination of shop and site welding has been exploited to advantage. The objective of easier fabrication methods and economy in the use of steel have been achieved by specifying all component units, such as columns, roof girders, glazing girders, L type rakers, 5-ton gantry girders, side framing units, etc. as of welded construction, partly done in the shop and partly at site. The field connections are bolted and this has ensured quickness of erection. A fully rigid design for large spans would involve heavy site welding and put up the cost of the structure.

All columns less than 40 ft. in length and all 5-ton gantry girders were fully shop-welded and despatched. For those columns in the 80 ft. bays of the main assembly shop, which are 53 ft. long, the roof leg and the bottom shaft were despatched separately. On arrival at site, the two were assembled, checked for alignment, held in a jig and finally welded. The attachment of the jig to the roof leg and crane shaft was through location bolt holes already drilled in the shop.

The main roof girders of 80 ft. and 50 ft. span and the 40 ft. glazing girders were fabricated partly in the shops and partly at site. The shop work consisted of fabricating the top and bottom chords in part lengths. These units, as also the web members of the girders, were despatched to site with all the gussets welded and provided with ½" pilot location holes. The assembly of the components at site was done on a steel staging platform with accurately positioned fixtures to hold the members in alignment and prevent distortion. The joints in the girders were then tack-welded and the length and alignment checked before being welded fully.

For the erection of the steelwork for the main assembly shop, a 5-ton Scotch Denick with 110 ft. jig was provided by the administration and made mobile by mounting it on



A view of the Factory site as it was in September 1952. Pile driving in operation. Over 2,500 piles have been driven to support the Factory's structure.

trollies running on railway tracks specially laid for the purpose.

STANDARDISATION IN SHOPS

In the design of the shops, standardisation has been kept prominently in view. All units, such as the roof girders, glazing girders, side framing and other details, are common to all shops. This has meant lower fabrication costs. The crane spans have also been standardised.

After detailed investigation, the percentage of glass in the northlight roof of the shops, has been fixed at 30 per cent of the floor area. In order to improve ventilation, the glass is arranged in two stretches with an intervening space between. The roof is of asbestos "big-six" sheets. In the side walls, concrete louvre openings have been provided in all the shops. All these features it is hoped, would keep the shops cool.

Considering the poor soil conditions, a heavy type of concrete floor has been adopted in all the shops. It consists of 6" of stone soling with 3" metal rolled and consolidated with a 10-ton roller. Over the sub-grade is laid 6" of graded concrete with 1" thick wearing surface.

UNDER-GROUND SERVICES

All the services, such as compressed air, water supply, electrical and telephone cables, etc. are carried in trenches laid in the floor and covered over with steel chequered plates. This feature, as compared with the practice of carrying the pipes and services above the ground, has contributed towards general cleanliness and neat appearance of the shops.

It has been the practice in the past to plan the distribution and carrying system of water, compressed air and electricity independently above the floor level resulting in a multiplicity of supporting schemes criss-crossing the shops. The present-day development is however to lay all the services underground below the shop floor as a co-ordinated scheme In the new factories that are under construction in western countries this method is being adopted.

The shop area is well served by concrete roads and railway sidings to help the easy handling of material.

Individual machine foundations have been prepared for all heavy machines and for the hammers, pile foundations have been adopted. However, the common purposes machines and other lighter machines are placed directly over the concrete floor of the shops.

ANCILLARY BUILDINGS

The most important of the ancillary buildings connected with the workshops is the administrative office building. This is a four-storeyed steel-framed structure founded on piles, and is completely air-conditioned. The estimated cost of the structure including air-conditioning is Rs. 14.93 lakhs. The building has a floor area of 59, 252 sq. ft.

A large double-storeyed structure outside the compound of the factory serves as a workers' canteen. It is proposed to run the canteen as a cafeteria. Under the roof of each shop, one or more foreman's offices have been constructed on R.C.C. platforms supported on heavy R.C.C. cantilevers. The offices will be fully glazed on the sides so that from a height, the foremen can have a good view of the shops.

For carrying out the civil engineering works of the magnitude described, it is economical and also time-saving if the heavy equipment and plant is procured by the administration and given to the contractors either free for use or hired out at agreed rates. It will than be possible to put into the field several contractors of comparatively limited means, and in accordance with this policy, steam cranes, mobiles caterpillar cranes, road rollers, compressors and compressed air tools, derricks, winches, concrete mixers, etc. were procured as general charges and made available to contractors.

A small workshop under civil engineering looked after maintenance and repairs to the plant. This workshop came in handy for the manufacture of odd items of steel work and other equipment so necessary for the successful and early completion of the works.

STAFF COLONY

While the factory was thus taking shape, work on the staff colony proceeded rapidly, and it was possible to house most of the construction staff in these buildings, thereby avoiding unnecessary expenditure on temporary structures for housing the essential staff on the construction.

The colony is planned on a 33-acre estate close to the factory and has been completed at a cost of Rs. 26.8 lakhs. This colony is well served by the transport system of the city of Madras. The smallest type of flat has a plinth area of 325 sq.ft. and is electrified and fitted with a tap. Lavatory and bathing facilities are provided at the scale of one closet and one bathing place for two families. All the other types have individual sanitary and bathing facilities.

Dust-proof roads and water-borne sewage have been laid for the colony. Ample playgrounds for adults and a children's park add to its amenities. Keeping of cattle has been prohibited in the colony and to serve the needs of those who wish to own cattle, community cow sheds have been built at a convenient distance from the residential flats.

Protected water supply for the factory and the staff quarters has been arranged by bringing water from Ennore, a distance of 11 miles from Perambur. The scheme is a joint venture of the Southern Railway and the Integral Coach Factory administration and costs Rs. 11.5 lakhs.

(*Continued on page 32*)

COST DATA

The project, it is confidently hoped, will be completed in all respects well within the estimated cost. The figures for the main works and for the project as a whole, are :

		In lakhs of rupees
1.	Land	5.79
2.	Shop structures including boundary walls, etc.	132.30
3.	Services inside shops, such as, roads, track, water supply, drainage, sewage, etc.	17.45
4.	Staff colony including services	34.09
5.	Administrative office building	8.42
6.	Water supply	6.26
7.	Sewage scheme	1.68
8.	Staff amenity buildings	3.60
9.	School and hostel	10.48
10.	Machinery and plant with foundations and general charges	265.48
11.	Electrical plant and installations	56.22
12.	General charges for the whole project	82.4
13.	Carriage and freight for the whole project	46.95
14.	Preliminary expenses, permanent way, etc.	64.03
	Total	735.15

A FINE JOB

It has been the rare privilege of the writer to have been associated with the designs and construction of the two major workshops established by the Ministry of Railways after independence, viz. the Chittaranjan

IDEAL CONDITIONS OF WORK AT COACH FACTORY

By R. M. Sambamoorthi
Indian Railway Service Engineer, Executive Engineer (Workshops)

HOUSING AND WELFARE ARRANGEMENTS

IT is being increasingly recognised the world over that unless congenial and healthy surroundings are created for the factory worker to work in, he cannot be expected to give of his best to any industry. In a welfare state like ours, it becomes all the more essential that the welfare of the worker within the works, as well as of his family outside, receive the special attention it deserves. The Indian Railways, biggest of the nationalized undertakings in our country, have been known to be the pioneers in labour welfare.

Sri R. M. Sambamoorthi.

In the case of the Integral Coach Factory, the workers' colony is sited close to the works and is intended to house all the essential categories of workers required to live near the workshops, such as the security force, fire brigade, key operating staff for each shop for any emergency, electrical staff, chargemen, foremen, etc.

COLONY'S LAYOUT

The colony, built on a 35-acre plot, is at present intended to house 400 families and has been built on the flat system to conserve space. It has well laid-out, dust-proof, asphalted roads, planted with shade-giving

(Continued from page 31)

Locomotive Works and the Integral Coach Factory. He could not have hoped for better good fortune.

The fulfilment of the task to targets set by Government would have been impossible but for the magnificent work and co-operation from the large number of contractors engaged on this project in Madras and in other parts of the country. It would also have been impossible without the devotion to duty and the whole-hearted endeavour of the staff of the project working in the offices and in the field, from the humble unskilled worker to the topmost executive.

A mighty industrial unit has been constructed and brought into production exactly three years from the date the first pile was driven at site. Judged even by standards set by countries more industrially advanced and possessing unlimited resources of building material and mechanical equipment, the team may well be proud of a fine job.

A view of the Children's park and playground in the I. C. F. residential colony.

and flower trees and is fully electrified and provided with underground water borne sanitation. The colony is largely self-contained with its own childrens' school, park and playground, a recreational institute, a bachelor's chummery and a subordinates' rest house.

A sanitary cow shed has been provided on nominal rent to occupants of the colony to house their cattle away from the colony, but within easy reach. In course of time, it is intended to have a post office and a small marketing centre for the colony to make it completely self-contained. In addition, the colony is well-connected by the Madras city bus routes and important business and marketing centres of the city are, therefore, within easy reach of the colony.

TYPES OF HOUSES

Of the 400 flats provided in the colony, 200 are of Type I for lowest grade semi-skilled and unskilled workers. The next 100 of Type II are for skilled workers and artisans. Of the balance, 76 of Type III are for chargemen and 24 of Type IV for foremen.

This colony of 400 flats has been constructed at a cost of Rs. 26.8 lakhs, exclusive of the development cost on roads, drains, sewers, water supply and electricity. The cost of these services works out to Rs. 3.39 lakhs. The cost of the other ancillary buildings, such as the institute, rest house, apprentices hostel, etc., is Rs. 8.98 lakhs. This would put the total cost for the colony, including these ancillary buildings, at Rs. 39.17 lakhs.

The floor area and living accommodation provided for workers is roughly based on the living habits of each class and caters for progressive improvement in their status and emoluments.

HOUSE FOR Rs. 5 P. M.

For instance, Type I, intended for the lowest grade of workers, provides a living

room 10′×12′, a kitchen 7′×5′ and a rear verandah 7′×7′. Bath rooms and lavatories have been attached to the block at the rate of one set for two families. The kitchen has a raised cooking platform and chimney and is provided with an individual water tap and wall shelves for storing utensils. The rear verandah has a loft above for storing fuel, junk, etc. The main living room itself has wall shelves for books and other odds and ends and is well-ventilated. The flat is electrified with individual meter and the sanitized bath rooms and lavatories are connected to the underground sewerage.

This type is intended for workers drawing a salary from Rs. 30 to Rs. 55 p. m. The maximum average rent that can be realized is Rs. 5 p. m. For this rent, the accommodation and amenities provided cannot be secured in private buildings even in less costly areas than Madras.

The quarters of this type have been so designed that at any time later, they can easily be converted into two-roomed types. The need for keeping the overall cost of construction as low as possible has also been constantly kept in mind and economies have been achieved without reducing the quality or standard of amenities prescribed. All the buildings in the colony have been treated architecturally to give a pleasing exterior and to improve the aesthetic appearance of the colony as a whole. The costs compare very favourably with buildings of similar construction elsewhere.

OTHER AMENITIES

Next to housing, the colony contains other important items of amenities.

The school is housed in a separate building built for it within the colony and provides instruction for children upto the Vth Standard. The full strength of the school is 230 and with the colony only partly occupied, the attendance at the school is already 163. The school is aided by the local Government, the Railways meeting the balance of the running expenses.

The childrens' park and playground is situated centrally in the colony and is provided with see-saws, swings, slides etc.

The Institute (club house) which is the centre of social activity has a stage and an auditorium, a library and an indoor games room with an attached snacks room or canteen. Around the building, ample space has been included in the compound for outdoor games such as tennis, badminton etc. Periodical music and dramatic performances are held by the staff as part of their cultural activities. To cater to the staff attached to, or visiting the factory on duty, a rest house and a chummery have been provided.

In the factory proper, the amenities provided are: works canteen, lavatories and bathing cubicles, and first aid post and dispensary.

BEAUTIFUL ENVIRONMENT

Lastly, mention must be made of the extensive gardening being undertaken to beautify the surroundings of the workshops of this factory. Even the best of the factory buildings with the finest equipment installed in it is incomplete if the surroundings are bare and neglected, with only the heat and glare of the concrete roads to relieve the atmosphere. A place where thousands of human-beings work has to have a restful and congenial atmosphere. It has to be recognized that apart from the need for providing amenities for the physical well-being of the worker, the satisfaction of the aesthetic sense of the human being in the worker is also very essential.

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Training Worker-Citizens For Integral Coach Factory

By Sri U. A. Kamath
Principal, Technical Training School, Integral Coach Factory.

ROLE OF TECHNICAL TRAINING SCHOOL

THE Technical Training School of the Integral Coach Factory was inaugurated on March 20, 1954 by the Deputy Minister for Railways, Sri O. V. Alagesan.

To meet the production targets laid down, the labour force in the factory was scheduled to be increased from 110 in July, 1955 to 3,800 in July, 1959. Skilled workers were to total 2,850 or 75 per cent of the number. Of these, a total of 2,545 would be required in three main trades, fitter, machinist and welder. The School was, therefore, designed to provide training capacity for 200 fitters, 200 welders and 120 machinist apprentices, every year, recruitment being half-yearly. By 1959, it was planned that the school would turn out 1300 fitters, 520 welders and 725 machinists, thereby meeting a major portion of the demand for skilled workers in the factory.

Sri U. A. Kamath.

The task of training worker-citizens for the Integral Coach Factory involves training for proficiency in work, instruction for encouraging a sense of belonging within the firm and non-vocational education for life. These are the goals which the school has set before itself.

(*Continued from page 34*)

In the Integral Coach Factory, no effort has been spared to create this atmosphere, restful to the eye and congenial to work in Extensive lawns with flower beds and gardens have been laid out around the various workshops of the factory. In front of the works canteen also where the workers take their food and spend their midday recess, a beautiful garden with lawns, porgolas, etc., has been laid out. These extensive lawns and gardens have been laid to suit the layout of the various workshops and to fit in with the busy industrial atmosphere of the factory.

Having built a modern factory with up-to-date workshop structures and the latest equipment, if the Administration has gone a step further emphasizing the welfare of the worker, it is because of its recognition of the fact that a contented worker is the best asset of an industrial undertaking.

TRAINING SYSTEM WITHOUT PRECEDENT

The system of training skilled craftsmen adopted at the school is without any precedent in India where apprenticeship of three and a half years to five years is accepted as standard. With a view to meet urgently the factory production targets, the Railway Board agreed, as a special case, to reduction of the period of apprenticeship to one and a half years. This reduction is achieved by the twin method of recruiting apprentices who before enrolment have undergone a minimum of one and half years training in their particular trade and by adopting more improved, intensive and efficient methods of training.

In view of the lack of precedent for this type of training in India, the syllabi of training have to be developed from scratch. The apprenticeship is made up of six months' basic training in the training workshops attached to the school followed by 12 months specialised training in the factory. This initial basic training is an important part of the training scheme. The main emphasis is on practical work on which the apprentice spends 27 hours a week, the theoretical and citizenship training consuming 21 hours, making a total of 48 hours a week. The training centre is like an enclosed swimming pool in which apprentices learn to swim, the factory being the open sea with some quite large waves.

SWISS INSTRUCTORS

Practical training in the training workshop is given under the expert guidance of Swiss instructors, one for each of the three departments, fitter, machinist and welder, assisted by Indian instructors, working under a senior Swiss instructor. Control is intensive to ensure that all apprentices attain a minimum basic level of skill by concentrated attention and provision of adequate raw materials, tools and other facilities, so that when they go to the factory floor for further training, they are in a position to handle independently under close supervision, jobs which naturally fall to the lot of skilled workers. This satisfactory result is obtained by systematic graded exercises which have been specially developed.

One of the highlights of the training workshop is its welding department. The integral coach is an all welded design and this throws a heavy responsibility on the school for training the high grade welders whose work will always be dependable and who can be relied upon to turn out modern all-welded passenger coaches under conditions of mass production. The lack of partially trained welders offering for recruitment places an additional burden on the school which has to be made up by relaxing standards of admission, by stricter control during training and by increased supervision.

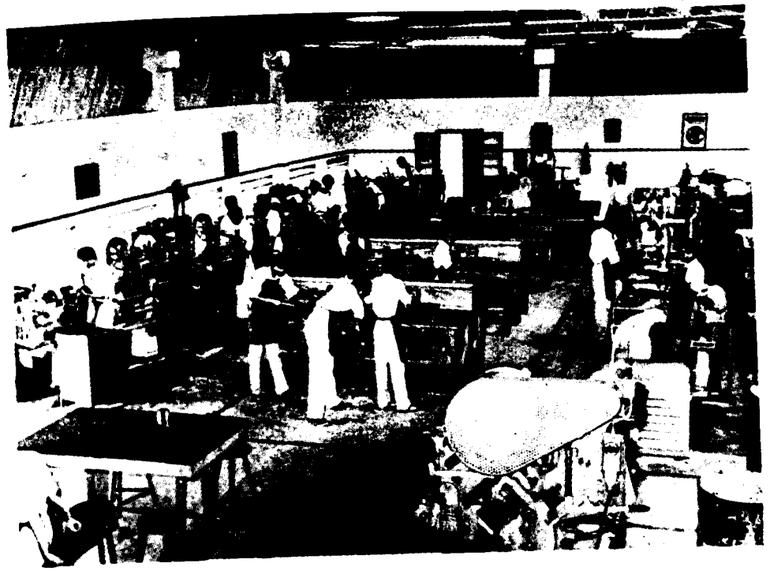
While the main emphasis is on the practical training, theoretical training is a valuable adjunct, keeps in step with it and assists the apprentices to grasp their practical work more clearly.

INCULCATING DISCIPLINE

It is made compulsory for all apprentices to join the Auxiliary Cadet Corps which was inaugurated in August, 1954. Training in this Corps has many facets such as parades, physical training, citizenship training, community work and sports, covering a total of five hours per week. In addition an hour has been set apart for an " individual expression " class to develop qualities of clear and coherent expression. Opportunities have thus been made available for displaying inherent qualities of leadership and developing traits of good citizenship.

Even more important than the training place itself are the instructors. The number of instructors has been increased to provide one for every 10 apprentices and a full time principal is employed. Starting from four Indian and two Swiss instructors in March,

Trainees receiving instruction from a Swiss instructor in the Welding Department of the Technical Training School at I.C.F.



General view of the machine department of the training workshop at I.C.F. Most of the machine tools in the department are manufactured in India.

1954, the School has now on its rolls 22 Indian and 4 Swiss instructors.

A separate organisation deals with the transfers of the apprentices to the factory, after the basic training and follows up their progress on the factory floor.

In-plant training for 12 months is an integral part of the apprenticeship scheme. During this period, the apprentice, who is already accustomed to independent work in the training workshop and possesses a versatile training, is given tasks which otherwise fall to a qualified worker. During this period, they are put in small batches to work under Swiss technicians and Indian technicians who had training at Schlieren. His abilities and attention to duties are recorded and a final trade test is given before his entry into the skilled grade.

SOCIAL LIFE

Since the School was inaugurated in March, 1954 with the two wings of the workshop, a third wing has been built and brought into commission in October, 1954. A new school building to cost Rs. 3 lakhs is planned to be built and brought into use early next year.

To assist the apprentices in gaining valuable social experience in community living, a hostel to house 250 apprentices has been planned and is now being built. The hostel will, when completed, cost Rs. 8,43,000 and will become the centre of the social life of the apprentices after working hours.

These new and impressive buildings for the school and hostel are expected to be ready before March next year and therefore it can be claimed that when the School completes its second year of existence in March, 1956, it would be well set to fulfil its functions laid before it in a satisfactory and efficient manner. The total capital costs would then total about Rs. 20 lakhs in all. Plans are also on the anvil for increasing the floor space and equipment provided for the training workshop to further improve the standard of practical training.

The aim of the Integral Coach Factory Technical Training School is, in short, to harness the ability and intelligence of the trainees, to impart suitable training through methodical practical work, to inculcate a sense of discipline and enthusiasm by widening the outlook through class room lectures, visual aids, opportunities for individual expression, etc. and thus to mould them into craftsmen in the correct sense of the word.

A TUBULAR QUIZ

Define the following: (a) Short ton (c) Metric ton
(b) Long ton (d) Freight ton

(a) American ton of 2,000 lbs.
(b) British ton of 2,240 lbs.
(c) Continental ton of 1,000 kilos = 2,204 lbs.
(d) Shipping measurement, 1 ton = 40 cubic feet.

What or who is a D. T. D. and a C. M. E.?

D. T. D.—Director of Technical Development, the man in whose name specifications covering materials used in the construction of British Aircraft are made out.

C. M. E.—Chief Mechanical Engineer, the uncrowned king of the engineering division of Railway undertakings.

ROLE OF MECHANICAL ENGINEERS IN SETTING UP BIG COACH FACTORY

By Sri K. Swarup
Deputy Chief Mechanical Engineer, Integral Coach Factory, Perambur.

SETTING up of a huge factory like the Integral Coach Factory, covering 51·5 acres of area and requiring 848,600 sq. ft. of covered area, is a task which needs careful planning and thought from the time it is decided to set up such a factory. Every little detail has to be carefully considered after taking the various sequences of operations into consideration, to eliminate subsequent bottlenecks or cross-handling of material. Such studies naturally require experienced men, who would know the manufacturing operations thoroughly, and such men have to spend considerable time in working out the best possible shop layouts.

The product to be manufactured at the I. C. F. is the light-weight all-welded steel coach developed in the last few years in Europe, and naturally for this task Indian mechanical engineers did not have the complete 'know-how', and, therefore, it was considered necessary to enter into a technical aid agreement with the Swiss Car and Elevator Manufacturing Corporation, Ltd., Schlieren, Zurich, Switzerland, who are the pioneers in the field of light-weight all-welded steel coaches.

SWISS COLLABORATION

Based on their 'know-how', the job of designing a suitable broad gauge coach for the Indian Railways was taken in hand by the Central Standards Office as early as 1950, in conjunction with the design engineers specially deputed by the Swiss collaborators. At the same time, the shop layout was undertaken, in early 1951, and civil and mechanical engineers co-ordinated with the Swiss specialists and experts in working out the general layout for the factory and later the detailed layouts for individual shops.

Sri K. Swarup.

After the general layout of the factory was finalised, the task was to find a suitable site for the project. After detailed investigations it was decided to site the Integral Coach Factory at the present site, west of the existing Southern Railway loco shops.

The next big task of the mechanical engineers was to draw up a list of plant and machinery that will be required for such a factory.

MAN-HOURS PER MECHANIC

This meant compilation of the time required for each operation on a particular type of machine, and as this type of coach was entirely new to India, the assistance of the Swiss Car & Elevator Manufacturing

A mammoth machine under erection at the Integral Coach Factory.

Corporation was very necessary in this matter. They very kindly placed their operation and planning cards at our disposal, and from these the Swiss man-hours were worked out for a particular type of machine.

The question now was to decide what will be the ratio of production of a Swiss worker to that of an Indian worker. The answer to this question was not readily available, though several experts in India and the field office of the International Labour Office in Bangalore were consulted. Detailed examinations were, therefore, made by a Swiss team, including the author, by visits to different factories in India and this team was of the opinion that the ratio in the case of a machine operator may be accepted as 1 : 1.8. This question was also discussed at Geneva with the experts of the International Labour Office and they agreed that the ratio of 1 : 1.8, as worked out by this team, was reasonable. Accordingly the man-hours for a particular machine were worked out, and based on these man-hours the approximate requirement of the various types of machines were finalised.

1800 TENDERS RECEIVED

The machine tool manufacturers have made great strides during and after the second world war, in improving the design of the machine tools, with which it was possible to get much higher speeds and feeds. Single-purpose machine tools for specific requirements were also in the field and manufacturers were willing to design and supply other single-purpose machines that were needed. It was, therefore, necessary to have close consultations with the manufacturers in order to get the most modern machinery with labour saving devices for a plant which was going to mass-produce one particular type of coach.

In order to save time and obtain the best possible deliveries at a most competitive price, it was decided by the Government of India to call for global tenders in Europe. The last date for the quotations to be submitted was 20th January, 1954.

The big task of going through 1800 tenders to select 544 machines now started in Schlieren, Zurich. The Government of India decided to associate a Director of Finance from the Railway Board and a Mechanical Officer from the I. C. F., with the Swiss consultants for going through these quotations and placing the orders.

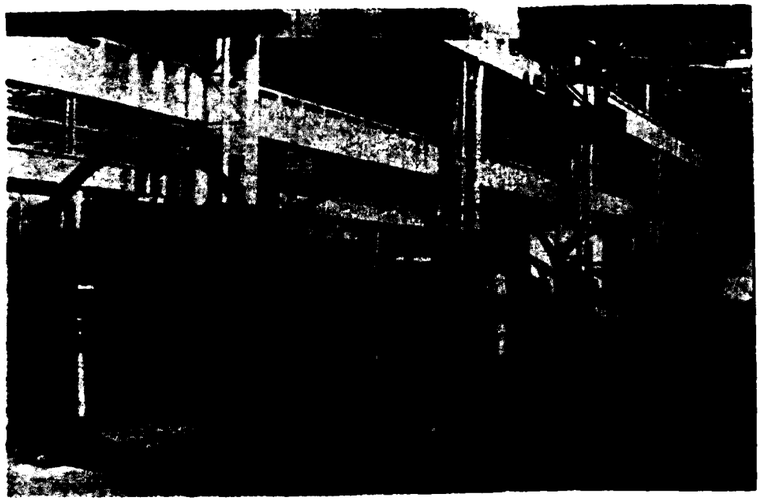
The screening of 1800 quotations was completed by this team in a record time of two months and ten days, and by 5th April 1954, it was possible to finalise orders for 541 machine tools costing £. 7,88,074—3—10.

Although the orders are distributed over 76 firms in eight different countries, ten firms in Europe have secured a large proportion of the orders, each one obtaining orders amounting to more than £. 20,000.

INSTALLATION OF MACHINERY AND PLANT

It was considered most advisable to leave the task of inspecting these machines, to the experts of Messrs. Swiss Car & Elevator Manufacturing Corporation, in order to ensure that machines were suitable in every respect.

By now all the machines have been received at the I. C. F. and most of them erected. The first Kirloskar 8½" centre lathe was installed by the Railway Minister in the Machine Shop on 20th January 1955, and during the eight months such rapid strides have been made as to nearly complete



Giant Roof Assembly Jig measuring 70 ft. X 10' 8" for the assembly of roofs.

the installation of most of the machinery and plant.

JIGS AND FIXTURES

While going through the operation and planning cards, the question of doing the various jobs on jigs and fixtures in order to ensure interchangeability was given thorough consideration. It was also considered essential that, to expedite assembly and welding work, suitable jigs should be designed in order to ensure that the assembly belt functioned without interruptions. Six hundred and seventy five jigs had to be designed, out of which 583 are being manufactured by Schlieren and the remaining 92 in India.

The big assembly jig on which the sides, ends and roofs are assembled on to the tough floor of the body shell, weighs 11.65 tons and has a platform to work on the outside up to a height of 8' 5" and there is a provision for putting up one platform inside at a height of 7' 10½" for enabling the workers to spot weld the sides, the roofs and ends from inside. The roof assembly jig weighs 8.75 tons and has a platform 3 feet high all round the jig, where the welders stand while the jig moves round at a slow speed to enable roof sheets being tack-welded after they are held in position on the carlines and cantrails.

D. C. welding sets have been preferred as it is our considered opinion that for welding thin sheets it is much more economical and more efficient. The claims of the A. C. welding sets were given full consideration before coming to the above conclusions.

For our smithy shop we have selected double-acting beche hammers on account of the soil conditions existing in Perambur and because of the better control obtainable in these hammers. For our machine shop we have selected Alfred Herberts Turret Lathes No. 9-B for bar work and Bœhringers' Turret Lathes for fixed chuck work.

INDIVIDUAL SHOP LAYOUTS

The sequence of operations and the best methods of obtaining an uninterrupted flow

of manufacture were carefully studied before finalising the layouts. The so-called " jobbing layout " was chosen for production, according to which the details and partly the sub-assemblies are manufactured in separate sheet-metal, smithy, fitter and machine shops. From here they proceed through the sub-assembly stores to the assembly lines.

Every year, 2,800 doors and 14,700 windows are required for the 350 coach body shells to be produced, and therefore for the window and door shops it was decided to manufacture them in special departments according to the so-called ' line layout '. Here the single machine tools and jigs are arranged directly according to the requirements of the flow of production, that is, where the layout places the machine along the line of travel of the produce part. This layout is considered to be the best solution for an economic manufacture of parts to be manufactured in large series.

In accordance with the above principles and taking into consideration the machinery and plant ordered, the various shops have been planned in order to get all uninterrupted flow of material to the assembly lines on which the coach body shell will move from one position to the other until it is finalised on the last position in the main assembly shop.

TOOL CRIBS

Tool cribs have been designed for the issue of the tools to the workers. For these tool cribs special tool cabinets with a centre locking device have been devised and based on the Swiss experience, Godrejs have been able to manufacture them in India. For transport of material from stores to individual shops, six Stacatruc fork lift trucks and six Lister trucks have been provided. During the erection stage we found these Stacatruc fork lift trucks very useful in handling the machine and in erecting the heavy parts.

MECHANICAL ORGANISATION

The mechanical organisation has been carefully worked out and every possible care has been taken so that the ' know-how ' is obtained by Indian officers, supervisors and men at all levels. An Indian is attached as a counterpart to a Swiss expert and they have to work together in close co-operation to establish production. It is proposed that in the initial stages the Swiss will organize the first assembly line and after it has been organized it will be handed over to the Indian counterparts and workmen to maintain the scheduled out-turn, under the general supervision of the Swiss superintendents. The Swiss experts will now be switched to organize the second and subsequent assembly lines with the help of Indians, until such time as the Indians have pickedup the complete ' know-how '.

In order to form the nucleus for the Indian supervisory and skilled staff, a technical training school was started very much in advance of the factory going into production. It was foreseen that it will be necessary for our Indian supervisors and skilled workmen to be sent to Schlieren for training purposes, and have accordingly sent 63 men in four different batches, to Schlieren for training varying from six months to twelve months.

Steps were also taken to select and train suitable Indians under training abroad, and a Committee consisting of the Railway Adviser and the Chief Inspecting Officer in London was formed to select suitable candidates. We have also recruited suitable supervisory staff from the open market, through the agency of the Railway Service Commission in Madras.

It was, however, found difficult to get suitable supervisory technical men from the open market with the requisite technical experience and therefore we had to adopt a scheme for training of supervisory personnel.

We have recruited 24 Improver or Probationary Chargemen and are giving them an intensified training for a period of six to nine months, to fit in these men on our rolls.

To meet the requirements of experienced men, various railway workshops were inspected by officers from the Integral Coach Factory and suitable persons selected for absorption. These men, along with the Swiss experts and specialists, are now playing an important role in the establishment of production in the I. C. F.

PRODUCTION SCHEDULE

A production schedule has been worked out for the achievement of the production targets in the I. C. F., based on the production targets as laid down in the Supplemental Agreement of 1953. The dates for establishing production in the paint and finishing shop, in the assembly shop, in the detail manufacture shop, have had to be worked out and are being adhered to rigidly.

On the basis of the start of production in the various shops, the raw material procurement had also to be drawn up. Here the difficulty was that most of the material required was according to the DIN specifications to which our Swiss consultants and experts were accustomed and on which they gained sufficient experience. The initial difficulties in this regard have been overcome and all the Government of India offices, particularly D. G., I. S. D. and D. G. S. & D, and the industry have co-operated in this matter fully.

LOCATING INDIGENOUS CAPACITY

For many of the imported items, a separate section has been established in the Mechanical Engineering Drawing Office for working out the indigenous products. Their *modus operandi* is to locate a suitable firm, who can produce the components required of the suitable standard and to place an educational order on them. After supply, these components are subject to rigorous tests before final acceptance. In this way it has been possible already to substitute 90 items from the imported list of 163 items. Efforts will continue until all the items have been located through indigenous sources.

DRAWING AND DESIGN OFFICE

A modern drawing office has also been planned with the most modern equipment in a very well-lit corner of the administrative office. The factory will now be producing only third class coaches according to a design which has been worked out by our Swiss experts in conjunction with the Central Standards Office of the Railway Board.

Our Design Drawing Office will be able to design, in light-weight construction, other types of coaches that are required for use on the Indian Railways. Provision has also been made for a prototype bay in the shops where the newly designed types will be worked out and fully tried before finalising the designs. Other research work will also be done in this bay as may be directed from the Central Standards Office or from the Railway Board from time to time.

TECHNICAL SOCIETY

A Technical Society has been formed where lectures by Swiss experts and Indian mechanical engineers are arranged on various technical matters, once a month. After a paper has been read out it is thrown open for discussion. It has proved very useful in bringing the Swiss and the Indian mechanical engineers together and has been found very helpful in broadening the outlook of the Indian mechanical engineers.

(Continued on page 46)

Stores Purchase for a Giant Project

By C. D. Ellicott, B. Sc. (Hons.) Edin. M. I. E.
Deputy Controller of Stores, Integral Coach Factory

MATERIALS WORTH Rs. 25,000,000 PROCURED

THE object of this article is to give the layman a brief insight into the work done by the stores organisation on projects, some of the handicaps under which it has to work, and what is expected of it by the consuming departments.

To the layman, there appears at first sight to be little need for a separate stores organisation on a project. On mature thought, however, it will be apparent that if the officers of the consuming departments are left to procure their own materials, they will be able to do so only at the sacrifice of valuable time which they can well devote to the actual construction work.

On a big project where numerous different works are simultaneously in progress, a large number of men have to be employed for various construction works from day-to-day. When any required material is not immediately available, progress is liable to come to a stop resulting in an appreciable number

Mr. C. D. Ellicott

of men sitting idle, waiting for the material, thereby resulting in infructuous expenditure.

(Continued from page 45)

PRODUCTION OFFICE

A proper production office is also being established for the planning of 600 different components and sub-assemblies that go to make the coach body shell. Expert staff will be employed for time and motion studies on the actual shop floors. This production office will also have a suitable section for job costing each batch order processed through the manufacturing shops. This office will also be responsible for seeing that the various components and sub-assemblies are in the right place at the right time for the belt to proceed without any interruptions.

The present assignment for the Mechanical Department of the Integral Coach Factory is to produce 350 light-weight all-welded steel construction body shells by 1959–60. The quality and the quantum of work produced by our apprentices in the first assembly line which has already been established, and the co-operation that is obtaining at different levels, encourage the hope that we should be able to achieve the production targets without much difficulty.

Photo shows a view of the main stores depot at I. C. F. showing 15 ft. high steel racks.

5,000 ORDERS

At any one time there are always about four to five thousand purchase orders outstanding, some in India and some abroad, and each and every one of these orders has to be watched, progressed, and chased, so that there might not be even one single instance where the required material is not immediately available when required, lest this retard progress of the work on the project. Only when these implications are fully realised, the enormity of the work of the stores organisation attached to a project can be appreciated in its correct perspective.

Whether due to lack of foresight or, which is more often the case, due to being able to decide on the required material only as the actual construction work progresses, about 60 to 80 per cent of the indents received each month during the construction phase are "very urgent" and the stores department has necessarily to act promptly on these indents and to produce the goods by the date stipulated on the indent, if it is to do its bit towards the common cause of completing the construction work by the target date.

STEEL PROCUREMENT

The Stores Department of the I. C. F. started functioning as a separate unit from April 1, 1952 and since then it has procured materials to the value of Rs. 2.5 crores. While the Engineering Department issued "works tenders" for 7,000 tons of steel work required for shop construction and obtained this quantity direct, thousands of tons of steel rods and cement, required for reinforced concrete work by the Engineering Department, have had to be procured and supplied by the Stores Department: 1,020 tons of Armco sheets were obtained by importation from America and a like amount of the same item is again shortly expected to be received from this source; 2,400 tons of steel to the German "DIN" specification had also to be imported.

Including both the requirements of the Engineering and Mechanical Departments, more than 8,000 tons of steel have already been obtained by the Stores Department both from indigenous sources and by importation. The quantities of cement supplied by the cement factories at Dalmiapuram and Madukkarai also total approximately 25,000 tons.

For the procurement of machines required to be installed in the factory, global tenders were arranged to be issued with the approval of the Railway Board and considerable publicity was given to them through the Indian embassies in the various countries, so that quotations from firms all over the world were obtained for their supply. This tender was finalised at Schlieren, in Switzerland, and 544 machines were ordered abroad to the total value of about Rs. 10,723,000. In addition 65 other machines were ordered in the country to the value of Rs.2,100,000. Already 512 machines have been received and a good proportion of these have been erected.

More than 500 erection tools had specially to be procured for the installation of these machines, and more than 2,200 different production tools have been ordered for use on the machines. As many as 2,168 production tools have been received. Tool cribs and tool cabinets for housing these tools have since been procured from Messrs. Godrej & Boyce Manufacturing Co. who came forward in

response to the enquiry issued by the Stores Department and successfully manufactured them for the first time in their workshops at Bombay.

The integral coach being a completely welded unit, has necessitated the purchase of 800,000 ft. of Oerlikon Electrodes of different gauges. The raw materials, semi-finished, and finished items required for the manufacture of 270 coaches have already been arranged for supply, and indents for similar materials will shortly be submitted for a further 175 coaches. Hundreds of gallons of special corrosion-resisting paints have also been arranged for the painting of the integral coaches before they are turned out of the factory.

ENCOURAGING INDIGENOUS SUPPLIERS

While the aim is to ultimately have the integral coach manufactured entirely out of indigenous materials, at present due to Swiss collaboration and the fact that the Swiss technical advisers are accustomed to continental specifications and practices which are new to Indian manufacturers, a certain proportion of the coach components has temporarily to be imported from abroad.

Where materials are not available in the country and there are no agents of foreign manufacturing firms in India, and where time does not permit of the material being obtained through the Director General, India Store Department, London, costly cables have to be sent abroad calling for quotations in sterling and orders placed thereafter, duly obtaining a user's import licence from the Chief Controller of Imports, New Delhi. By the issue of educational orders in the country, however, the number of imported items is gradually being reduced and it is likely that within the next few years, the objective of building an all-Indian coach will have been realised.

CHANNELS OF PROCUREMENT

Procurement has been invariably arranged through the normal channels of procurement, and by the submission of indents on the Supply Department organisation in India or in London, wherever the value required this being done and the time of delivery, as specified on the indent, permitted the adoption of such a course. In fact, special powers of purchase for direct procurement action were arranged to be obtained for the Regional Director of Supplies, Madras, by this Administration, so that this might facilitate purchases being made by him for the Integral Coach Factory.

PECULIAR PURCHASES

A stores officer attached to a project has of necessity to be resourceful and to continually keep on solving problems that might well baffle the average man. It is the duty and responsibility of the stores officer to obtain the correct goods in time and how he does this is solely his responsibility and concern.

For example, it is not uncommon for giant packing cases to be received at Madras harbour from abroad. These have to be brought to the Integral Coach Factory as soon as they are received and some of them frequently measure anything upto 74′ × 10′ × 10′. These cases, however, present very little difficulty in transport in as much as they are consigned to the factory from Zurich in Switzerland by Messrs. Swiss Car & Elevator Manufacturing Co., which is collaborating with the Indian Government in the manufacture of Integral Coaches at Perambur. The Swiss technicians with their usual foresight and detailed planning have made the transport of these large cases an easy matter, but occasionally giant packing cases, received from other sources, create some consternation on receipt at the harbour.

SEARCH FOR A TRUCK

A large case measuring 22′ × 8′ × 11′–6″ and weighing 38 tons 10 cwts. was recently received with material relating to a 1,000-ton hydraulic oil press which was required to be urgently installed in the factory, and while normally it should have been conveyed in a BWL "Well" truck by rail, the Southern Railway could not supply such a truck immediately and considerable delay was anticipated in its becoming available. The cart contractors all shook their heads and proclaimed that the case was too heavy to be borne on their carts; all the public transport companies in Madras stated that they had no suitable vehicle on which to convey it; the military authorities, who were contacted both at Madras and Avadi for a tank carrier, regretted that they had no immediate facilities to help in the conveyance. Finally, after a good deal of investigation, the Public Works Department came to the rescue and obtained from Bhavanisagar a Foder Tractor and a 40 ton "KARYMOR" trailer, on which the case was successfully loaded and brought to the factory where it had to be unloaded with the help of four locomotive jacks obtained on loan from the Southern Railway.

"IMMEDIATELY, PLEASE!"

As to the procurement of items of peculiar identity, the writer can quote quite a few examples but perhaps only one will serve as an illustration of what one has to cope with when procuring stores for a project. Recently the Stores Department were asked to procure urgently and stock 3,250 lbs. of Kapa Fazer Kitt. One might well wonder as to the type of material which was actually required to be purchased; which procurement section of the office was to deal with the purchase; to what line of firms were enquiries calling for quotations to be sent; and which ward was to stock the material. But why worry? Leave it to the Stores Department to procure the goods—and "immediately", please!

A TUBULAR QUIZ

Is copper lighter or heavier than steel?

Copper is heavier than steel.
A cubic inch of copper weighs approximately 0.321 lbs.
A cubic inch of mild steel weighs approximately 0.283 lbs.

Which is correct English—"FEETAGE" or "FOOTAGE"? Why not be correct?

Feetage.

ONE COACH EVERY SIX HOURS

By C. G. Devaya, B. SC., G. I. Mech. E.
Production Engineer, Integral Coach Factory.

PRODUCTION PLANNING AND CONTROL

CONSTRUCTED and designed for a production programme of 350 broad gauge steel coaches a year when in full swing production, the Integral Coach Factory will turn out coaches at the rate of one every six working hours.

To achieve this colossal production task, the orderly planning of work through the factory is obviously necessary and the function of the Production Planning and Control Departments is to make possible such orderly arrangements.

Planning is the technique of foreseeing or picturing ahead every step in a long series of separate operations, each such operation to be of maximum efficiency and of so indicating each step that routine arrangements suffice to cause it happen in the right place and at the right time. The mental labour of production is reduced to a minimum by planning before the work is started, by defining what work shall be done, how the work shall be done, where the work shall be done and when the work shall be done.

900 TYPES OF MACHINES

At peak production in the factory, there will be nearly 900 various types of machines including welding sets in operation. Several of these are single purpose or special purpose machines capable of producing coach components at the very fast rate demanded by the heavy output programme chalked out for the factory.

The effective utilisation of these modern high speed machines calls for the provision

Sri C. G. Devaya

of up-to-date tools which are being produced in the machine tool world. Tool engineering is now a large field of specialisation in which there is a constant trend towards improved methods which have far-reaching effects on production. The Production Department has, therefore, ensured that the factory is equipped with the latest tools that are being manufactured to assist the industries to cope with the demands for high speed production in this era of mechanisation.

OVER 2,000 ITEMS OF TOOLS

For the factory, in the first instance, the tool requirements for the production of

250 coaches have been procured and this consists of 2,168 different items of tools totalling to about 250,000 numbers purchased at a cost of about Rs. 16 lakhs. Besides these, several special tools have been procured for use on special purpose machines.

An efficient organisation for tool control will ensure the availability of the correct tools and their maintenance. Proper maintenance of inventories and tool records including their history in service will enable evolving tooling of jobs to an efficient degree.

The issue of tools in the various shops will be from suitably located tool cribs which enables the various tools to be stocked and issued in a systematic manner. The tool room will ensure that the tools are kept ready in advance so that when required by the operator, the right tools are immediately available at the tool cribs. Inefficient tooling and tool control are frequent causes of workshops not obtaining the maximum output from the installed capacity. The tool crib operation will provide for careful, accurate and rapid service. The double token system which will ensure quick issue without any paper work will also locate the tools already issued as well as the parties to whom issued.

670 JIGS

As this factory has been built to produce one particular type of coach known as the integral coach in the first instance, there is a concentration on the manufacture of specific types, of products as compared to the various types to be manufactured against customers' requirements in other commercial factories. In other words, long production runs are made possible which gives the maximum scope for the use of jigs and fixtures. Taking full advantage of this fact, in the pre-production planning, 670 jigs have been provided for at an approximate cost of Rs. 20 lakhs which will greatly assist in simplifying the manufacturing operations by eliminating individual attention that otherwise be necessary to the marking and clamping of the work and guiding of tools with respect to each job. Of these jigs, four are large assembly jigs, for welding the various members together to be utilised in the assembly shop for the under-frame, roof construction, end construction and final body assembly where the shell is completed.

RAW MATERIALS

Steel items of various sections, thin steel sheets and plates, light alloy sheets, tubes and pipes, rubber profiles and parts, light alloy extrusions, castings and forgings, pipes and pipe connections, stainless steel screws and nuts, springs, paint and insulation material etc. are the various types of raw materials that are required for the coach.

When the coach is turned out of the factory in an unfurnished state together with the bogie, each coach will weigh 32 tons and for the 350 coaches it will be seen that about 11,200 tons of materials will have to be stocked in stores and handled through the manufacturing shops.

In addition to these 350 coaches which will be currently turned out during the year, the components for the future batch orders will have to be manufactured continuously and the amount of materials that will be stocked and handled is expected to be at least two to three times the above tonnage including the several items of other consumable items and indirect materials required for the manufacturing processes and the maintenance of plant. By scheduling carefully well in advance it will be ensured that the raw materials are made available for the commencement of production on each batch order.

MECHANICAL HANDLING

Efficient handling and conveying arrangements are most essential for economical

production. The transport of materials, so that they will be made available at the proper time and at the proper place in correct quantities, requires considerable organisation.

Very often the cost of production is almost directly proportional to the cost of handling materials. Handling has, therefore, been eliminated wherever possible and for the handling that is necessary mechanical means have been provided for. Fork Lift trucks, Lister trucks with trailers, pallets, containers etc. cater for the movement of smaller parts between shops and good concrete roads provide for efficient inter-communication. The installations include 20 cranes of 5 ton capacity, 4 cranes of 20 ton capacity, 2 traversers of 70 ton capacity, 3 lifts and several portable hoisting arrangements for feeding the various machines. Wheels and axles in storage are handled by a 5-ton steam crane and a Neals 5-ton tractor crane is available for other miscellaneous purposes. For the handling of sheet metal between the various machines, ball transfer arrangement has been adopted.

In order to ensure easy transport and availability of the purchased and manufactured parts required on the assembly lines, each part or sub-assembly is nominated to be stocked in a conveniently located Finished Part Stores.

MASTER LIST OF PARTS

In preparing for production, a master list of parts has been drawn up after dividing the coach into various groups indicating the individual components required for the roof, side walls, and construction, under-frame, draw bar and buffing gear, vacuum brake and bogies separately.

The decision whether the part is to be manufactured or purchased and the number of coaches to be produced on each production order is decided taking into consideration the manufacturing capacity developed at each stage. The maximum efficiency in production is no doubt obtained by manufacturing the required quantity of the product, of the required quality, at the required time by the best and cheapest method. In several cases parts are stored as sub-assemblies for greater ease and efficiency in assembling.

A master operation plan is made out after an operation study indicating description of the part to be manufactured, the raw material required, the machine group to be utilised for each operation, special tools, jigs or fixtures to be used and setting and operating time for each operation.

TIME STUDY OF JOBS

For most of the jobs actual time study is carried out while the operation is in progress to ensure the accuracy of timings laid down. Special instruction sheets furnishing the particulars of tooling, speeds feeds and depth of cuts are issued to shops so that the operator is in possession of the complete 'know-how' to produce the job. The gauging of the efficiency of the plant and the success of any incentive system of payment that may be introduced in the factory will greatly depend on the efficient planning and rate fixing for the various operations.

Time study is not made to force the last ounce of effort out of the workers, but its usefulness lies in the fact that by a scientific study reasonable timings are fixed and as a result very often it is possible to improve methods and also standardise equipment. Certain operations are eliminated or simplified or a better sequence of operations adopted.

Time observations are made over a long stretch of period and several such observations are made as there is a difference between what a man can do for short times and what he can maintain. This enables fixation of reasonable timings for the preparation of the master plan where taking all the above

factors into consideration, the time for setting up and operation is recorded.

SCHEDULING AND PROGRESS SECTIONS

A Scheduling Section working in the Production Department is responsible for fitting of the specific jobs into a general time table so that in mass production each component may arrive at and enter into an assembly in due order and on time.

After the manufacturing processes have been finalised by the Planning Department the Scheduling Section gets down to the detailed schedule wherein specific target dates are assigned for each job duly taking into consideration the raw material availability, the time required for the manufacture of the components, machinery capacity available and the latest date by which the coach component is required on the assembly lines. These assigned dates for each component are entered in the job cards and the progress sheets so that the manufacturing and the Production Control Departments can watch and ensure that the programme is actually put into effect and the dates set for each operation are observed.

The function of the Progress or Expediting Section is to ensure that for each operation the raw materials are available in time and that the operations are commenced and completed as per the scheduled dates. All delays are pin-pointed and necessary expediting action taken.

While the progress sheets enable the watching of the progress on individual operation, a Master Progress Board is maintained which at a glance indicates upto the minute information as the inventories and the progress of manufacture in relation to the planned programme. If bottlenecks or obstructions arise to impede the flow of production, it is for the Progress Department to take effective action and clear the way so that the production programme can be adhered to.

It has to be ensured that the machinery capacity is properly utilised and the loading on the various groups of machines is evenly balanced.

If at a particular stage for any reason, the load on a group of machine exceeds the capacity available, the machine loading section brings this fact to the attention of the Production Planning Department who in turn will plan the operations to be carried out on other types of machines where spare capacity may still be available.

At a glance from the board, the Production Department will be in a position to keep a track on machine loading and have upto the minute information regarding the capacity available in each machine group for the absorption of the future production orders.

PLANT EFFICIENCY

From the detailed planning of manufacturing operations, the actual time that should be taken on the various jobs in the plant is known and this is compared with the actual time taken. Such losses are analysed under the various headings such as machine breakdowns, inefficiency of operator, inefficiency of tooling, defective materials etc. and the Planning Department investigates the reasons for such losses in machine hours and takes necessary action to prevent the future leakage of machinery capacity due to such reasons.

Planned production serves as a means of waste elimination and cost control. It is most essential that the coaches should be produced in the most economical manner and the aim is to bring the cost of production to as low a level as possible as compared to the cost of coaches that were being imported. To ensure this, strict vigilance will be maintained in the factory on the various items of expenditure.

(*Continued on page 59*)

Water Supply For Coach Factory

By A. K. Ramayya
Executive Engineer

Rs. 11.55 LAKH SCHEME EXECUTED

ALTHOUGH the Integral Coach Factory when in full production is estimated to provide employment for about 4,000 workers, the staff colony attached to the factory has been built to accommodate 400 workers of the essential category.

The water supply scheme for the Integral Coach Factory has, therefore, been planned not only to meet the requirements of water for production processes but also for the needs of the workers within the workshop area for drinking and washing and for domestic consumption in the staff colony. In addition, the water requirements of a Swiss hostel, club building for staff, rest houses for officers and subordinate officials, hostel for 250 apprentice trainees, a technical school with attached satellite workshops and, last but not the least, horticultural activities in the staff colony and workshop area, have to be catered for.

Sri A. K. Ramayya

TOTAL REQUIREMENTS

For the staff colony, which is completely sanitized with modern fittings and water-borne underground sewerage system, it is proposed to allow 40 to 50 gallons of water

(*Continued from page 58*)

PUNCHED CARD SYSTEM

It is intended to introduce and elaborate cost accounting system so that a maximum analysis of expenditure is possible whereby a check can be maintained on wasteful production and expenditure. The system of punched cards is likely to be adopted in the factory and with this end in view, the production documentation is so designed that the relevant data can be transferred on to the punched cards.

By a proper system of coding, the information required by the Production Engineer can be extracted accurately and quickly.

These are the various means whereby, when the factory sets about its task of producing 350 coaches each year, the inevitable operating friction will be reduced to a minimum and clear instructions issued to every man in the factory regarding the production methods so that high man and machine hour productivity is ensured.

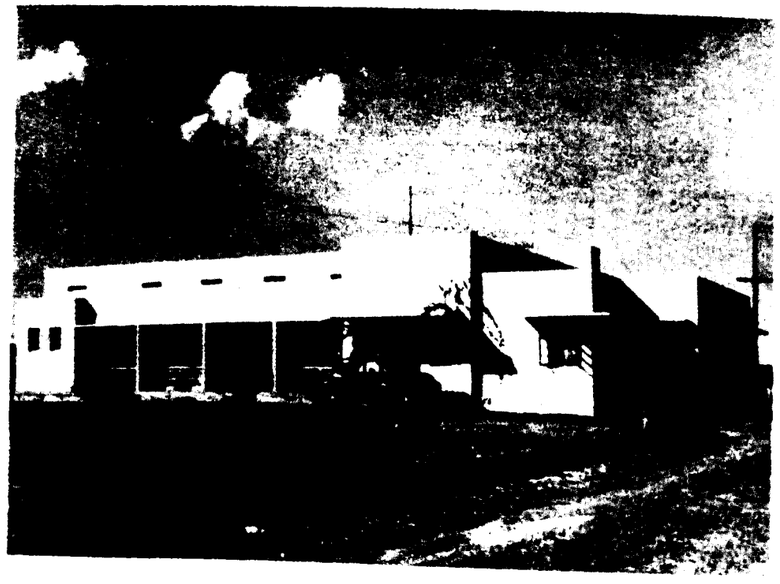


Photo shows the I. C. F. Institute, a Club House for the Factory's workers.

Photo shows the Canteen Building of the Integral Coach Factory.

per head per day. Assuming five persons in an average family, the following statement gives the total quantity of water required daily :

	Gallons
(a) Staff colony including officers' flats and Swiss hostel	85,000
(b) For workers inside the factory (4,000 × 5 gallons)	20,000
(c) Manufacturing operations	50,000
	1,55,000

This quantity of 1,55,000 gallons, which represents the total requirements of raw and filtered water for the factory per day, will meet the needs of the factory during normal times. An allowance of 45,000 gallons per day is, however, made for future expansion of the colony and increased production in the workshops, thus placing the total anticipated requirements at 200,000 gallons per day.

WATER FOR SOUTHERN RAILWAY

The Southern Railway workshops and their staff colony in Perambur have also been experiencing much difficulty for water in the past. And, as most of the efforts to obtain their entire requirements of water in and around Perambur had failed, a joint scheme costing Rs. 11.55 lakhs was drawn up by the Integral Coach Factory in consultation with the Southern Railway Administration for pumping adequate quantities of water from a site near Ennore village to Perambur.

At present the Southern Railway administration have a pumping installation on the north-east line at mile seven (from Madras) between Ennore and Tiruvottiyur stations, from where water is being pumped through a 9" C. I. pumping main to Tondiarpet Marshalling Yard and Basin Bridge. This supply meets the demands of the Southern Railway at Basin Bridge Loco Shed, Madras Central Station and the Railway Marshalling Yard at Tondiarpet. The feasibility of expanding this source and pumping the additional yield thus obtained to Perambur, to meet the increasing demands by the Southern Railway and fresh requirements of the Integral Coach Factory, was also considered.

The requirements of water for the Southern Railway at Perambur to meet the needs of the staff colony and the loco and carriage repair shops was computed to be approximately 450,000 gallons per day. Adding to this 200,000 gallons of water required for the Integral Coach Factory, the total requirements at Perambur would amount to 650,000 gallons per day. Out of this, 250,000 gallons will be filtered water for domestic consumption and for drinking inside the shops and this will be supplied by a pumping station already working at Perambur which filters water from a nearby ground level reservoir and supplies the same through a set of five high level tanks after chlorination.

The total combined demand for Basin Bridge, Central Station and Tondiarpet Marshalling Yard is assessed at 600,000 gallons of water per day. Adding to this another 400,000 gallons required at Perambur, the total proposed out-take of water from the pumping station at mile seven would be approximately ten lakhs of gallons of water daily.

FEATURES OF SCHEME

To meet this demand, a scheme costing about Rs. 11.55 lakhs was drawn up (i) to improve the source of supply at mile seven ; (ii) to electrify the existing diesel driven pumps ; (iii) to lay a duplicate 12" dia. C. I. pumping main from mile seven north-east to Korukkupet and a new 9" C. I. main from Korukkupet to Perambur ; (iv) to build ground level reservoirs and pumphouses at mile seven north-east and Korukkupet ; (v) to take electric supply from the Madras Electricity System ; and (vi) to acquire additional land around the water supply source etc.

MEN BEHIND THE I. C. F. ORGANISATION

SHRI K. SADAGOPAN

AFTER a brilliant academic career, Shri K. Sadagopan joined the ex-South Indian Railway in 1926 as a Probationer in the Accounts Department. After working in various as a Junior and Senior Accounts Officer, particularly in new constructions, Shri Sadagopan was promoted as Deputy Chief Accounts Officer in 1944. On the new year day of 1946, he became the Financial Adviser & Chief Accounts Officer of the ex-South Indian Railway—one of the youngest at that time to hold such a responsible post.

He then moved into a higher sphere of activity and became Director of Finance, Railway Board, in March 1949, and held this post for a little over four years, in the course of which, he also officiated for a short time, as Financial Commissioner, Railways. He also played a prominent part in the integration of the ex-State Railways into the Indian Government Railway System.

Shri Sadagopan had been twice deputed abroad, once in 1951, jointly with the Chairman, Railway Board, in connection with the procurement of rolling stock for Indian Railways, and in 1953, he had to go to Europe a second time for negotiating a revision of the Agreement with Messrs. Swiss Car & Elevator Manufacturing Corporation of Zurich in Switzerland for the establishment of a Coach Building Factory in India. After his return to India on the successful completion of this mission, he was posted as Chief Administrative Officer, Integral Coach Factory, in July 1954 and entrusted with the great task of organising and establishing the Integral Coach Factory on the most modern lines.

In all the responsible posts, he had held, Shri Sadagopan was distinguished by his

Shri K. Sadagopan

suave and polished manners and his capacity to create 'esprit de corps' amongst all the Officers and others working under him.

Besides being a gifted and impressive speaker, he is keenly interested in promoting the welfare of all those working under him and is always ready to partake in social activities in a truly democratic spirit.

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SHRI M. GANAPATI

Shri M. Ganapati, B. E., M. E. Hons., M. I. E. (Ind.), Development Commissioner, Kandla Port Project, was born in November 1903, and graduated from the Engineering College, Guindy, Madras, in 1925. After completing his apprenticeship with the Tata Power Company at Bombay, he served with that firm as an Electrical Erection Engineer, and later became an Engineering Supervisor on the construction of the Mettur Dam. He joined the East Indian Railways, as an Assistant Executive Engineer in the Indian Railway Service of Engineers, in March 1928. Between 1928 and 1933, Shri Ganapati was attached to the Lucknow-Sultanpur construction works, Lower Zone Bridge regirdering and the Calcutta Chord Railway construction. Between 1933 and 1936, he was on open line works, when he joined the East Indian Railway Bridge Office on special duty connected with the reorganisation of bridge maintenance. After four months as Bridge Engineer towards the end of 1939, he joined the Dufferin Bridge regirdering project. When this work was postponed, due to the war, he proceeded on special duty in connection with the construction of the Panagar Base and later in 1943, was in charge of the

Shri M. Ganapati

restoration and reconstruction work caused by the Damodar river breaches near Calcutta on the E. I. R. Between 1944–45, he served as Trach Supply Officer at the E. I. R. Head Office, and during the succeeding two years was Deputy Chief Engineer in charge of the regirdering of the Dufferin Bridge at Banares. After three months as Deputy General Manager (Works), he took over as Engineer-in-Chief of the Chittaranjan Locomotive Works, on January 1, 1948. On completing the construction of this 15-crore project by the end of March 1951, he was assigned the work in connection with the construction of the Integral Coach Factory, Perambur. In April 1953, he was appointed as Development Commissioner, Kandla Port Project costing Rs. 14.15 crores. Two stages of work in the

Bunder and the Oil Jetty, which form part of the major harbour works construction at Kandla, having been completed and the main stage of work in the construction of the Cargo Jetty being in fully swing. Shri Ganapati has been recalled for service in his parent department, and has been posted as General Manager, Western Railway. In recognition of his outstanding services, the President of India conferred upon him the award of "PADMA BHUSHAN" on the 15th August 1954.

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SHRI O. S. MURTHY

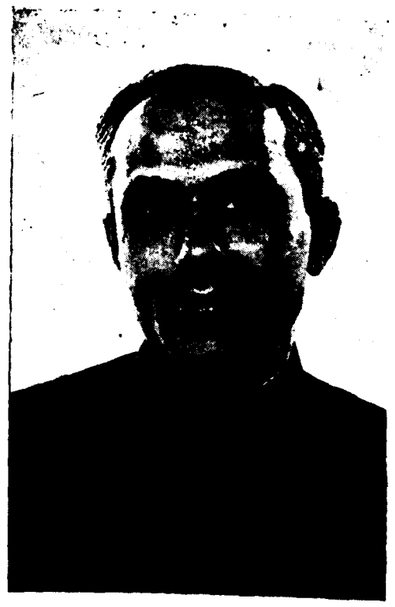
Shri Murthy took his B. A. degree in the year 1931 from the Madras University in the I Class, standing first in the University in Mathematics.

He joined the Guindy Engineering College and passed the B. E. degree examination with Honours in the year 1935.

He was recruited to the Indian Railway Service of Engineers and in 1936, he was posted to the ex- G. I. P. Railway.

During the subsequent 12 years, he served on the ex- G. I. P. Railway in various capacities–as Assistant Engineer, Assistant Bridge Engineer, and Engineer-in-Charge (Projects). During this period, he was responsible for executing two major remodellings of yards and the construction of several hundred staff quarters and other connected works.

In December 1948, he was placed on Special Duty with the Railway Board along with two other Officers for scrutinising the designs of steel structures of the Chittaranjan Locomotive Works Project, and was subsequently posted as Executive Engineer



Shri O. S. Murthy

in charge of the construction of the workshops. On completion of this assignment, he rejoined the ex- G. I. P. Railway in April 1951 as Bridge Engineer. In May 1951, however, he was transferred to the Integral Coach Factory Project as Executive Engineer. He took over the duties of the Engineer-in-charge of the Project from April 1953. In July, 1955, Shri Murthy was deputed to Switzerland for finalising the detailed floor layout of the factory in consultation with M/s. Schlieren of Zurich.

Shri Murthy is a Corporate Member of the Institution of Structural Engineers and has published two technical papers, one on "Gradients in Hump Yards" and the other "An analysis of the main causes of derailment".

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MR. C. D. ELLICOTT

Charles Donald Ellicott was born on 9th November, 1906 at Hyderabad Sind. He received his earlier education at the Karachi Grammer School, from where he passed the European High School Examination in 1922. He passed the Senior Cambridge Examination in the same year and two years later, after passing the Inter Science Examination in the D. J. Sind College, Karachi, he proceeded to Scotland and graduated at the University of Edinburgh securing the Bachelor of Science (Hons.) Degree in Civil Engineering in 1928.

Shri C. D. Ellicott

On his return to India, he was selected as a Student Engineer on the ex-East Indian Railway and received his practical training in the Cawnpore Area Remodelling Scheme. After the completion of this training, he was appointed as a temporary Asst. Engineer on the ex-South Indian Railway on 26—5—1930 and posted as Personal Assistant to the Engineer-in-Chief, Surveys & Construction. He was later put in charge of the final location and Land Requisition Survey in connection with the Shoranur-Ernakulam Broad Gauge conversion. After successfully completing this work, he held several assignments in the Engineering Department, and was finally transferred to the Stores Department as Asst. Supdt. of Stores on 7—4—32. He was elected as Associate Member of the Institution of Engineers (India) on 20—4—37. He was promoted to officiate as Dist. Supdt. of Stores on 1—3—38.

On 7—5—43, he was promoted as Deputy Controller of Stores/Golden Rock. He officiated as Controller of Stores on the ex-South Indian Railway from 22—6—47 to 3—2—48 and again from 1—2—51 till 23—7—51 when he was reverted as Deputy consequent on the amalgamation of the Railways in the Southern Zone. He was elected to the membership of the Institution of Engineers on 23—7—1951.

After amalgamation, he was transferred to Madras as Deputy Controller of Stores and later reverted as Dist. Controller of Stores (Purchase) in the combined office of the Controller of Stores. On 27—7—53, he was again promoted as Dy. Controller of Stores in which capacity, he has continued to work since then. He joined the Integral Coach Factory as Dy. Controller of Stores on 17—1—1955.

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SHRI K. SUBRAMONIAN

Born on 19—4—22, in Travancore, Shri Subramonian had his early education in various Schools in the State and passed the English School Leaving Certificate Examination when he was fourteen. He then joined the Maharaja's College of Science, Trivandrum and passed the B. Sc. (Hons.) Degree Examination of the Travancore University with Mathematics as his subject, in 1942. After serving as an Assistant in the Railway Board's Office from 1943 to 1946 and in the

Shri K. Subramonian

Directorate General of Industries and Supplies for a few months, he joined the ex-South Indian Railway as a Probationary Assistant Personnel Officer in December 1946. He was deputed to the Calcutta University in 1948 for a Diploma Course in Social Work (Labour Welfare) and shortly after the successful completion of the course, took up his first working post as Asst. Personnel Officer (General) in December 1948. From May, 1949 to November 1951, he worked as Asst. Personnel Officer (Traffic), Headquarters Personnel Branch, Trichinopoly. During this period, he had to deal with the implementation of the Adjudicator's award on the Traffic Department of the ex-S. I. Railway, involving the recruitment and training of large numbers of staff in a short time. In November, 1951, he was promoted to the Senior Scale and posted as the first Personnel Officer in the Mysore Region of the integrated Southern Railway. He was transferred as Personnel Officer, Golden Rock Workshops in June, 1953 and then put on special Duty in connection with the preparation of combined Seniority Lists on the integrated Southern Railway, in December 1953. He joined the I. C. F. as Personnel Officer in March 1954 and when the 'RAILCOACH' was started in January 1955, its editorship was assigned to Shri Subramonian.

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SHRI U. A. KAMATH

Shri U. A. Kamath, born on 4th October 1922, passed his Intermediate in Science from the Loyola College Madras in 1938. He

Shri U. K. Kamath

then spent a year each at the Annamalai University and at the School of Mines, Dhanbad. On 1—4—1941, he joined Railway Service as a Special Class Apprentice at Jamalpur on the E. I. Railway. He successfully completed his 4 years training during which he passed Sections A, B and C of the Associate Membership Examination of the Institution of Mechanical Engineers, London. After a short period of 6 months further training in Ajmer Shops of B. B. & C. I. Railway, Shri Kamath sailed for the United Kingdom in September 1945. In U. K., he was attached to the London and North-Eastern Railway and received practical training in Locomotive and Carriage and Wagon Building and Repairs and in the Drawing Office. During August 1947, a short period was spent studying the work of the French State Railways under the guidance of the late Monseieur R. Leguille, a French Railway Mechanical Engineer. From September 1947, to January 1948, Shri Kamath was attached to the India Supply Mission, Washington, as an Observer to watch and report on the construction for the Indian Railways of the W. P. prototype locomotives then under constuction at the Baldwin Locomotive Works Philadelphia.

On his return to India in February 1948, he joined the M. & S. M. Railway as an Asst. Locomotive Works Manager at Perambur. He subsequently worked at Bezwada as ATS Power and as Asst. Works Manager, Hubli Workshops. On promotion to the Senior Scale in May, 1951, he worked as District Mechanical Engineer, Guntakal and as Production Engineer, Golden Rock. Shri Kamath was then placed on special duty for 6 months to prepare the remodelling scheme and detailed layouts for the Hubli Workshops at an estimated cost of Rs. 80 lakhs. Shri Kamath joined the I. C. F. as Principal, Technical Training School in March 1954.

During his Collegiate days, Shri Kamath was a keen Tennis player and a Rover Scout. He won the Singles Championships of the Indian School of Mines, Dhanbad in 1939. His other hobbies are Stamp Collecting.

SHRI G. N. UPADHYAY

Shri G. N. Upadhyay was born in Uttar Pradesh on July 1, 1903. He matriculated from the Patna Collegiate High School and after doing Intermediate from the Central Hindu College, joined the Engineering College, Benares and graduated in Electrical and Mechanical Engineering in 1927.

Shri G. N. Upadhyay

He joined the ex- G. I. P. Railway on 6—12—1927 and was promoted as Electrical Inspector in 1933. He became a Chartered Electrical Engineer on election as Associate Member of the Institution of Engineers (India) in 1937. From 1942 to 1947, he was in charge of all Electrical construction works on the Central Railway and was promoted as Asst. Electrical Engineer (Construction) in January 1948. In December of the same year, Shri Upadhyay was transferred to the Chittaranjan Locomotive Project where he was engaged in the execution of High Tension supply mains,

workshop lighting, wiring up and commissioning of the electrical equipment of all workshop machines as well as a large number of electric cranes of different types and capacities. He officiated as District Electrical Engineer more than once and on the close of construction, he was given charge of operation and maintenance of all the electrical equipment in the Factory.

In September 1953, he joined the Integral Coach Factory Project as District Electrical Engineer and has been in charge of all electrical installations in the Project.

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SHRI A. K. RAMAYYA

Born on 5th August 1923, Shri Ramayya had his early education in Nellore where he

Shri A. K. Ramayya

passed the Intermediate Examination in 1940. He then joined the Guindy Engineering College and after a brilliant academic career, took his B. E. Degree in Civil Engineering in 1943, with honours, scoring record marks. He joined the service of the Madras P. W. D. as a Junior Engineer in October, 1943 and after serving as a Supervisor Instructor for the training of Draftsman in the National Service Labour Tribunal for about a year and a half he joined the Indian Railway Service of Engineers as a Probationary Assistant Engineer on the ex-M. & S. M. Railway in October, 1945. After working at various Stations on the M. & S. M. and the Southern Railway, Shri Ramayya was transferred to the Integral Coach Foctory in April 1952. He assisted Shri Murthy in the design of the Steel Structures in the Shops and was promoted to the Senior Scale and posted as Executive Engineer in charge of the Construction of the Workshops, in May 1953. Since May 1954, Shri Ramayya has been in charge of the Buildings and Services Division.

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SHRI R. M. SAMBAMURTHI

Born on 15—2—21, Shri Sambamurthi studied in the Municipal College, Salem, prior to joining the College of Engineering, Guindy, Madras in 1938. He passed the B.E. degree examination in 1942 from this College with honours obtaining the College and University Gold medals for that year.

He entered the Indian Railway Service of Engineers as a probationary Asst. Engineer in the North-Western Railway on 15-9-1943. Subsequently he held the post of Asst. Engineer at Ferozepore and Rawalpindi. On the partition of India, he opted for service under the Government of India and was transferred to the then M. & S. M. Rly. in September, 1947. During the period 1947 to 1952, he occupied various posts in the M. & S. M. Rly. successively as Officer-in-Charge of the Chief Engineer's Drawing Office, Personal Assistant to the Chief Engineer, Bridge Engineer, District Engineer, etc.

During the period from May to October 1950, he was deputed to undertake the Engineering Survey of the Kakinada-Pithapuram Main line Diversion which was completed in time. He joined the Integral Coach Factory in March 1952 and was in charge of the Buildings and Services Division till May 1954. Since then, he is in charge of the Workshops Division.

Shri R. M. Sambamurthy

His main hobbies are Photography, Horticulture and Astrology; and he is a man of varied interests. His contributions to the 'Railcoach', in the form of ideas and suggestions, have been invaluable.

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SHRI C. G. DEVAYA

Born on the 5th December, 1919, Shri Devaya graduated as Bachelor of Science from the Presidency College, Madras in 1938 and then joined the Engineering College, Guindy. In 1939, he was selected as Special Class Apprentice for the Indian Railways and had his four years training at the Jamalpur Locomotive Workshops on the East Indian Railway and a further two years' training in the Locomotive and Carriage & Wagon Workshops on

Shri C. G. Devaya

the G. I. P. Railway. He passed the Associate Membership Examination of the Institution of Mechanical Engineers in 1943.

In 1945, he was posted to the M. & S. M. Railway as Assistant Transportation Superintendent (Power) and promoted as Production Engineer, Locomotive and Carriage and Wagon Workshops, M. & S. M. Rly. in 1947. From 1950 to 1952, he worked as Works Manager, Metre Gauge Locomotive and Carriage Works, Hubli. In 1952, he was placed on deputation to the India Supply Department, London, as Senior Railway Inspecting Officer where he continued till 1954. During this period, he worked in Locomotive and Carriage and Wagon Factories in Belgium and Germany. On his return to India in June 1954, he was posted to the I. C. F. as Production Engineer.

Shri Devaya is a distinguished sportsman, having won the Individual Championship in Athletics in the Engineering College. He has played representative matches in Hockey, Cricket and Tennis for the Colleges and the Railways. He is the Secretary of our Sports Club and has been taking very great interest in the promotion of sports in the I. C. F.

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MR. W. J. BRÆM

Mr. Bræm was born in Zurich-Seebach (Switzerland) on 18th January, 1905. After passing the regular school courses plus some additional courses of a preparatory school for the Technical College, he spent 3 years as mechanic apprentice in the Swiss Car & Elevator Manufacturing Corporation Ltd., Schlieren-Zurich. Then he joined the Engineering College at Winterthur-Zurich and got his degree in Mechanical Electrical Engineering. He served for several years in different firms in Switzerland, France and also in the U. S. A. for two full years with the A. B. See Elevator Manufacturing Co. in New York.

In between, he also underwent military training courses which were compulsory in Switzerland and passed the special courses for officer ranks in the Signal Corps.

In 1931, when he was in the U. S. A., the Swiss Car & Elevator Manufacturing Corporation Ltd, where he had worked as an apprentice approached him for taking up services with them again. This offer was accepted and since then, i. e. for the past 24 continuous years, he has served them, passing through various stages and departments viz., Lift Erector, Lift Designer, then 8 years as the Engineer Representative for Schlieren in the North-Western district of Switzerland, and subsequently as Sales Engineer in the firm's rolling stock section, in which he became the Chief of the Department.

During the last world war, Mr. Bræm had to serve as an Officer in the Signal

Mr. W. J. Braem

Corps of the Swiss Army where he rose to the rank of a Lt. Colonel.

In 1947-48, Mr. Bræm had the opportunity to make the first contacts on behalf of Schlieren, with the Indian Railway representatives who were then touring the Continent and the U. S. A. in order to investigate the modern constructional developments in rolling stock outside India. Hence it so happened that Mr. Bræm is associated with this development scheme of the Indian Railways for better Rolling Stock from the very inception.

On the formation of the Schlieren Team for the I. C. F. in 1953, Mr. Bræm was appointed as the leader by the Swiss Car & Elevator Manufacturing Corporation, Schlieren-Zurich and he was deputed to Perambur on 1—12—54 since which period, he continues to act as the Chief Technical Manager in the I. C. F.

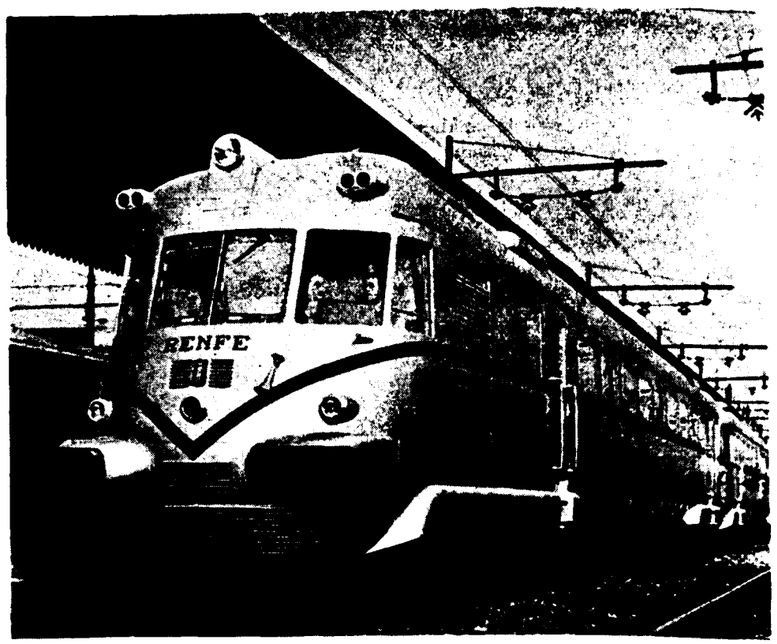
FIAT RAILCARS

THE Fiat Company of Turin (Italy), famous the world over for its motor cars, of both utility and high quality types, manufactures also many other mechanical products: commercial vehicles, tractors, aeroplanes, aviation engines (including turbo-jets), railway and tramway rolling stock, marine and stationary diesel engines, machine tools, domestic electrical appliances (refrigerators and washing machines), besides castings, forgings, stampings and lubricants.

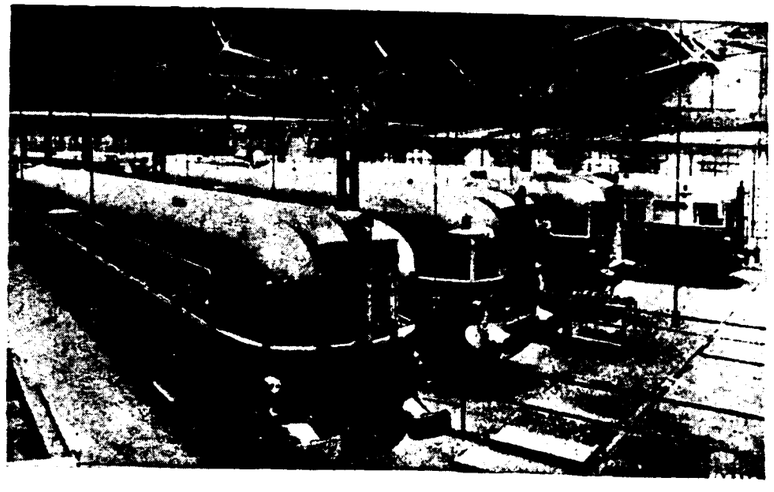
Fiat has been building railway rolling stock, notably motor railcars, since 1931 and was the first firm in Italy to design this modern form of rail transport and build it on a production basis.

The forerunner of the modern Fiat railcar was a small open type petrol driven tram, which carried people on a narrow gauge track around the grounds of the Milan International Exhibition of 1906. Travellers on this early example of a motor driven railway vehicle certainly did not taste the joys of high speed, but were subjected to frequent and harmless derailments and often had to lend a hand to put the car back on the track. Both car and rails ended their days in India, having been bought by a wealthy Rajah for the amusement of his household and his guests.

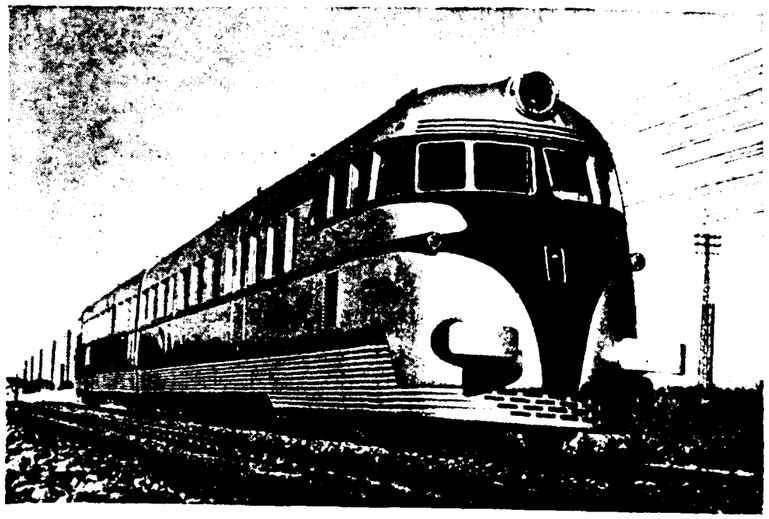
It is a far cry from that primitive vehicle to the luxury train built by Fiat for the Egyptian State Railways, originally for the use of the then Royal Family. This fine train consists of two close-coupled inter communicating cars. The overall length of the train is 152' 6"; it is built entirely of steel and weighs 114 tons. Power is supplied



De luxe train built for the Egyptian State Railways



Assembly of Fiat Railcars.



Diesel train set composed of power car and one trailer.

by two SBD–OM Saurer diesel engines, each with 12 horizontal cylinders (2 opposed banks of six) giving a total of 480 hp. at 1400 rpm. Maximum speed 75 m.p.h.

The outside of this train (which is the only one of its kind in existence) is finishied in aluminium colour, which gives the impression, when the train is travelling at speed, of a flash of silvery light.

This Egyptian train is lit by fluorescent lighting, is air- conditioned and has a complete automatic 16 line (2 external, 14 internal) telephone exchange and a radio sending and receiving set.

The equipment, furnishing and decoration of this train are most complete and luxurious; every detail is of Italian design and workmanship.

Fiat's international reputation in railway engineering won them this very important order. Other modern types of railcars have been supplied by Fiat to the Italian State Railways, as well as to the railways of Greece, Spain, and other countries.

Twenty 3-car train sets (two railcars and a trailer in the middle) have been supplied to the Spanish National Railway System (RENFE). Each of the power cars in these trains has a 480 hp., 12-cylinder horizontal diesel engine, installed under the floor. Of the 2 bogies, one carries the engine while the other is a plain bogie. These trains are 273 feet long overall and have seating accommodation for 174 passengers. The maximum speed is 75 m. p. h. on a gradient of seven per thousand. The train can be divided as there is a driving compartment at each end of the two railcars.

Three similar train sets have also been supplied by Fiat to the Portuguese (CP) railways.

For the Greek Railways Fiat has supplied 16 railcars and 8 trailers. Each car is 78′ 9″ long and seats 85 passengers. Two railcars and one trailer coupled together make up a train 236 feet long, with accommodation for 273 passengers. The seats are comfortable and the corridors wide. The windows afford a good view of the scenery; the cars are heated in winter and have every modern convenience, including a bar.

Fiat's Railway Rolling Stock Division, well and modernly equipped, was of great help in reconstructing Italy's railway rolling stock depleted during the war. Since 1945 149 damaged or burnt out railcars and 3 semi-destroyed motor trains have been rebuilt.

Up to 1939 Fiat had built 134 petrol driven railcars and 518 diesel powered cars, 3 experimental types were completed during the war and over 100 new railcars were built, besides about 40 trailers. Further, over 200 six-cylinder type 700 railcar diesel engines have been supplied to various buyers in Italy, Greece and Australia.

A TUBULAR QUIZ

What is the object of a Bourdon Coil?

A Bourdon Coil is used for measuring pressures (or temperatures). A small tube is flattened and then coiled and sealed off at one end, the other being attached to a small conduit: as the pressure in the conduit increases the coil tends to straighten out and the pressure may be gauged by the extent to which this tendency is marked.

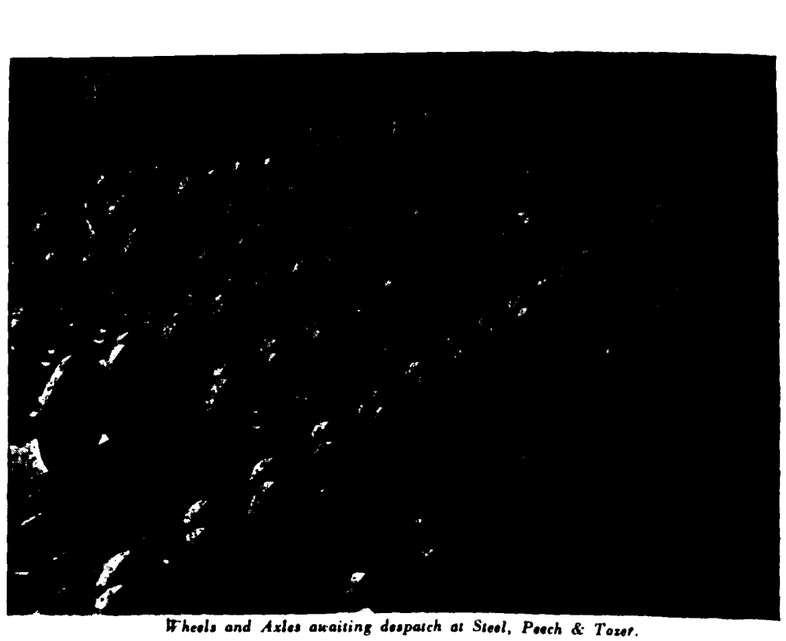
The Production of Railway Materials at STEEL PEECH & TOZER

STEEL Peech & Tozer have been major producers of railway materials for many years, and a substantial proportion of their output has always been supplied to Commonwealth and overseas railways, and rolling stock manufacturers. The company was founded in 1883 at Rotherham, and from relatively small beginnings, the present day large and modern works has grown up, producing about 1,000,000 ingot tons of steel per annum and employing over 7,000 people. As a member of the United Steel group of companies, which together produce one-eighth of Britain's annual steel output, Steel Peech & Tozer can call upon the extensive research facilities available at the United Steel Central Research & Development Department, which is unexcelled by any private research organisation in the world.

Wheels, tyres, axles and springs from the principal railway materials made by Steel Peech & Tozer. In addition to their own machine shops, the company can also draw upon the services of two associated concerns in the United Steel group, Yorkshire Engine Company Limited and Owen & Dyson Limited, the former specialising in the machining of crank axles, while Owen & Dyson carry out the machining and assembly of wheels and axles.

WHEELS

Wheel manufacture begins with the division of an ingot into suitably sized blocks, this operation being effected in a specially designed ingot breaking machine. Each block is carefully marked and retains its identity throughout the manufacturing process, so that



Wheels and Axles awaiting despatch at Steel, Peech & Tozer.

there is a complete check back from the finished wheel to the cast of steel from which it was made. After reheating in a continuous gas fired bogie furnace to a temperature of about 1,200° C., the blocks are descaled and transferred to a 6,000 ton forging press. The forged wheel blank has a smaller diameter and thicker web than the finished wheel, so that—after further reheating—it must next be rolled in a finishing mill.

This mill is of the vertical type, designed to produce wheels from 18 in. to 48 in. in outside diameter, the wheel blank being supported by a mandrel whose ends rest in slides. The only driven rolls are the two web rolls, which are rotated by variable speed D.C. motors. Actuated by oil pressure, these rolls swing in a horizontal plane; when thrust inwards, they exert equal pressure on the two sides of the web of the wheel blank, which consequently begins to rotate in a vertical plane. The two edging rolls then move up and press against the rim, thus controlling its width. Finally, the back roll, which has a centre corresponding to the tread and flange of the finished wheel, is brought up into position. Each wheel is rolled close to profile, so reducing the amount of subsequent machining require, with beneficial effects on the physical characteristics.

Charging machines transfer the rolled wheels to a 1,500 ton hydraulic dishing press, where the wheel boss is brought into the correct horizontal plane relative to the tread. It remains only for the desired heat treatment to be given and the wheels are ready for inspection and testing—both important features of works practice at Steel Peech & Tozer where rigorous standards are laid down for every kind of product.

TYRES

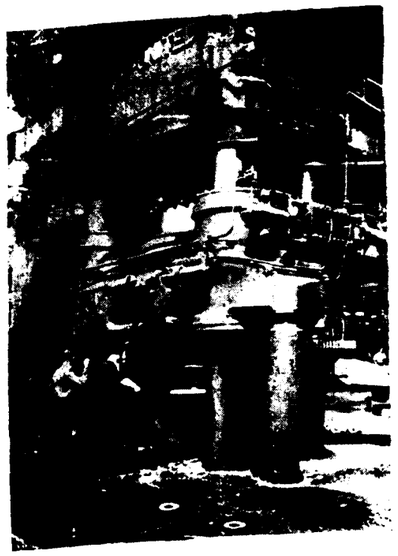
The tyre mill and auxiliary plant have a production capacity of approximately 1,500 tyres per week for every kind of rolling stock, including locomotive, carriage and wagon, electric stock, light railway and tramway. Tyres varying from a minimum internal diameter of 12 in. to a maximum of 90 in. can be rolled, and particular attention is devoted to the manufacture of high tensile tyres to meet arduous service conditions, including extremes of temperature, severe gradients and sharp curvature.

As with all the other railway materials described here, steel from the company's open hearth furnaces provides the basis for the finished tyres. The ingots are first divided into separate blocks—on the same machine as the wheel blocks—and the blocks are then charged into a continuous furnace for heating up to about 1200° C. After a thorough soaking at this temperature, the blocks are removed, weighed and transferred to a 2,000 ton press. Here, each block is forged into a tyre blank, the centre being punched out in the process. On completion of forging, the tyre blank is reheated to the correct rolling temperature and transferred to a vertical roughing mill, where the section is rough formed.

Finish Boring of Wheels at Steel, Peech & Tozer

The final operation is carried out on the finishing mill, which is of the horizontal box roll type, the main roll forming three sides of a box into which the tyre is forced by the centre roll. When the correct diameter is reached, it is shown on a special indicator gauge, the gauge setting being adjusted to give the correct diameter when the tyre is cold.

A small hydraulic press stamps the maker's and customer's initials on the tyre, which is then allowed to cool before being inspected for defects and gauged for size.



6000-Ton Wheel Forging Press at Steel, Peech & Tozer

AXLES

With over seventy years' experience in the manufacture of axles, Steel Peech & Tozer have recently taken another stride forward by installing a new axle forge, at a cost of £. 150,000/-.

This forge, designed for an output of upwards of 100 axles per shift, takes advantage of the most up-to-date techniques in axle production and the equipment installed has been laid out to ensure continuous flow of the material during the different stages of manufacture.

Axle blooms from the company's rolling mills are received in wagons by rail and are removed by electric overhead crane for stacking adjacent to a continuous furnace. The blooms are pushed down the furnace by an electric pusher, the normal heating period being approximately five hours. When it has

Forging a Railway Axle on a 7-Ton Hammer in the New Forge at Steel, Peech & Tozer

reached the correct temperature of 1,250° C., the bloom is delivered by a friction roll pusher, operating at right-angles to the centre line of the furnace, on to gravity rolls, from which it is picked up for forging.

Throughout the forging process, the bloom is held by a 6,000 lb. low, straight-line, bridge-type manipulator of the non-revolving type, operating on a track which runs in front of a 7 ton hammer.

When forging of one end of the axle is complete, it is rotated mechanically through 180° and forging of the other end proceeds. Doublegrooved fixed swage tools are used, one groove forging the middle of the axle while the other shapes the end collar, journal and wheelseat.

On completion of forging, the axle is placed on a tilting gantry which raises it to the height of the fore-hearth of the heat treatment furnace. Here, it is allowed to cool below the point of recalescence before being charged into the furnace. It rolls through the furnace during a period of four hours and is reheated to 850° C. On leaving the furnace, the axles roll on to a platform above a dipping tank if they are to be oil-quenched, those which are to be normalised passing straight over to a turntable. From the turntable, the axles roll forward to cooling racks, and are next transferred to a straightening press, which can exert a pressure of 150 tons; hydraulically-operated spinning rollers are provided to facilitate rotation of the axle during the straightening operation. The ends of the axles are then cut to the correct length by double-headed saws and pass forward for inspection.

Each axle is given a surface inspection and dimensions are checked. Axles may be loaded either direct into railway wagons for despatch to destination, if required in the "as forged" condition, or on to lorries for delivery for machining, this latter operation being carried out by Owen & Dyson Limited.

To cope with demands for axles when, for any reason, the new 7 ton hammer and its ancillary equipment are out of service, an existing 5 ton hammer has been transferred to the new axle forge building. Normally, this hammer operates as an independent unit on general forgings. It is served by two new batch type gas-fired furnaces, situated one on each side of the hammer. Each furnace is served by a 4 ton electrically-operated jib crane.

LAMINATED SPRINGS

The provision of efficiently made springs from reliable steel plays a big part in reducing maintenance costs on rolling stock. Steel, Peech & Tozer springs are supplied to railways all over the world and are designed to meet a wide range of operating conditions.

Furnaces and Presses in the Laminated Spring Shop at Steel, Peech & Tozer

Spring steel reaches the fully mechanised spring shop from the rolling mills in bar form. The bars vary in length from 14 ft. to 16 ft. rolled to close tolerance. They are cold sheared to length, each bar being turned after each cut so as to give uniform scarfing to the ends. The plates are next heated and the required nibs and slits hot punched. This is followed by spearing and shaping, according to specification, and where the design calls for a rolled eye back plate, the ends are heated and subsequently rolled in a special machine.

All the plates are charged into a continuous gas fired furnace in the correct sequence for assembly. Temperature at the delivery end is controlled automatically and is normally set between 950 and 1,000° C. On removal from the furnace, each plate is placed in a hydraulic press for bending to shape; it is then quenched in either a water or oil bath, as specified by the purchaser.

Endless conveyor belts lift the quenched plates out of the baths and they are then transferred to another conveyor belt which passes through a tempering furnace. Each plate is in the furnace about 25 minutes, the temperature being maintained at 450° C.

In the assembly section, each plate is checked against the preceding one to ensure a close fit after final assembly. To rectify any small irregularities, small hydraulically-operated presses are installed. A temporary buckle is fitted to the spring after assembly, and it then passes to a 20 ton scragging machine where the camber is tested. After a liberal application of linseed oil to prevent corrosion, the plates are assembled prior to buckling. Buckles are heated to 900° C. before fitting to the spring and are subjected to simultaneous horizontal and verticle pressure in a special press after they have been placed in position.

All springs are carefully checked to ensure that the buckle is accurately positioned and a proportion of the completed springs are tested under load.

There remains a considerable demand for hand-made springs for special purposes and these are produced by highly skilled craftsmen in a separate shop, where the plates are bent, hardened, tempered and fitted by hand.

Fifty Seven Years of Dunlop Enterprise in India

Fifty seven years ago, in 1898, the first pneumatic tyre arrived in Bombay and from that date commenced Dunlop's associations with India. In course of the years, profound changes have come over the life of this great sub-continent. The striving for modernisation has made itself felt in every sphere—whether education or industry, transport or public health—and has found a comprehensive expression in the Five Year Plan. This article deals briefly on the origins of Dunlop enterprise in India and its growth up to present times.

IN the closing years of the last century, the Modern India we know today had just started taking shape. The railway system was gradually branching out to all parts of the land. By 1890, nearly 4,000 miles of railway track had been laid, the Great Indian Peninsular and South Indian Railway Companies had just been formed. A beginning had already been made in the industrial sphere; textile mills had sprung up in and around Bombay drawing upon the rich cotton harvest of the black soil area of Western India. Similarly, along the Hooghly in Bengal, jute mills were thriving on the enormous output of raw jute which Bengal's fertile soil yielded.

It was in this setting that the first pneumatic bicycle tyre arrived in Bombay, in November 1898. John Boyd Dunlop's leisure time experiments had by then been transformed into a successful industry in England. Initial reluctance had been swept away in numerous cycle races in the face of concrete evidence of the superiority and comfort of the pneumatic over its predecessor, the solid tyre. When, in the course of ten years, the Company had firmly taken root in England, the eyes of the pioneers turned overseas. Representatives were sent out to many foreign countries, even to the distant West Indies and the countries of the South American Continent. The small off-shoots of the parent Company then established, have developed in course of the years into an inter-dependent globe-girdling organisation, the Associate Dunlop Companies of today.

Mr. R. J. C. Park, representative of the parent Company, was largely responsible for opening the Dunlop Company in this sub-continent. The manner in which it came into being is best described in his own words:

"..After my appointment to open and develop the Overseas business of the Company in 1897, I toured the whole of South America, the West Indies and then the States. Following that I went to South and East Africa to organise the business there. During that time Mr. Arthur Huet was appointed to India to open up that branch of the business and arrived in Bombay in November 1898, but was taken ill, and I was cabled to proceed to India, which I reached shortly after.

The goods taken over by Mr. Huet were stored in a godown, and he had taken an office next to a firm of Silversmiths. There was a small stock of tyres in the office, which in those days were hand made, and the result was that the whole of the Silversmith's shop was blackened by the sulphur from the tyres. Consequently they brought an action against the Company, which, however, I was able to settle satisfactorily, on the condition that we left the building.."

DEVELOPMENT OF THE COMPANY

While history alone can give the final verdict, it is not perhaps mere egotism which makes us of the 20th century, claim for our own times a dynamism unequalled in the past.

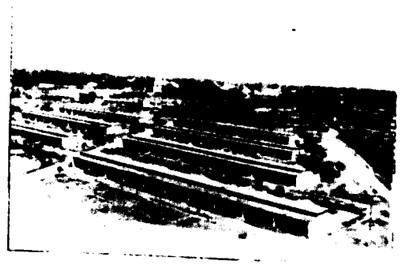
In this country, a significant landmark was the founding in 1911, by Jamshedji Nusserwanji Tata, of the Tata Iron & Steel Co. Ltd., which marks the birth of heavy industry in this part of the globe. In 1914 came the World War I which cut off all imports for four years. Isolated, India was thrown back upon her own resources. Indigenous industry received a great impetus.

More and more villages which had so far lived in a self-sufficient world of their own were gradually moving into the orbit of modern economic relations. Because of this fact, and also the mounting needs of industry, ever increasing demands were being made upon the country's transport. A great responsibility devolved upon Dunlop who had the organisation for servicing transport requirements. To cope with the increased volume of work, branches had to be multiplied. Depots were established and are now located in Calcutta, Bombay, Madras, Delhi and Lucknow with sub-depots at Jullendur, Nagpur, Ahmedabad, Bangalore, Madura, Cochin, Vijayawada and Gauhati.

Another noteworthy event was the opening of "Dunlop House" in Calcutta in 1928. Prior to this, the Calcutta office had been located in a building on Lindsay Street. Bombay was still the Head Office as it had been right from the beginning. It was only in 1935 that it was decided to transfer the Head Office to Calcutta to be in close proximity to the factory at Sahaganj, which was then under construction.

THE FOUNDING OF THE FACTORY

Thirty-six miles away from Calcutta, off the Grand Trunk Road, leading North lies the small village of Sahaganj. Marking the village's boundary on one side runs the meandering Hooghly. On both its banks, for miles and miles out of Calcutta are dotted innumerable mills, manufacturing mostly jute, prime source of Bengal's economic wealth. Sahaganj too had a jute mill but its American management closed it down during the slump.



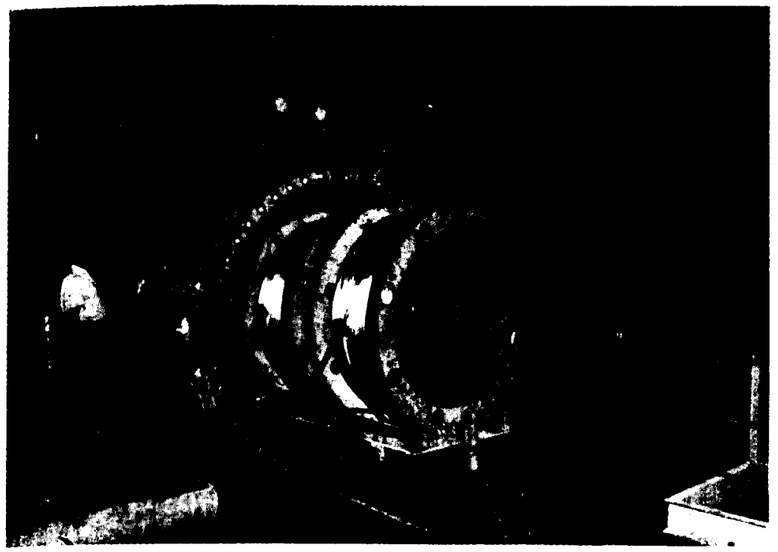
Quarters for married operatives (left foreground) and bachelor type quarters (to the rear) accommodate 60 % of the factory workers.

Chemicals are added to rubber in two ways. In the process shown here, chemicals are added as the masticated sheet passes between the rollers; in the other, mixing takes places in the bowels of the machine called the Banbury.

A 4,580 ton hydraulic press in which lengths of transmission belting are vulcanised.

The factory building lay vacant, and Sahaganj once more fell back into the sleepy quietness of the rural countryside.

A Dunlopillo mattress is being removed from a mould.



Dunlop started manufacture at the Sahaganj factory for the first time in India in 1954, long length braided hose by the lead press moulded process. This photograph shows the lead covered hose, coiled on to a drum, being pushed into the Curing chamber.

The halcyon interlude was, however, short-lived. The search for a suitable home for the factory which Dunlop was proposing to build led to the untenanted mill at Sahaganj. Located near enough to Calcutta, the industrial hub of the nation, but not too near the congested area, it was an ideal choice for the progressive enterprise needing plenty of room for future expansion. It was well served by river, road and rail transport. The main E. I. R. line (as it was then called) passed through Bandel, a stone's throw away. The Hooghly, with its numerous flotillas of barges and steamers, almost touched the factory wall and only some two miles away lay the Grand Trunk Road.

Somnolent Sahaganj came to life again as busy engineers put together and installed a huge new plant. In July, 1936, the factory started production. It was at this time too, that significant developments were taking place in the rest of India. Many new industries sprang up. In the U. P. and Bihar, for instance, scores of sugar mills were installed. The hydro-electric enterprises sponsored in these years made cheap electricity available to many new areas. In the context of the growing volume of India's industrial activities during the 30's, the founding of the Dunlop Factory served to meet an urgent national need.

It started with a complement of some 1,200 workers. Judged by present standards this figure seems unimpressive, but in those days of recurring economic crisis it was considered a bold step to commence a new enterprise on such a scale. Despite the difficult international situation and the waves of panic which stalked Europe during the days of the 'Anschluss' and Munich conferences, Dunlop went ahead unhesitatingly. Every year new plant and machinery were added to augment the volume and range of production, so that by the beginning of the last War the annual output exceeded ten lakh covers and tubes for cycles, and a further two lakhs for cars, trucks and buses.

EXPANSION DURING WORLD WAR II

When hostilities broke out in Europe in September, 1939. Sahaganj factory had already attained a stature which marked out for it an important place in the war effort in this part of the world. The entire production machine was changed over to meet priority orders for Defence.

Aero tyres and tubes were added, in 1940, to the range already being produced by the factory. Additional plant and equipment were installed and a considerable expansion in the output of tyres and tubes was recorded. In January 1943, the factory was bombed by Japanese raiders; 10 were killed and 20 were injured but work continued in full swing and by V. E. Day, production at Sahaganj was four times the 1939 figure.

With the end of the war, peace-time plans were resumed and installations of a cycle rim plant was completed, production commencing in 1946. The need for indigenous production of high quality rims was emphasised by the Tariff Board Report on the Bicycle Industry. With the growing use of bicycles in India, and the opening of new bicycle factories, the great utility of the Dunlop cycle rim plant—employing the most advanced technique and equipment — has been clearly established.

NEW LINES OF PRODUCTION

After independence, the most momentous event in the economic and social life of India was the inauguration of the Five Year Plan for the period 1951—56. Agriculture, power, transport and heavy industry (such as iron and steel) have been given special importance in the Plan and to each of these branches Dunlop has an important contribution to make.

The recent extensions to the Dunlop factory are of particular interest in relation to the Plan. Manufacture of agricultural and industrial belting has commenced in the

belting factory officially declared open by Dr. B. C. Roy, Chief Minister of West Bengal, in December 1952. With the large increase of power generation as foreseen in the Plan, transmission belting will become vitally important. The Dunlop factory, which is turning out rubber transmission belting of the best quality, will ease the strain on foreign exchange resources by reducing the need for imports.

The manufacture of rubber Conveyor and Elevator belting, which are of particular importance to both heavy industry and for food storage purposes, has commenced at Sahaganj. Moreover, Dunlop were the first in India to manufacture long length braided hose by the lead press moulded process and a number of special types of quality hoses - hitherto imported - have been added to the range.

Production of Dunlopillo, or latex foam cushioning, commenced at Sahaganj in 1951. Its increasing use on public transport vehicles — as also in cenemas, Assembly Houses and the home — promises a great future for this product.

An event of importance was the production, at the end of 1953, of tyres for jet aircraft, the first to be made in India, to meet the needs of the Indian Air Force.

Thus is Dunlop enterprise serving the nation's economy — ever extending its range of activities so that today India can depend on her own resources for a large number of vital rubber manufactures.

WELFARE ACTIVITIES

Alongside the development in production, welfare amenities for workers and staff employed at the factory have been consistently enlarged and improved. Already 60 per cent of the total labour force of about 4,000 is housed on the factory estate.

The factory hospital built and equipped at a cost of approximately Rs. 6 lakhs is unquestionably one of the finest industrial hospitals in the country. The operating theatre is fully equipped with up-to-date appliances and is air-conditioned. There is, in addition, an X-Ray plant and an electrotheraphy section equipped with Ultra-Violet, Infra-Red and short and long wave Inductotherm apparatus. The hospital kitchen is fitted with electric cooking ranges, a refrigerator and water heaters.

Any account of the Dunlop estate would be incomplete without a mention of the amenities which contribute so much to the welfare of the residents. Playing fields, a Club House, the schools, shops, water tower, all serve to make the Dunlop estate an integrated township supporting a happy and healthy community.

Another notable feature of Dunlop enterprise in India is the steady progress made towards implementing the company's policy of entrusting to Indian personal positions of responsibility at all levels in the organisation. As pioneers of a new industry, the Dunlop factory was faced at the outset with the dfficult task of finding experienced supervisory personel. The solution to this problem was found by giving young men who had distinguished themselves in their work every facility to widen their experience and knowledge. In suitable instances, further training is arranged in associated factories abroad, particularly at Fort Dunlop, Birmingham, the largest and best equipped tyre plant in the Common-wealth. Up to now a large number of members of the staff have been sent abroad under this scheme, and a firm basis has thus been laid for an increasing proportion of the higher administrative and technical positions to be filled by qualified Indian nationals.

Since the first pneumatic tyres arrived in India in 1898, these 57 years have indeed witnessed spectacular progress. Dunlop enterprise, it can justly be claimed, has not only kept pace with the growing needs of the nation's economy but has also successfully anticipated future requirements. There is every reason to believe that Dunlop will acontinue to play their part in the years to come—years that will bring to a successful realisation the ambitious and far-reaching development plans on which the nation is now so firmly launched.

TATA LOCO'S PROGRESS

The Tata Locomotive and Engineering Company reports steady improvement in output, which is indicative of the rapidly increasing tempo of efficiency in the factory.

For the past four consecutive months, the actual output of locomotives was five per month, against the target of four units per month required to fulfil the Company's commitments to the Government of India.

The output of boilers, which has been maintained steadily up to schedule, exceeded the target of eight units per month in April and May.

The output of Diesel truck and bus chassis has also mounted up to over two hundred units per month.

For the year ending June 30, 1955—the first year since the end of the development stage for locomotives—the Company's output of locomotives was 50 units, which exactly fulfils the Company's commitment under its Agreement with the Government of India.

CONSTRUCTION OF ROLLING STOCK IN BELGIUM

THIS Company, having a registered capital of Belgian francs 100,000,000 was founded in 1913.

It originated from the amalgamation, at that time, of two important construction Works, one of them dating back to the middle, the other to the end of the nineteenth century.

The total area of the plant amounts to 90 acres, with a covered surface of 30 acres.

Normally, more than 2,500 workmen and clerical staff are employed.

The main object of the Company is the construction of rolling stock for railways and tramways, of which it is one of the leading builders in Europe; its productions are exported to all countries of the world.

Besides the construction of rolling stock, the Company possesses a large Mechanical Division, consisting of three sections respectively for the machining of cast iron and cast steel pieces up to 30T., the production of precision pieces for the textile and electric industry and high machining precision tools.

It was with a view of manufacturing these last, that in 1950, new workshops have been built and equipped with first class high precision machines.

Its long industrial experience afforded to La Brugeoise et Nicaise & Delcuve the means of forming a general staff, a management and a personnel fully trained for the construction in mass production, as well as to the enforcement of quality standards and of complete interchangeability.

The engineers and technicians of its designing department are fully equal to undertaking and solving any problem in the rolling stock or the steel construction line.

The machining operations and the assembly belts are studied by the technicians in charge of the preparation of the work, who have at their disposal abundant data as well as great experience, which have been gathered during numerous years. The unceasing progress made by them in this connection certainly puts La Brugeoise et Nicaise & Delcuve in an unrivalled position.

The personnel of the Works includes specialists belonging to all sectors of mechanical construction.

A special office studies all gauges necessary for machining and assembling purposes, according the rules of a total interchangeability.

The laboratories and testing departments of the Company permanently supervise all the products of its manufacture and the materials supplied by its sub-contractors.

The plant includes assembling and erection shops as well as the departmental workshops: manufacture of springs, joinery shops, steel works, with machining shop and high precision workshop.

The equipment includes the most modern machinery and plant, in the assembly shop (machines for plate bending and draw benches for coiled steel strip etc.), as well as in the erection shop (equipments for spot welding with electronic control and X-ray apparatus for examination of the welds). The machining workshop possesses a special section for heat treatment, with salt bath furnaces, electrically heated and provided with automatic regulation, and a section of metrology.

The above installations enable La Brugeoise et Nicaise & Delcuve to manufacture in its own Works the components and parts entering into the construction of the Clark Fork Lift Trucks.

It was this guarantee of uniformity of quality which induced the Clark Equipment Co. to grant, in 1950, its first manufacture license in Europe to La Brugeoise et Nicaise & Delcuve.

THE SURAHAMMAR METHOD

FOR ASSEMBLING WHEEL PAIRS

PREVIOUSLY the wheel seat and hub bore, and the mating surfaces of the wheel centre and tire were turned in a lathe. The usual method then consisted of shrinking the tires on the centres and pressing the wheels on the axles. This method is used the world over. Dimensions for press grip and required surface-finish were not usually specified. All that was stipulated was that the final pressure required for pressing on must be between specified minimum and maximum values, e.g. 3 and 4 tons/cm. ($7\frac{1}{2}$ and 10 tons/in.) of the hub diameter for railway wheel pairs.

Very careful consideration has been paid to this method at the Surahammar Works, and it was concluded that several factors difficult to control are introduced by the pressing-on operation, so that it can no longer be considered adequate for present-day requirements.

It was clearly evident that, in the first place, both the finish of the mating surfaces and the dimensional tolerances required improving by the introduction of a better machining technique. Grinding the wheel seat, hub bore and mating surfaces of the centre and tire was therefore introduced at the same time as Surahammar changed over to shrinking instead of pressing the wheel on to the axle. Subsequent dismantling was provided for by the introduction of a method for pressing off the shrunk-on parts which was invented and patented by Mr. Bratt of SKF. This method is characterized by the process of forcing oil under pressure between the wheel and its seat, so that it can be pressed off with a pressure only a fraction of that required to remove a wheel pressed on by the older method. The application of this method is made possible by the provision of the necessary grooves and holes in the hub for introducing the oil.

Tests show that a shrink fit of one pro mille, applying to both tires on centres and wheels on axles, is sufficient. For tram wheels, which will not be fitted with brakes, and which are on very light wheel centres, the shrink fit should be somewhat less, say 0.7 pro mille. The shrinking is done at a temperature of only 200—250°C (390—480°F), thus the structure and strength of the material are not affected.

The Surahammar method provides the following advantages :

1. Full interchangeability of the components.
2. Higher fatigue strength of ground parts due to the excellent surface-finish and accurate dimensions.
3. Simple assembly and removal of the wheel without risk of bent axles, as well as a more secure bond.
4. More even stress distribution in the various parts and no permanent deformation.
5. Better dissipation of heat from tire to centre, which, in conjuction with a good shring fit, reduces the risk of the tire being loosened by braking loads.

TOLERANCES

All parts are ground to a high surface-finish and very close tolerances in spite of the fact that the components of the wheel pair are relatively heavy and unwieldy. The wheel seats on the axles are ground cylindrical to a tolerance of $^{+0.0008}_{-0.0000}$ in. ($^{+0.02}_{-0.00}$ mm.) on the diameter and

the hub bore to a tolerance of ± 0.0004 in. (±0.01 mm.). The diameters for different types of wheel pair vary between 4.724 and 7.87 in. (120 and 200 mm.). The outer diameter of the wheel centres and the inner diameter of the tires are ground to within ±0.000 in. (±0.02 mm.). The diameter of the different types varies between 19.68 and 38.37 in. (500 and 1,000 mm.).

RESEARCH

Both manufacturers and purchasers of wheel pairs have always wanted to be able to measure and record the stresses and strains occurring in the different parts under service conditions. This would make for safer dimensioning, would enable the life to be predicated, and, lastly, would lead to proposals for improved design, all factors which it is hardly possible to calculate theoretically. Fundamental investigations of problems falling under this category have been carried out at the Surahammar works in co-operation with the Swedish State Railways and ASEA. This research work has also led to very good results. Strain gauges now make it possible to obtain (simultaneously) a large number of elongation values from which the stresses and strains in the outer surfaces of axles and wheels under service conditions can be calculated.

It proved difficult at first to transfer the very weak electrical impulses obtained to the instrument cabin in the railway coach, but a solution was found. The enormous accumulation of recorded measurements necessitated much subsequent time-consuming work, but this was eliminated by the design and construction by ASEA of a classifying impulse calculator which makes possible the direct reading of the measurements in the units desired.

Tests have also been made with models, and one of the findings was the fact that, if an axle is tapered down slightly in the middle, particular care being taken, however, that the transition to the hub has the proper contour, the fatigue strength of the wheel seats will improved. Measurements of the kind mentioned above, as well as model tests and full-scale fatigue tests on wheel pairs, have made an objective valuation of both construction and materials possible and have provided a more reliable basis for the further development of the design of the wheel pair.

A TUBULAR QUIZ

Name three factors which reduce the demand for Loco Tubes?

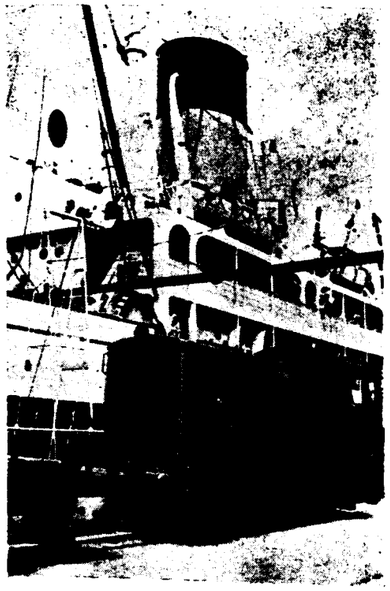
(a) The practice of "safe-ending"—i.e., cutting out old tubes, removing the scale, welding on short pieces and re-installing them.

(b) The development of the Diesel Electric Loco.

(c) The electrification of Railways.

DIESEL LOCOMOTIVE OPERATION IN MALAYA

DURING February and March all six of the 300 b. h. p. Paxman-engined diesel-hydraulic shunting locomotive shipped to the Malayan Railway at the end of 1954 were introduced with normal service at Kuala Lumpur and in the Port Swettenham docks area. The first three locomotive were off-loaded by the 100-ton floating crane at Singapore, owing to temporary lifting difficulties at Port Swettenham, but the last three went direct to Port Swettenham.



Port Swettenham.

In general, shunting work was begun at Kuala Lumpur carriage sidings, marsh[alling] the stock for all passenger trains [in] Kuala Lumpur Central station, the heavi[est] of these weighing 550 to 600 tons. In thi[s] work the locomotives were on call 24 hr. a day. Some of the units actually began their work in the Sentul works and running shed yards that is the principal locomotive, c[arriage] and wagon establishment of the M[alayan] Railways, which now employs 2,400 me[n].

After being run in on these two jo[bs] practice has been to transfer these six units to Port Swettenham, for the shunting at which harbour they originally intended, though one is to country to undertake all shunting at Anson. Here again 24 hr. a day service scheduled, and high availability, of order of 90 to 95 per cent, has been atta[ined] in conjunction with low fuel consum[ption] approximating to 0.87/0.89 m p. g. B-class fuel that is now used. D[uring] February ambient temperatures of 107[°] F. were experienced, but cabs engine rooms did not become uncomforta[ble] except on the odd occasions when the had to be closed up during tropical storm[s].

A TUBULAR QUIZ

What is (a) "GRIEF STEM" (b) "KELLY JOINT"?

(a) A heavy tube having a square outside section and a circular bore. It is used in oil drilling and passes through a square hole in the Rotary bed plate, thus giving the circular motion to the drill pipe to which it is coupled.

(b) [Of] the famous night club in Panama City which, having attained prosperity is [well] known as "Kelly's Ritz," but in fact merely another name for (a) above.

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