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The Indian Railways Workshop Magazine

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THEFTS ON INDIAN RAILWAYS

THERE is no doubt that the Indian Railways lose every year many lakhs and sometimes even crores of rupees by thefts, pilferages, robberies and vandalism. These actions of a fairly large number of anti-social elements tend to swell the working costs of our railways and the leakage and loss of the tax payers' hard earned money.

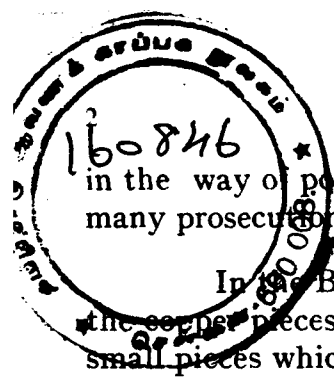
There is undoubtedly planted in the heart of every man, woman and child born, this great commandment of God "Thou shall not steal" and there is the voice of conscience to tell us that it is wrong and sometimes very gravely sinful to take what belongs to another. But thieves and robbers, pilferers and vandals deaden and finally kill that voice of conscience, so that it ceases to accuse them any more, and go about gaily on their nefarious business without let or hindrance. Often nemesis and the justice of the Creator pursues them in this life and in the end they are caught and stand to lose much more than they have gained wrongfully. Crime does not always pay.

On the Railways there exists a very extensive field for theft, pilferages, robberies and vandalism, and they offer a vast scope to the criminally inclined person. Taking the workshops first, it will be conceded that it is nearly impossible to protect the vast amount of railway property which lies in shops and which may be considered as works in progress.

Starting with the Foundry, the non-ferrous section of this shop becomes a target for nefarious practices. Virgin copper and tin have to be mixed in various proportion with scrap bronze to produce bronzes of various grades for bearing of all sorts. Similarly lead and tin in various proportions have to be melted together to form white metals of various classes. Now copper, tin, bronzes are valuable metals which fetch a high price on the market and these are therefore pilfered in small quantities every day or week until at the end of the month these substantially enhance the income of the thief or thieves, because quite a number of them operate in gangs. The Watch and Ward and Security personnel are many times in league with the thieves, as get their payment from the proceeds of the swag. Sometimes thieves not satisfied with little, get bolder and carry away whole bronzes weighing many pounds. The writer as a Shop executive in the old days has been sometimes called to see a thief who had a 16 lb. bearing brass strapped to his stomach by his dhotie with the shirt thrown over. On another occasion it was a whole copper ingot weighing about 15 pounds similarly strapped and hidden. These were lucky catches, but for one thief caught at least a dozen get away.

At another time a whole gang was rounded up at the time of handing over their swag to the "fence" who was to take it away. This was the meritorious work of special C. I. D. personnel who were pressed in to reduce thefts during the war when metal prices had soared to very high levels. In the prosecution which followed out of 8 workshop men caught only 2 were sent to jail and the others were discharged and went back to work.

The trial of these was interesting. The Public Prosecutor made a bare statement of the arrests and the reason for them and sat down. While the defence lawyer cross questioned witnesses and pulled them to pieces, the Public Prosecutor never said a word. The judge was all in favour of the criminal and blamed the Railway for putting temptations



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in the way of poor men by not protecting its property sufficiently. Needless to say not many prosecutions were launched after that one.

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In the Boiler Shop where locomotive boilers are cut up after they are condemned, the copper pieces from the copper fire-boxes are stolen in fairly large quantities, because small pieces which fit into the coat pockets are never missed, but cumulatively provide a good income to the thieves.

Bolts, nuts, screws, studs, tools and similar small items can be stolen little by little over long periods, without being missed, because they form the stock in trade of most shops.

During the last war when theft on Railways had assumed a very serious threat it was not unusual to have brand new micrometer gauges to be stolen from the railway and sold back as new. The trick was discovered when certain etched marks on these gauges were found to be the ones marked by the Tool Room of the Railway.

In the Carriage and Wagon Departments of Railways in the old days Officers' and Senior Subordinates' furniture could be brought in for repairs and it was not a rare thing to have new furniture made and taken out as repaired furniture. Also Officers' furniture could be stored in the shops and often old furniture was discarded and new furniture taken out as stored furniture. Fortunately on the discovery of this ramp the permission to repair or store any furniture for officers was withdrawn.

It was also permissible as it is to-day to bring Officers' cars to the shops and complete overhauls, repairs, machining and welding if necessary was done at shop expense, but today with the vigilance tightened up these facilities no longer exist.

Petrol tanks used to come to wagon shop for repairs or overhaul and often residual petrol to the extent of 2 to 5 gallons was usually available to thieves. This instead of going to the Railway account frequently found its way into the petrol tanks of officers and often subordinates' cars. I remember an enquiry on the question of petrol and the officer tutoring the subordinate as follows, "X, you know that I have taken this petrol and I know that you have also taken this petrol. Now what are you going to say?" "Sir, I will say I never took any petrol." "Good boy, I am going to say the same."

Railway Stationery in the form of foolscap paper, pencils, erasers, pens, books, blotting is frequently pilfered by clerical staff for their school going children, and cumulatively it assumes sizeable proportions.

These are internal thefts and there are many more kinds, but the external thefts and vandalism costs the Railways a pretty penny.

There are gangs of robbers who plan goods train derailments at out of the way places by removing fish plates, and often holding up the drivers and the guard at the point of the dagger or pistol make good with their loot. There are other gangs who make a speciality of boarding running goods trains and by tampering with the security fastenings are able to take goods and drop them at appointed places while the train is on the run for their members to collect them. The railways have to make good by the payment of huge claim bills which often run into many thousands of rupees. These thieves are so clever and their plans so well laid that it is known that gold bars and bullion which is always

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kept in the custody of the guard has been stolen and hidden under railway culverts to be removed when conditions are favourable.

There was a time in the not too distant past when vandalism was rampant. Electric lights, switches, all brass fittings were literally wrenched off and leather cloths and rexines were cut away in patches. This was done in spite of all security precautions until it was discovered that the vandals were among the security personnel. The writer remembers a fully equipped dining car with its complement of crockery, cutlery, table linen light and fan fittings etc. being sent out of the shops after complete overhaul and returning within three days with 75% of the equipment stolen en route before it was accepted by the Transportation Department.

On the open line of Railways many opportunities for theft exist. Regarding permanent way material to be supplied by Contractors the correct weight or number is paid for by the Railway Accounts Department, but it often happens that the correct quantity is not supplied, and on receipt of payment by the Contractors a certain pre-arranged amount goes into the pockets of Railway Staff concerned. It is a form of theft which is very difficult to detect.

Although much has been done by the Railways to minimise thefts by the introduction of a Vigilance Branch and the Anti-corruption Branch yet thieving persists though on a reduced scale. It must be accepted that Vigilance staff can be corrupted and are susceptible to accepting bribes or percentage commissions for closing a blind eye to criminal actions. As one very highly placed Police Officer said to the writer "every person has a price for being corrupted and if that price is paid anything from a pin to a locomotive can be stolen from any Railway". Perhaps this may be a slight exaggeration but basically there appears to be some truth in it.

Truth, honesty and integrity unfortunately are not the outstanding virtues of Railway-men generally. It would be a travesty of the truth to say that there are no honest men on the Railways, either in the Superior or Subordinate staff, but then their number is so small that they are usually considered as fools or cranks.

Since the Railways were Indianised they are considered to be a national asset and therefore they belong to us as tax-payers, and therefore the opinion sometimes expressed is that "there is no harm if I take something from an asset which belongs to me." These ideas have to be changed if thefts on Indian Railways have to be reduced.

Departmental action for dealing with theft cases is most cumbersome, and very frequently the thieves get away. Chargesheets have to be served on culprits, witnesses are to be found, an enquiry has to be carried out and all facilities given to the accused to defend himself and finally a show cause notice why he should not be dismissed given to him and a month has to be given to him for his reply. If in the course of investigation any part of the procedure is not meticulously followed the whole enquiry may be vitiated. In the meantime direct and indirect evidence sometimes disappears and the accused gets away with his crime or has to be re-instated.

Theft on Railways is indeed a very serious problem but unless it is tackled seriously and very deterrent punishment inflicted on the anti-social elements it can hardly be expected to improve.

Making Rail Travel more Comfortable

By D. R. Khanna

General Manager, Central Railway

In spite of special emphasis having been laid on the development of goods traffic for the Five Year Plans and rapid rise both in goods and passenger traffic, the Central Railway has made a determined bid to make rail travel more comfortable.

In the article, the Central Railway Chief details the various measures taken by his Railway to ease the problem of overcrowding and provide a number of facilities to millions of its patrons.

IN this era of planned economy, the role of the Indian Railways has been obvious. As a major transport undertaking, the Railways have been called upon to provide in an ever increasing measure the sinews of efficient transportation to cope with the spiral of increasing traffic—goods and passenger.

In view of rapid industrialisation contemplated in the Second Plan, the requirements of goods traffic had naturally to be given an overriding priority over passenger traffic. The main emphasis in railways' planning was therefore on movement of goods.

A large number of Civil engineering works were therefore, undertaken during the Second Plan period on those sections of the Railway where the line capacity had been strained to its saturation point and where additional capacity had to be provided for coping with the increasing goods traffic.

Our ability to introduce additional trains was therefore determined to a very large extent by the pressure of goods traffic.

PASSENGER TRAFFIC

It would however, be wrong to give the impression that with the preponderant emphasis in the Second Five Year Plan on the requirements of goods traffic, the problems affecting passenger traffic have either been ignored or forgotten. The Railways have, indeed, given a good deal of attention to the problems of passenger traffic and have endeavoured to provide reasonable facilities for travel and to add to the comforts, however modestly, of the millions of passengers.

During the Second Plan, additional trains could be introduced only on these Sections where some spare

capacity was available. Some orientation in this policy would perhaps be possible in the Third Plan period when heavier (and longer) goods trains—with the special bogie type of wagons—would be run. The idea is to exploit the available line capacity to the utmost by running heavier trains instead of more trains. This policy would, to some extent, release some capacity for additional passenger trains where they are necessary and justified.

STEADY SPURT IN PASSENGER TRAFFIC

One aspect of our passenger service for which the Railways have been subjected to constant criticism is overcrowding. This criticism, however, does not take due notice of the fact that although quite a few measures have been adopted to mitigate overcrowding, the Railways have not been completely successful in catching up with the ever increasing spiral of passenger traffic. The authors of the Second Plan provided for a 15 per cent increase in passenger traffic during the Second Plan period over the 1955-56 level.

A striking picture of the trends of passenger traffic on the Central Railway is easily provided by following figures. In the year 1938-39 the Central Railway carried 66 million passengers, and this figure rose to 264 millions in the year 1955-56. The approximate number of passengers carried by the Central Railway in the year 1960-61 is 336 millions—nearly 550 per cent of what it was in 1938-39 and 136 per cent of what it was at the end of the First Five-Year Plan period! Likewise, passenger miles, which stood at 3.320 millions in 1938-39, rose to 7,186 millions in 1955-56, 8,515 millions in 1959-60, and would approximately be 8,846 millions in the year 1960-61. The passenger miles have increased nearly 320 per cent over the 1938-39 level and nearly 23 per cent more over the 1955-56 level.

ADDITIONAL TRAINS ON CENTRAL RAILWAY

It is obvious, therefore, that the rapidly increasing passenger traffic is more than what we have been able to cope with, in spite of the measures taken during the Second Five-Year Plan period.

The Central Railway had programmed for the introduction during the Second Plan period of 16 additional passenger trains. In July 1956, the Delhi-Madras Janata Express was converted from a bi-weekly service into a daily service. In February 1957, a Deluxe Express was introduced between Madras and Delhi, with air-conditioned First class and air-conditioned Third class accommodation. The Hyderabad-Howrah Express, which was introduced in October 1957, provides a direct fast service between Hyderabad, the capital of Andhra Pradesh, and the northern coastal districts of this State. In November 1957, after Bhopal became the capital of Madhya Pradesh, the Bhopal-Bilaspur Express was introduced in order to provide a convenient service linking up important far-flung cities in Madhya Pradesh. On 1st October 1959, the bi-weekly Bombay-Madras Janata Express was converted into a tri-weekly service and a year after a bi-weekly Janata Express between Bombay and Howrah via Allahabad and the Bombay-Nagpur Express was also introduced.

Additional passenger trains were also introduced during the Second Plan period on the Wadi-Secunderabad, Kazipet-Hyderabad, Kazipet-Balharshah, Bhusawal-Khandwa, Jhansi-Kanpur, Secunderabad-Mahbubnagar and Bina-Katni sections.

With the completion of the last stage of construction in December 1960, the entire Khandwa-Hingoli Metre Gauge Rail link was declared open to passenger traffic on January 2, 1961. We now have passenger services between Akola and Khandwa, and Akola and Purna on this Metre Gauge Rail link.

CHANGES IN TRAFFIC PATTERN

With the re-organisation of the States in 1957 and the location of the capital of Madhya Pradesh at Bhopal and of Andhra Pradesh at Hyderabad, the pattern of passenger services serving these capitals had to be re-orientated in order to fit in the changed demands of traffic.

In the case of Andhra Pradesh, convenient services had to be provided between Hyderabad and the

coastal areas of Andhra Pradesh north and south of Vijayawada. Likewise, in the case of Bhopal, the capital of Madhya Pradesh, such distant points as Bilaspur and Indore had to be linked up by a fast passenger service serving the capital also. In the case of Maharashtra, an Express train was introduced between Bombay and Nagpur, particularly to meet the requirements of the Vidarbha area, and also in view of the State Legislature holding its winter session in Nagpur.

SHORTAGE OF ELECTRIC LOCOS

One of the major difficulties the Central Railway has had to contend with in respect of passenger and goods operation, was the shortage of electric locomotives on the Bombay division. Consequently proposals for the introduction of additional long distance trains in the division could not be progressed with. A number of steps were however, taken in recent months to overcome this shortage. The first was the transfer of five 3000 Volts D. C. locomotives from the Eastern Railway for modification and use on 1500 Volts D. C. The five locomotives, received from the Eastern Railway, have already been converted and brought into use on the Bombay Division.

Of the seven locomotives on order from Japan, two will be on replacement account and five will be the additional power that will be placed at the disposal of the Bombay Division. Of these seven, four locomotives have already been received and the balance would be available in April 1961. Ten locomotives are under manufacture at Chittaranjan and are expected to be available in the course of the year.

STEPS TO EASE OVERCROWDING

One of the measures which the Central Railway took during the Second Plan period and which helped to some extent in easing overcrowding had been to increase the loads of Mail and express trains from 12 to 13 coaches. This provided substantial relief on some of the most popular trains between Bombay and Calcutta, Delhi and Madras.

A large number of sectional coaches were introduced during the period, between important cities so that a convenient direct service was provided between such cities and the pressure on the through coach correspondingly reduced. In 1960-61, four such sectional coaches with Upper class accommodation and three Third class coaches were introduced.

Rail Traffic and Performance— Some Recent Trends

By S. K. Guha

Director of Statistics & Economic Adviser
Ministry of Railways

Shri Guha says that the Indian Railways have, by and large fulfilled the demands made on them as a result of industrial expansion and increase in agricultural production under the Five Year Plans.

With the aid of statistical data he has shown that the rail traffic has more than kept pace with the rise in industrial production in the country. He also has indicated the various measures the Railways have taken to effect economy in expenditure and promote operational efficiency.

A railway system in India originally designed by the British mainly for their military and administrative needs and to serve a predominantly agricultural economy had, with the independence of the country, to be switched on to the meeting of the needs of a developing economy under the impact of the successive Five Year Plans.

In the planned economy, the emphasis is on development on several fronts, more particularly on heavy industries, mining, agriculture and power as also progressive advance towards the goal of a welfare state.

The Indian Railways occupy a dominant position in the transportation system of the country and have, by and large, fulfilled so far the demands made on them consequent upon the expansion of output of the various industries and the increase in agricultural production. It may be of interest to see how the general pattern of traffic affecting earning and the levels of wages and prices influencing the cost of operation of the railways have been changing during the last decade.

RISING TRAFFIC WITH INCREASING PRODUCTION

The traffic levels have been rising and the increases in freight traffic in the background of increases in industrial production may be seen from the figures quoted below :—

	1950-1	1955-6	1959-60	1960-1 (provisional)
Tons originating (millions)	91.4	114.0	144.2	154.0
Index	100	124.7	157.8	168.5
Ton miles (millions)	26,963	36,434	50,149	54,720
Index	100	135.1	186.0	202.9
Index of industrial production	100	122.4	151.9	167.5
(For the first 10 months)				

In the Third Five Year Plan based on the targets of increased production in the basic industries like coal, steel, cement and in agriculture and other spheres, the probable volume of originating freight traffic is estimated at 243.5 million tons subject to such modifications as may be found necessary in the light of subsequent developments.

The increase in passenger traffic during the Second Plan period alone has been of the order of 26 per cent and during the Third Plan period, provision has been made for a further increase of 15 per cent in passenger traffic.

SPURT IN FREIGHT TRAFFIC

In this context, it will be interesting to study the figures of rail traffic under selected commodities in

relation to their production during the last decade. The comparative figures for the years 1950-51, 1955-56 and 1959-60 for the major commodities which account for more than 60 per cent of the goods traffic are set forth in the table on page 10.

Even without going into the special characteristics of individual commodities, it will be readily observed that the bulk of the output of coal, cement, iron and steel, manganese ore, iron and other ores, paper, tea, jute raw has been transported by rail and further that the proportion of tonnage transported by rail under some of the commodities like cotton raw, cotton manufactured, sugar, etc. have shown a declining trend indicating some shift in the pattern of distribution of the traffic between the different modes of transport under these commodities.

CHANGING PATTERN OF TRAFFIC

One significant feature is that the pattern of freight traffic moving by rail now contains a larger proportion of industrial raw materials such as coal, ores and lime stone as will be apparent from the following data :

Percentage of tons originating of public coal, ores, marble and stone including limestone and dolomite to total tonnage originating of all revenue earning commodities.

1950-51	37.3
1955-56	37.4
1956-57	37.5
1957-58	39.6
1958-59	41.6
1959-60	42.3
1960-61 (estimated)	45.0

The broad tentative breakdown of the 243.5 million tons of originating traffic anticipated at the end of the Third Five Year Plan indicates that this proportion is likely to go up to 54 per cent in 1965-66. It will thus be seen that under the impact of planned development, there is already a marked tendency towards preponderance in rail traffic of low rated commodities.

This factor, coupled with the diversion, to some extent, of the high-rated commodities to other modes of transport, will necessarily entail a lesser rate of increase in the earnings compared to the increase in the volume of freight traffic. The traffic in coal, ores and stones including limestone and dolomite during 1959-60 in fact, accounted for 37.3 per cent of the revenue earning ton miles but contributed only 25 per cent to total goods earnings.

CARRYING LOW-RATED GOODS

It is well known that low freight rates are charged on coal and industrial raw materials to accord with the broad national policy of balanced industrial and economic development of the various regions of the country.

Separate ton mile statistics under 22 broad commodity heads which account for more than 75 per cent of the revenue earning traffic are available from 1959-60 and thus a broad idea of the financial effect of the low freight rates charged on industrial raw materials etc. can be had from the table below which summarises the average rates charged per ton mile for these 22 heads of commodities over the broad and the metre gauge railways.

AVERAGE CHARGE PER TON MILE IN 1959-60

	(nP)	
	B. G.	M. G.
Coal for public	3.33	3.33
Grains	4.68	4.96
Oilseeds	6.93	7.79
Cotton raw pressed or unpressed	14.75	15.09
Cotton manufactured	16.02	17.63
Marble and stone	5.80	6.03
Salt	5.05	5.19
Metallic ores :		
(a) Manganese ore	7.19	6.79
(b) Iron ore	7.46	5.70
(c) Other ores	6.37	7.63
Mineral oils :		
(a) Oil fuel	9.64	9.59
(b) Kerosine oil	9.68	9.96
(c) Petrol	17.13	15.56
(d) Other mineral oils	9.97	9.95
Sugar	10.44	9.27
Cement	7.33	7.53
Cement manufactured products	9.81	10.04
Iron and steel wrought	9.48	10.5
Wood unwrought	6.30	7.58
Jute raw pressed or unpressed	14.75	17.73
Vegetable oils	9.34	10.30
Fruits and vegetable fresh	5.60	7.21
Other revenue earning commodities	6.83	8.49
Total revenue earning traffic	5.86	7.25

The gradual increasing costs of the coaching services on account of rising prices and wage increases as also the expenditure on passenger amenities have had this result that since 1957-58 expenses have exceeded the earnings but the imposition of the passenger tax in September 1957 limited the scope for any further adjustments in the passenger fare structure to meet even the normal increases in costs.

It is significant that the overall adverse results of passenger services commenced in that year. As regards good services even though the proportion of expenses to earnings has declined from 1950-51, if allowance is made for the increases in freight rates, the improvement is only marginal.

In other words, the increase in expenditure has been higher than the effective increase brought about in the freight rates per ton mile or fares per passenger mile. This is unmistakably a reflection of the shift in the pattern of traffic moving by rail consequent upon the preponderance of low-rated traffic coming to rail without any corresponding increase in the high-rated commodities. There have also been unavoidable increases in costs arising from increasing wages, prices and users' amenities on one hand and the absence of increase in passenger fares and freight rates to correspond fully to such increases in the costs on the other.

STRESS ON ECONOMY AND EFFICIENCY

In the larger interests of the general economy of the country, the railways are continuously striving to effect economy in expenditure by various means including intensive utilisation of railway assets, such as tracks, locomotives and wagons.

Performance of Variable Speed Internal Combustion Engines for Automotive Purposes

With the object of providing a referee method for evaluating the performance of variable speed internal combustion engines for automotive purposes, the design of which has already been type tested, the Indian Standards Institution has published an Indian Standard Specification for Performance of Variable Speed Internal Combustion Engines for Automotive Purposes (IS: 1603-1960).

The standard specifies the performance requirements and tests for normally aspirated variable speed

The table below summarises the achievements of the three pronged operational drive launched by the Railways during the past decade. This table gives the number of wagons and engines on line for moving one million net ton-miles of goods per day during the four crucial years—1938-39 (pre-war), 1950-51 (pre-Plan), 1955-56 (eve of Second Plan) and 1959-60 (penultimate year of the Second Plan):—

<i>No. of units required for moving one million net ton miles of goods per day.</i>		
<i>year</i>	<i>No. of goods locos (all traction) on line, B. G.</i>	<i>No. of wagons (in term of 4-wheelers) on line.</i>
1938-39	66	2849
1950-51	56	2304
1955-56	47	1848
1959-60	39	1686

Similar improvements have been made in more intensive utilisation of the track facilities also, as will be seen from the following table showing million ton-miles moved per annum per thousand running track miles during the same 4 years:—

<i>Year</i>	<i>Broad gauge</i>
1938-39	749
1950-51	1212
1955-56	1572
1959-60	2056

It is apparent that in the years to come, the Indian Railways will be required to play an even more important role in the planned economic development of the country and there is little doubt that they will not be found wanting.

THE SURI-TRANSMISSION



MR. M. M. SURI

It has been repeatedly stressed that strict secrecy and speed of development are the essence of commercial success, till an invention is proved. For this reason, in spite of the fact that great efforts have been afoot for over three years, hardly a word has been spoken to reveal the art or science of the Suri-Transmission. Somewhat of a mystery has surrounded the transmission ever since the Chairman Railway Board, Mr. Karnail Singh, announced its merits publicly. A great volume of enquiries have piled up. Time has come to answer some of these.

Effort has been made to briefly put across in the write-up that appears on next page, the general principles of construction and operation of the Suri-Transmission. The matter revealed is just sufficient for any engineer to grasp the fundamentals and know the advantages of the Suri-Transmission. Experts would want to know much more, the manner of superimposition of the diesel engine characteristics, actual test results with figures,

measured cushioning at changeover, and a horde of other relevant data. To them, at this stage, I can only offer my apologies. Our associates, Messrs. Maschinenbau Kiel (MaK) desire some more time to lapse, some more range of horse powers to be covered (2000 h.p.), before data collected from bench tests and service trials is made public.

But I sincerely trust that the following pages answer a great many questions and satisfy a large measure of technical curiosity.

M. M. Suri

THE SURI-TRANSMISSION

By M. M. Suri
Jt. Director (Diesels)

A BRIEF DESCRIPTION

THE Suri-Transmission, in its latest form, provides simple but highly efficient means for transmitting power in diesel rail traction units. It employs only two circuits, a Brockhouse type of convertor-coupling, and a fluid-mechanical-coupling. The two are arranged in parallel. The convertor-coupling can be arranged, according to particular needs of actual service, to cover the vehicle speed range from zero to 60—70% road speed. The fluid-mechanical-coupling comes into function from that speed onwards upto 100% vehicle speed.

A judicious superimposition of diesel engine characteristics obtained by 'reverse governing' upon the Brockhouse convertor-coupling and the fluid-mechanical-coupling, makes the Suri-Transmission a very satisfactory means for universal application to rail traction. In the larger horsepowerd vehicles, e. g. 400 to 2000 h. p. and above, advantages of the Suri-Transmission summarised below are of even greater interest—

- (i) Because of two circuits only, the construction is simple, compact and robust, low in weight and in price.
- (ii) Using a convertor-coupling, the need for automatic changeover is obviated, simplifying control systems, primary and secondary. Manual control over circuit changeover is provided enabling good drivers to effect maximum amount of saving in fuel. The transmission is inherently fool-proof against mismanipulation, and indifferent or poor driving cannot result in overall operational efficiencies any worse than those obtained with the best automatic transmission circuit changeover governors, even when the governors are fitted with load-speed correction mechanisms.
- (iii) The circuit changeover from the convertor-coupling to the fluid-mechanical-coupling occurs under full load and power of the diesel engine, without shock, and without

SURI TRANSMISSION
(AS BUILT BY M.A.C.)

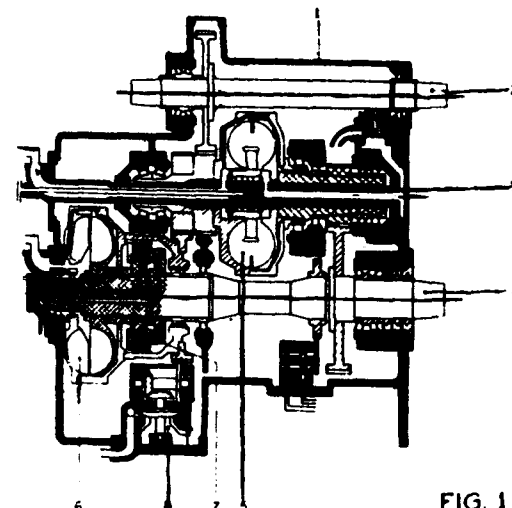


FIG. 1

- | | |
|----------------------------|-------------------------------|
| 1 HOUSING | 5 BROCKHOUSE TORQUE CONVERTOR |
| 2 INPUT SHAFT | 6 FLUID SYNCHRONISER |
| 3 CONVERTOR REACTION SHAFT | 7 PLATE CLUTCH |
| 4 OUTPUT SHAFT | 8 OIL PUMP |

interruption at any stage of tractive effort of the vehicle.

- (iv) The losses inside the transmission are a minimum, and both the hydraulic as well as the mechanical circuits yield optimum efficiencies in their respective ranges (Fig. 2).
- (v) The part-load efficiencies in the convertor-coupling are exceptionally high for which reason this transmission is ideally suited for shunting purposes.
- (vi) Because of highest attainable efficiencies available from the mechanical line of transmission, which can be engaged from 50—70% road-speed onwards, this transmission is ideally suited for mainline service.
- (vii) An added gain of the order of 1 to 2% in

the overall efficiency of the locomotive accrues from operation in the purely mechanical line of transmission. All Electric and Hydraulic transmissions require power for dissipating the heat generated inside the transmission system. The mechanical line when engaged requires no cooling. In fact, advantage can be taken of this to relieve even the engine cooling circuit to some extent, by providing a heat exchanger between the transmission oil and the radiator water. This makes effective use of the radiation capacity of the transmission housing when running in the mechanical gear. This feature is of real interest to Railways of tropical countries.

The exploitation of 'reverse-governing' technique using the 'Suri-Governor' on diesel engines developed in collaboration with Messrs. Maybach Motorenbau has played an important role in the success of this transmission and in its universal applicability. The use of the Brockhouse convertor-coupling, specially developed for use in the Suri-Transmission, also marks an important advancement in the technique of obtaining higher traction efficiencies for locomotion.

In rail traction the cost of fuel on any large Railway System of the world, generally represent the single largest item of expenditure. On the Indian Railways, for example, fuel costs amount roughly to 14% of the total operating expenses of the Railway.

A close study, especially on Indian Railways, reveals that 80—90% of the total fuel consumption takes place between the speed range of 70—90% designed speed of the Motive Power Vehicle—the locomotive or multiple unit high horsepowerd railcars etc. It is, therefore, of the greatest importance that the efficiency of transmission in this operating range of the rail-vehicle should be the highest attainable.

It is known that the highest possible efficiency between the input and the output shafts of a transmission can be achieved only through pure mechanical means. Whenever means such as, electrical, hydro-dynamic, and hydrostatic are used, losses of energy occur in conversion of mechanical energy of the input shaft to electric, hydro-dynamic or hydrostatic energy and losses occur once again in reconversion of this back to mechanical energy at the output shaft. These losses at both conversions are inherent and inescapable unless the input and the output shafts are mechanic-

SURI-TRANSMISSION
CHARACTERISTIC CURVES

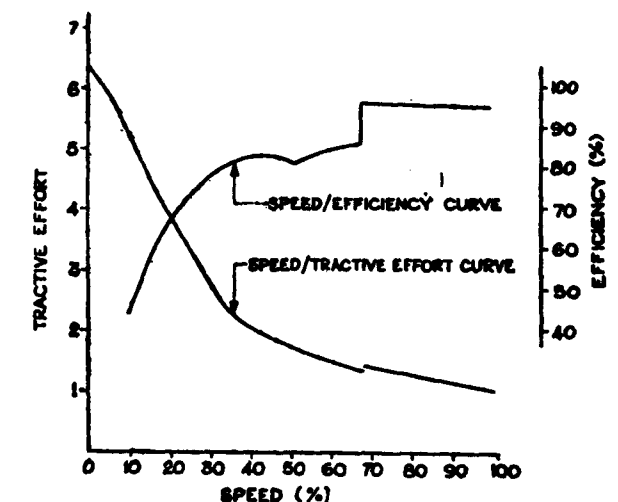


Fig. 2

ally and directly brought together with rigid coupling means. Energy is then transmitted from the input to the output shaft without any losses.

While with existing electric transmission, efficiency of transmission at rail of the order of 85% is achieved; and with hydrostatic or hydro-dynamic (convertor types) approximately 80—82% is achieved; and with hydro-dynamic (coupling types) approximately 90% is achieved; with a pure mechanical transmission a total efficiency of transmission unit at rail of approximately 95% can be demonstrated on a locomotive. It is, therefore, possible to save fuel costs to the extent of 5—10% by adoption of pure mechanical transmissions in preference to other rail traction transmissions.

Although the advantages of higher efficiencies of mechanical transmissions have been well-known, their applications on rail traction units have been limited to units of a maximum of 400—500 h.p. Application to larger units presents some basic difficulties more particularly in the case of rail traction.

A popular mode of coupling mechanically is by way of a plate clutch. The limitations of a clutch are readily understood. For example, when a train is picking up speed, at the point of changeover from one line of transmission with higher gear ratio to another line of transmission, the input shaft and the output shaft to be coupled by the clutch are moving at different speeds. Thus when the two shafts are suddenly coupled, considerable momentum will have

to be destroyed of all the primary members, shafts, gears, diesel engine etc., which are connected to the input shaft, in order to bring down the speed of the input shaft and synchronise it with the speed of the output shaft through the clutch. The shock load generated through change of momentum is inversely proportional to the time taken to effect the change. Therefore, if the clutch closes suddenly effecting coupling in an instant, the resultant high shock load, especially in cases of higher horsepower vehicles, tends to damage the transmission parts as well as the diesel engine. On the other hand, if the transition time is allowed to be larger and shock loading limited, as by permitting a progressively decreasing slip between the plates of a clutch till synchronisation is achieved, the plates of the clutch are subjected to considerable wear necessitating frequent replacement. This is not acceptable in present-day rail traction because of the fact that Electric and Hydraulic transmissions now in use have already reached a stage in their development where in spite of intensive use, frequent attention is unnecessary and parts do not wear, or require renewal, for periods of a few years at a stretch.

One means employed in the case of mechanical transmission to obviate these difficulties is through interruption of power from the engine when changing from one to another line of transmission. This is the case with automobiles or light railcars. In heavy duty rail traction, where the trailing weight is high compared to installed horsepower, this interruption of power is unfavourably viewed. When a train is accelerating, especially on a gradient, and the speed has been achieved where a change of gear is required, any interruption of power instantly slows down the train. A continuity of tractive effort is most desirable for rail traction right through from zero to 100% road-speed. During the operation of changing from one to another line of transmission, especially in case of the mechanical line of transmission of known designs, care has to be exercised to put back the throttle of the diesel engine. Otherwise, during the momentary total sudden offloading of the engine when one line is disengaged, and before the mechanical line can be engaged, the diesel engine and all primary components of the transmission would shoot up in speed further aggravating the difficulties faced in engaging of the complimentary parts of the mechanical coupling. For this reason also, an interruption of transmission of torque has been found unavoidable in existing mechanical transmissions.

The types of mechanical couplings used in Rail Traction today are either friction plate clutches, claw

clutches, or band-brake-type with epicyclic gearing. All these known methods achieve high efficiency of transmission, but result in disadvantages mentioned above which limit their use to low horsepower vehicles only.

The Suri-Transmission makes use of a fluid-mechanical-coupling wherein the mechanical-coupling housing provides within it, a small and inefficient fluid coupling (with high slip). This fluid-mechanical-coupling is arranged parallelly to a Brockhouse convertor. The operation of the whole transmission unit, its controls as well as the detailed features of designs of the different individual components in combination result in a transmission unit which successfully overcome the problems enumerated above.

The transmission as applied to a 650 h.p. Shunter is outlined in Fig. 1. The gear ratios selected are such that the torque convertor when filled accelerates the vehicle to approximately 70% maximum speed with the diesel engine running at full power and at full speed. The direct mechanical line is arranged to cover 70% to 100% speed. Fig 2 shows Tractive Effort/Speed Curve.

At start the torque convertor is filled with fluid while the direct mechanical line is kept fully disengaged till the time the vehicle speed reaches 70%. At this

FLUID-MECHANICAL COUPLING CHARACTERISTICS.

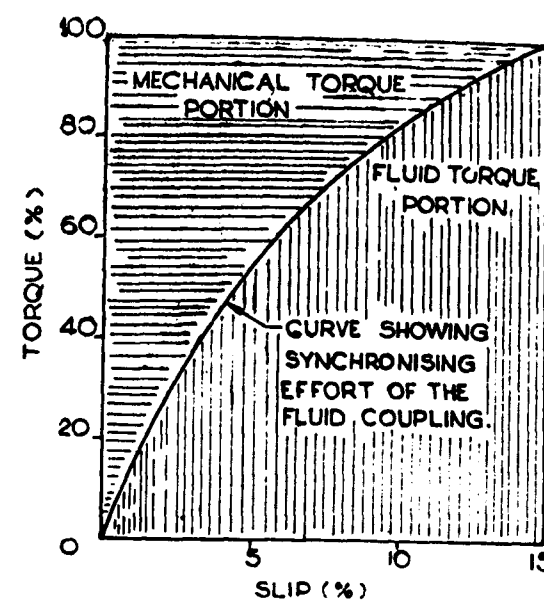


Fig. 3

time the two complimentary parts of the mechanical coupling are running at different speeds, the primary part attached to the engine is running at 100% speed while the secondary part attached to the output shaft is running only at 70% speed. To change from torque convertor circuit to the mechanical line, the flow of fluid to the torque convertor is diverted to the mechanical coupling which houses a high slip small size fluid-coupling, e.g. with a slip of 15% or so. As is well-known, a fluid coupling with this high slip is, in size and in weight, much smaller than the conventional traction coupling for rail traction which has a slip of the order of 4—6%. It would be readily appreciated that a 15% slip coupling is very soft in its action and, therefore, when fluid is filled into this coupling its engagement is gradual, cushioning the shock to primary and secondary parts.

The use of this small coupling, characterised by unusually high slip, solves the following problems immediately for rail traction :—

- (i) The size of the coupling and its weight, and hence the weight of the transmission unit is reduced. The simplicity and compactness of design are important for rail traction transmissions.
- (ii) The changeover from the torque convertor to the fluid coupling even when carried out within a minimum of time, does not shock load the components of the transmission. With this arrangement, there is no need to effect interruption of torque. The change is carried out with the engine running at full power and speed.
- (iii) Because the fluid coupling acts softly due to its high slip, it is not important that the torque convertor be emptied instantly and the coupling filled slowly in order to avoid the two circuits with different gear ratios working in opposition to each other. In the Suri-Transmission, no elaborate mechanisms are required, nor any exacting time controls, for filling and emptying of the two circuits because the risk of damage due to the two circuits remaining filled simultaneously and working in opposition to each other is very much reduced by the use of this unusually soft coupling.
- (iv) This feature of overlap of circuits resolves the problem of sudden offloading of diesel

engine and the tendency to suddenly shoot up in speed at a gear change—a difficulty experienced in most cases on known transmissions. The engine is never offloaded because before the first circuit, i.e. the torque convertor has fully disengaged, the fluid coupling has already come into function and taken the load of the engine.

It can be seen that without taking recourse to any elaborate control mechanism of filling and emptying of the various circuits, or providing the diesel engine with super-sensitive and exacting governor controls, the change from one line to the other takes place with smoothness, with continuity of torque, and with the engine under complete control, simply by deploying the high slip of a small and inefficient fluid coupling in the transition stage. At this stage the torque convertor has been emptied and the high slip coupling filled. The engine speed has dropped to 85% with the vehicle still at 70% speed. This in effect means that partial synchronisation has already taken place between the two complimentary parts of the mechanical coupling. It is no longer necessary to engage the plate clutch too instantaneously or very slowly in order to avoid wear to clutch plates or prevent shock loading because,

- (i) Partial synchronisation has reduced the difference between the input and output shafts to 15% and therefore, relative slip is now much less ;
- (ii) At higher relative speed difference between input and output shafts, the co-efficient of friction is lower necessitating higher coupling force, which leads to much higher heat generation and excessive wear of plates. Partial synchronisation in itself results in prolonging the life of clutch plates to the desired minimum in rail-traction ;
- (iii) When the clutch plates are being engaged, full torque is already being transmitted through the fluid part of the fluid-mechanical-coupling and the clutch plates are only acting in addition. The fluid part is helping actively throughout while the clutch plates are progressively taking over. The results of this technique of parallel working of fluid and mechanical coupling are extraordinarily interesting. When the torque splits through two channels i.e. hydraulic and the clutch plates, the torque through the fluid part of the coupling is

progressively reduced. Immediately that happens, as shown in Fig. 3, the slip of the fluid coupling reduces in accordance with well-known fluid dynamic principles. As more and more torque is transmitted through the plate clutch and less and less through the fluid, the fluid acts more and more severely to synchronise the input and the output shaft speeds. Thus a high slip coupling initially acts as a partial synchroniser and then in combination with a plate clutch it aids total synchronisation upto the moment of complete engagement.

- (iv) Results have shown that the engagement of the plate clutch in this manner does not cause any shock to the transmission and

the engagement is hardly felt on a locomotive.

It is, therefore, a feature of extraordinary interest in the Suri-Transmission that an inefficient high slip coupling, which by itself would be an unacceptable component in a rail traction transmission, and a simple plate clutch which also is an unacceptable mode of coupling in a rail transmission of high horsepower, nevertheless, when combined to act in the manner explained, results in a very satisfactory transmission unit characterised by its exceptionally high efficiency, by delivery of uninterrupted torque from zero to full speed, and by smooth changeover from fluid to the mechanical circuit and vice-versa. To a railwayman, this means savings in fuel costs and ease of operation, both for shunting as well as for mainline operation.

BRITISH LEAD IN RAILWAY ELECTRIFICATION

British engineers and manufacturers who have been working on new railway electrification projects have gained experience which has given them a lead in this form of engineering, said the chairman of the British Transport Commission, Sir Brian Robertson, addressing the Institution of Locomotive Engineers in London. Manufacturers, he said, had learnt and discovered things which had been unknown before.

Sir Brian, who was lecturing on "The Locomotive of the Future", reiterated both his faith in the future of British Railways and in the skill, efficiency, and integrity of British industry. He said traffic conditions on British Railways were probably more exacting than on any other railway in the world, "and equipment which will stand up to them has passed the sternest test".

When British Railways embarked upon their modernization plan, "the members of the British Transport Commission shared the considerable apprehension about the reliability of high-powered main-line Diesel locomotives", said Sir Brian. "Our only experience to date had been rather uncomfortable, and we were aware that railways in other countries had encountered a considerable amount of trouble when they first embarked on the plan of Dieselization.

CONFIDENCE JUSTIFIED

"I am glad to be able to say now that our decision to have confidence in British engineers and manufac-

turers to turn out locomotives that would not involve us in a sea of troubles has been justified. The standard of performance of our main-line Diesel locomotives, taken as a whole, does them much credit".

Sir Brian thought it could be justly claimed that the design panel set up by the British Transport Commission had fully justified its existence, "and that the appearance of our new locomotives and rolling-stock gives witness to the effectiveness of its efforts".

Speaking of electrification, Sir Brian said that British Railways had adopted the 50-cycle, 25 kV, alternating current (AC) system after careful thought. It was possible to argue that a direct current system of lower voltage would have been quicker and easier. "In spite of this, I am satisfied that the decision taken was a right one, and certainly the AC system is practically the only one which is saleable today in the export market."

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"DEODORANT" FOR DIESEL FUMES

A Diesel "deodorant" which neutralizes Diesel fumes and produces, instead, "an aroma of ice-cream soda" has been developed by a British firm specializing in oil additives and engine testing equipment. The firm believes that the new development can put an end to the present obnoxious smell of Diesel fumes from exhausts of road, rail, and water traffic using the oils.

Train Lighting of Integral Coaches as Furnished in the Integral Coach Factory

By D. R. Naha

District Electrical Engineer, Integral Coach Factory, Perambur

THE Integral Coach Factory was designed to manufacture passenger coach shells of the Integral design and the intention was that the furnishing work would be economically distributed over the existing Railway Carriage Workshops. With the ever increasing traffic demand for more coaching stock, it was not possible to spare any of the coach building capacity of Railway workshops for furnishing all Integral coaches. Hence, interior furnishing and provision of lights and fans in shell coaches is undertaken by the I.C.F. Furnishing Annexe, south of Shell Factory.

Electric lighting of coaches on trains was introduced in England in 1894 by employing axle driven Dynamo which is still the basic system in general use to-day all over the world. Electric lighting of coaches was first introduced in our country in 1920 with individual equipment. Block system of train lighting with axle driven generator and double battery equipment is adopted on the Indian Railways. Tourist cars, Inspection Coaches, Postal Vans, Air-conditioned coaches and Restaurant cars have their independent train lighting equipments with straight through wiring.

The Train Lighting of the Integral Coach employs the 24-Volts, double battery system. With this system, the battery is divided into two sections, one section is being charged from the Dynamo whilst the other floats at the requisite voltage for lighting and fan loads. In recent days there has been considerable increase of amenities to passengers and thereby heavier and variable electric load have to be catered. The third brush generator in combination with controlling equipment combines the functions of automatically controlling generator output lamp voltage and precludes battery over-charging.

The Generator is a shunt-wound, totally enclosed, variable speed, reversible machine of 24/32 volts, 100 amps. capacity specially designed to operate on Railway Carriage underframe and driven from one of the axles, is of rigid construction and of minimum weight

and bulk, besides being vibration and shock proof and weather proof. The Generator when connected to the battery has inherent self-regulating properties due to the provision of the third brush. The out-put of the generator is at its maximum at low speeds and it drops at high speeds. The phenomenon is particularly valuable for both slow and express services (i.e.) the battery charge in ampere hours over a given period is approximately same for either type of service. The brush gear of the Generator is designed with an automatic pole changing device to ensure constant terminal polarity of the Generator with relation to rotation.

Each of the two batteries comprises of 12 lead acid cells of 300 ampere hours capacity, iron clad type housed in metallic battery boxes suspended from the underframe. The cells are of special design to withstand the hazardous duty in moving coaches. The batteries are charged alternatively by the Generator by the function of the battery change-over mechanism which is incorporated in the auto cut-in and cut-out switch. Generally, in the Train Lighting shops of the Indian Railways, motor Generator sets are installed for charging batteries. Metal rectifiers of modern designed with all facilities for smooth charging and fine adjustments (Fig. A) are installed in Integral Coach Factory for charging batteries with a view to conserve space.



Fig. A

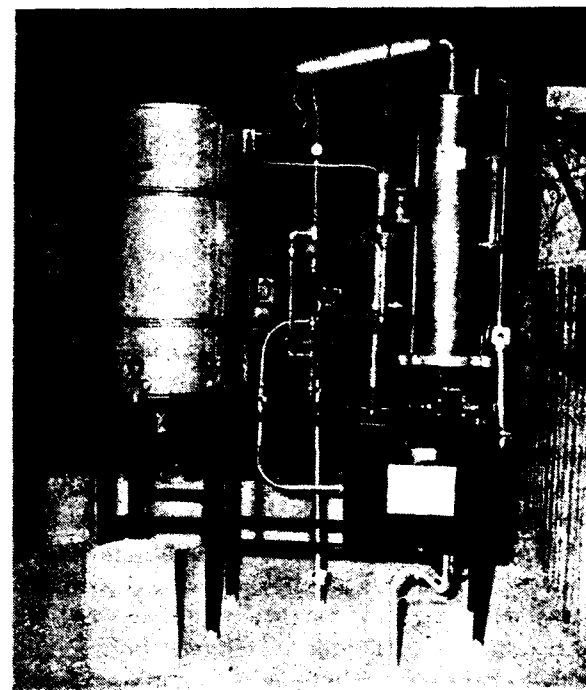


Fig. B

Electrically operated Water Distilling plants are installed (Fig. B) in the Train Lighting Shop for distilled water required for the preparation of electrolyte to guard against contamination and to conserve space as against the out-moded coal fired Distilling plants with elaborate arrangements adopted in the Train Lighting Shops.

A combined over-charge and over-voltage relay is provided on the Switch Panel suspended from underframe. The over-charge relay obviates over-charging of the battery from the dynamo circuit and reconnects the same when the voltage of the battery falls below pre-set value, generally set at 29 volts. The over-voltage relay usually set at a higher value—say 40 volts—is intended to isolate the dynamo from the battery circuit in the event of any undue rise in the generator voltage. This protects the armature, field coils, etc., from over heating and consequent damages.

A magnetic load switch which is mounted on the Switch Panel controls the operation of fans and lights in the coach. The load switch is controlled by the Three-Push Button control switch fitted at one end of the coach externally to operate fans and lights in an individual coach by the Guard of the train. Fans and lights for use by night or fans only for use by Day and OFF can be operated by the operation of the three-push button control switch provided in the

Guard's compartment which operates all the magnetic load switches throughout the train. Every fully equipped feeder coach is provided with one three-push button switch.

The lamp resistance mounted behind the switch panel of the coach is intended to regulate the lamp voltage. The Resistance comes into circuit only when the fans and lights are switched ON and automatically shunted when the fans and lights are OFF so that both the batteries get discharged in parallel.

A combined auto cut-in and cut-out switch is mounted on the Switch panel and incorporates also a battery change over mechanism. This gear controls supply from the Dynamos to the batteries.

The wiring of the coach can be divided into three sections:—

- (1) Main Roof wiring from 24 Way fuse and junction box to 15 way link junction box with connected branch wiring for the control of fans and lights.
- (2) Wiring to inter-vehicle coupler male and female.
- (3) Underframe wiring.

Main Roof Wiring : This comprises of 5 Mains and 4 auxiliary mains. The 5 Mains are intended for Block-Rake systems of working. The auxiliary mains are intended for the operation of equipment in that particular coach only.

Inter-vehicle Coupler : This wiring is provided at the two end walls of the coach and are intended in conjunction with the couplers for Block-Rake operation.

Underframe Wiring : This comprises of all wiring between the Generator, control gears and batteries which finally terminates at the 24 way fuse and junction box.

The fittings provided in the integral coach of various types are of the latest design. The external lights are automatically controlled through auto Cut-in and Cut-out switch, so that the lights are ON when the train is slow or at stand still and go OFF when the train picks up speed of 12 to 15 miles per hour. These lights assist in lighting up of platforms that are not electrified and also serve as external illumination of the coach and light the vicinity of the train when stops between stations for signals, etc., and also helps in



Fig. C

security measures. An interior view of a Third Class Sleeper coach can be seen at Fig. 'C'.

The wiring of the Integral coach which is all steel requires suitable modification over the system employed in the conventional timber-bodied coaches. Special care is taken to see that all cables are completely isolated from metal work. The Roof Mains are

run in the centre of the coach from end to end and suitably cleated and encased. The branch wiring to the fan and light points are suitably clipped to the timber car lines. The wiring between the junction boxes and inter-vehicle couplers is run through G. I. pipes suitably bushed.

Dis-similar to the usual practice of running under-frame wiring on wooden cleats, the wiring in the underframe of shell coaches is taken in steel conduit with necessary inspection boxes, etc., and terminated in the Switch Panel on the underframe. This has the advantage of eliminating pilferages of cables on the underframe, as experienced on coaches wired otherwise.

This Factory is at present engaged in the manufacture and furnishing of Third Class, Third Class Sleepers and Guards Compartment with Third Class coaches. The furnishing of First Class coach has just been taken up.

The furnishing and provision of electric lights and fans in the Integral shell coaches manufactured in the Integral Coach Factory was started in May, 1957. It is proposed to furnish 300 First Class coaches during 1961—62 and 350 First Class coaches during 1962—63 under Third Five-Year Plan. It is also anticipated that the furnishing of Upper Class, Electrical Multiple Units will also follow in the years to come by which time with the wide experience gained on Train Lighting and Furnishing, further advancement is expected to be achieved.

PVC Insulated (Heavy Duty) Electric Cables

NEW TYPE OF RAILWAY CAR

The Indian Standards Institution has just published an Indian Standard Specification for PVC Insulated (Heavy Duty) Electric Cables, IS: 1554 (Part I)—1961, which covers the requirements of both armoured and unarmoured single core and multicore PVC insulated and sheathed cables with an outer sheath, for electricity supply and control purposes.

The cables specified in this standard are suitable for use on AC single phase or three phase (earthed or unearthed) systems for rated voltages upto and including 1100 V. These cables may be used on DC systems for rated voltages up to and including 1500 V.

This draft standard is one of a series of Indian Standards for insulated wires and cables, eight standards having already been published on the subject, which have been prepared for the guidance of the fast-developing cable industry in the country.

* * * * *

Nikolai Labutin, a Soviet engineer, has designed a new type of passenger railway car. The compartments having the shape of a parallelogram are arranged in the new car on both sides of the passage. This has permitted to increase the number of accommodations by a third.

Moreover, this has been attained without affecting in any way the passengers' convenience; on the contrary, the cars are fitted with an air conditioning system that is more efficient than it used to be and with comfortable upholstered seats. There is a cabinet in each compartment for keeping food and travel accessories. Such a layout of railway cars had formerly never been applied to either Soviet or foreign car building practice. It will make for reducing transportation costs and for better servicing of passengers.

Method Study in the Integral Coach Factory

By D. R. R. Sastri
Mechanical Engineer/Work Study

THE Integral Coach Factory came into being in October 1955 with the aid of Foreign Technical consultants, who had themselves been engaged in Railway Coach manufacture in Switzerland, a country noted for its high efficiency. In helping us to establish this Factory, the foreign consultants were, therefore, able to bring to bear their rich experience and to introduce the latest ideas in Coach building technique. The Integral Coach Factory thus had a flying start and then aided by the enthusiasm of its workers, who quickly learnt the operation of modern machines and who adopted uptodate technical methods it has gained the reputation that it at present enjoys.

Obsolescence, however, swiftly overtakes all things complacent and slow, and the Integral Coach Factory is aware that unless it keeps racing forward its ultra-modern of to-day will become the ancient past of tomorrow. The Integral Coach Factory in the effort to keep pace with a changing world, employs various means amongst which 'Method Study' occupies prime position. Method Study itself is a part of the larger subject of Work Study, which is gaining stature every day in the great national drive for Higher Productivity.

METHOD STUDY

Method Study as the name implies is the study of the method employed and through such a study it is always possible to find a better way, for there is nothing so good that cannot be done better.

Method Study essentially is a science derived from common sense, which can be applied alike in a factory or an office, in a small or large establishment, in a backward or a modern industry. Method Study, for instance, teaches the elementary axioms that by performing work with both hands instead of by one hand only greater production results and that by performing work in bent position the operator is sooner fatigued than in erect position. The principles of Method Study are thus already largely known to many, but the value of Method Study lies in its method of approach. Method Study takes nothing for granted.

It does not accept the traditional "we always did it this way"; it is not content with a brainwave "That's a first class idea!"; it only believes in detailed questioning, critical and demanding, and the answers through an analysis lead to a better method.

AIMS OF METHOD STUDY

Method Study recognises the following five principal factors, which contribute to production and endeavours to get the highest productivity from each within its capacity:

- (1) Man
- (2) Machine
- (3) Operation
- (4) Tools and
- (5) Transport

(1) *Man*: The capacity of an operator can broadly be divided into mental and physical and it is obvious that if a large amount of thinking is involved in an operation the output is low. Therefore, every complicated operation is broken down (not necessarily the most elementary as repetitive work of too elementary operations can have adverse effects on the operator) but to an optimum stage so that with reduced effort in thinking, the output is increased.

As the second step all unnecessary body movements are eliminated so that physical energy is conserved and directed towards useful work. Thus, without imposing any additional strain on a normal operator higher production can be expected. For this purpose, Method Study has listed out five basic movements—

- (1) Finger movement
- (2) Wrist movement
- (3) Elbow movement
- (4) Shoulder movement
- (5) Waist movement

The swiftness of executing each of the above movements, is in the order stated, commencing with the finger movement as the maximum, and the energy expended is also in the same order but with finger

movement as the minimum. Method Study therefore aims at reducing the movements to the fastest possible and the least energy consuming.

Again in respect of arm movements the following principles are followed to get the maximum production with least strain on the operator (See Fig. 1).

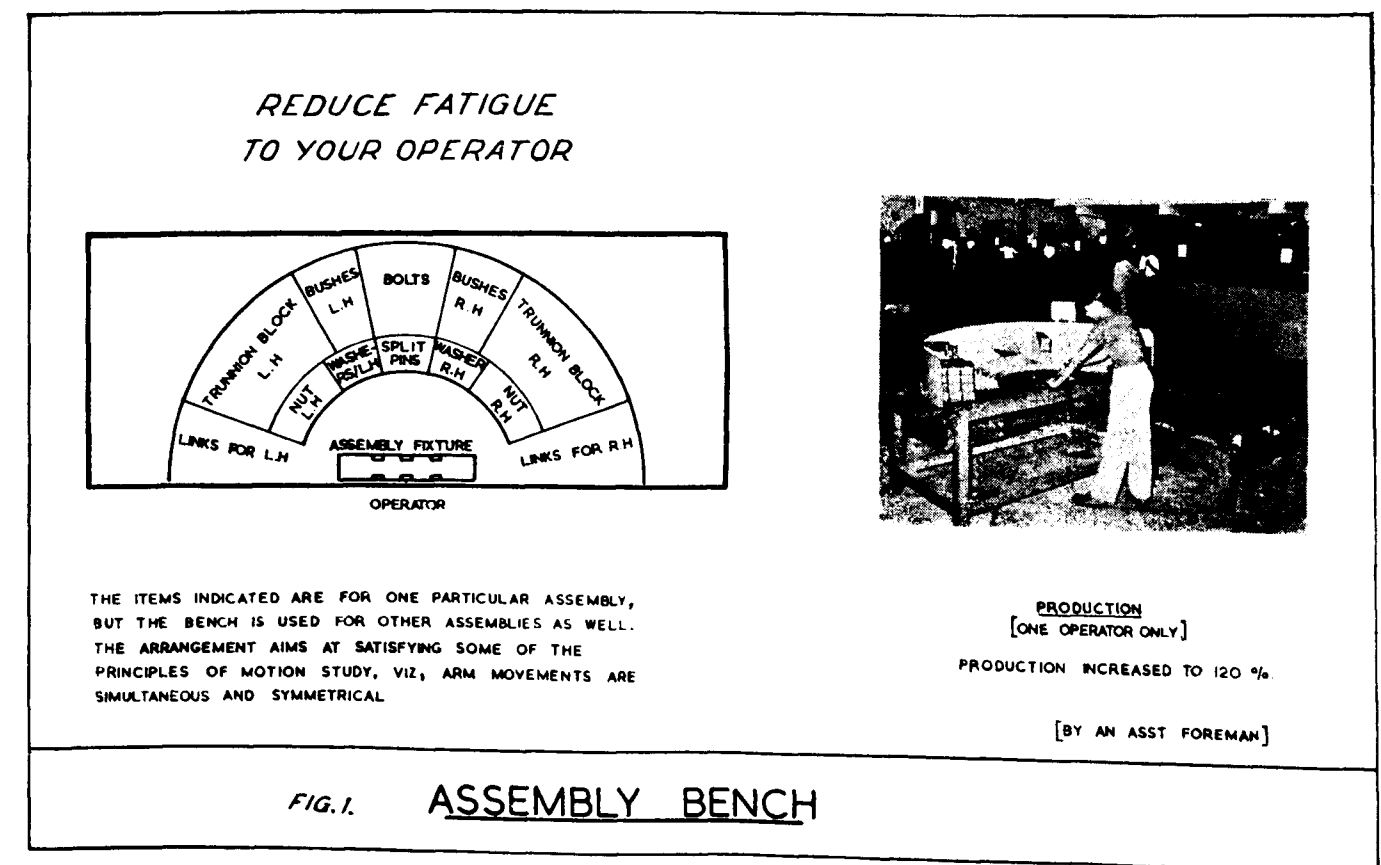
- (1) Begin and end each movement simultaneously with both hands.
- (2) Use simultaneous arm motions in opposite and symmetrical directions.
- (3) Keep motion path within normal working area.
- (4) Avoid operations above shoulder level.

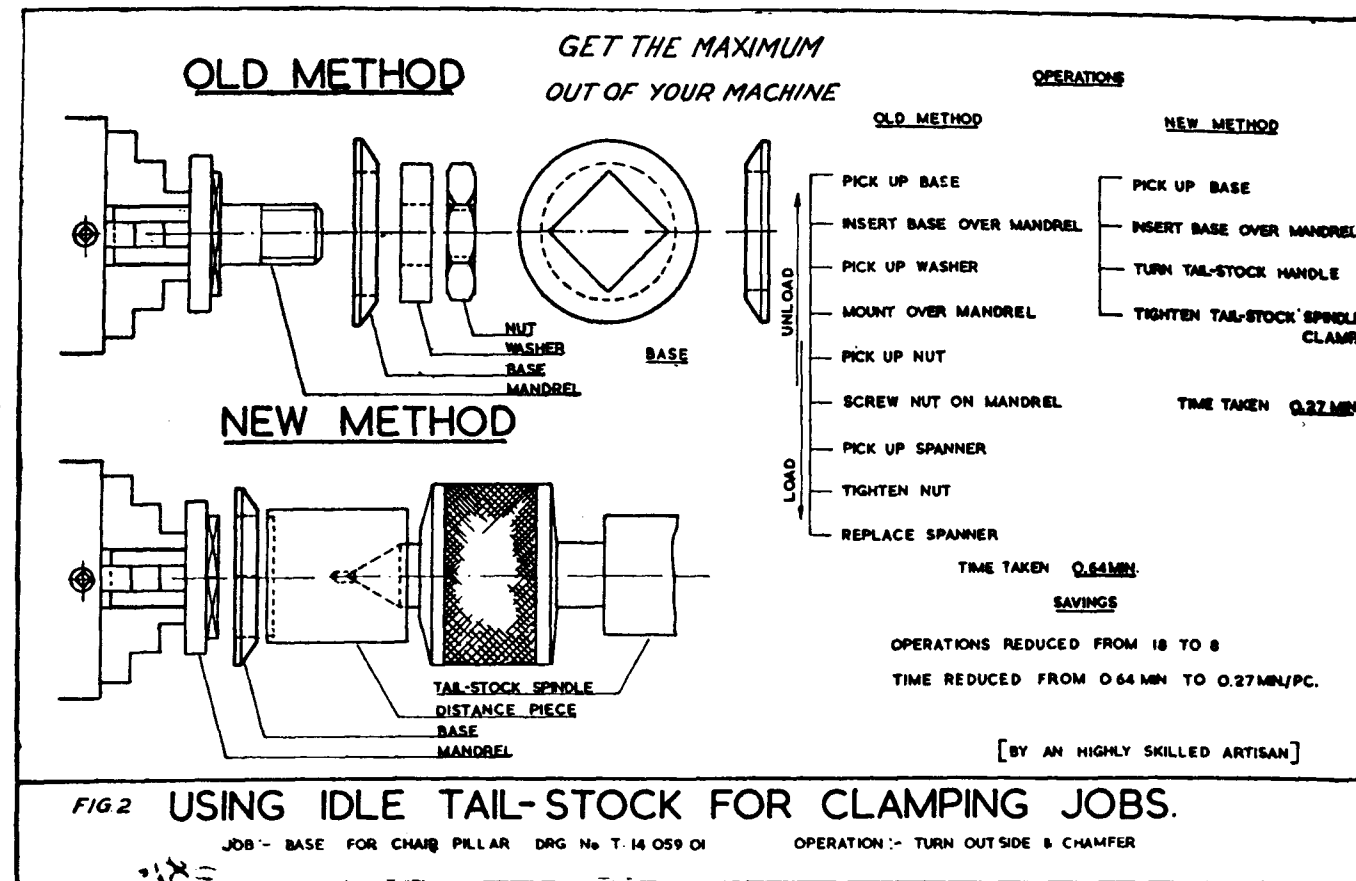
The feet and legs of an operator can also be used to assist the hands and arms. In a primitive way, the street cobbler adopts this principle and while squatting on the ground holds the job between his feet and uses both his hands for passing the thread through. In a

slightly advanced fashion the shop tailor operates his sewing machine with his feet and frees both his hands for guiding the cloth through the machine. In manufacturing operations similarly it is possible to co-ordinate the movements of the feet with the hands and with a little practice all four limbs can be brought into play either simultaneously or in sequence.

A further aspect that is examined is the posture the operator: the more comfortable it is, the less the fatigue and higher the production. Method Study, therefore, prefers sitting to standing, and upright working to bending. Specialised study has even been made to provide the operator with a seat that is best suited to the operations. It will be seen that in all the above principles, the ultimate aim is comfort to the operator, so that even without imposing any additional strain on him more can be produced.

(2) *Machine*: Method Study does not aim at the installation of new machines as its first objective, but instead endeavours to utilise the existing equipments to its maximum capacity. Each machine is defined by





its size, horse-power and accuracy and the points, which have therefore to be satisfied are:—

- (a) Is the machine in use the most appropriate for the operation?
- (b) Is the machine being used to its maximum with regard to its size, accuracy and power?
- (c) Are the fittings and accessories on the machine being utilised to maximum advantage (See Fig. 2)

(3) *Operation:* Here, the Method Study asks:

- (a) Is the operation necessary at all?
- (b) Is there an alternative and more advantageous form of carrying out the same operation? For example, forging may eliminate machining, blanking may replace gas cutting, semi-automatic lathe-production may be more advantageous than Centre Lathe.

(c) Can the operation be combined with any other operation? (See Fig. 3)

(4) *Tools:* Tools may be categorised as cutting tools or hand tools. In the former case the following points are examined:

- (a) Is the tool steel used for the cutting, the best under the circumstances; high carbon steel can be replaced with High speed steel and even more efficient cutting materials are the Tungsten Carbide (400 ft./min) and Cemented Oxide (7000 ft./min).
- (b) Is the Tool design satisfactory, that is, are the cutting angles and clearances correctly provided?
- (c) Is the tool correctly positioned with respect to the job?
- (d) Has sufficient support been provided to the cutting edge of the tool?
- (e) Can the tool clamping arrangement be

improved to reduce time and effort of the operator.

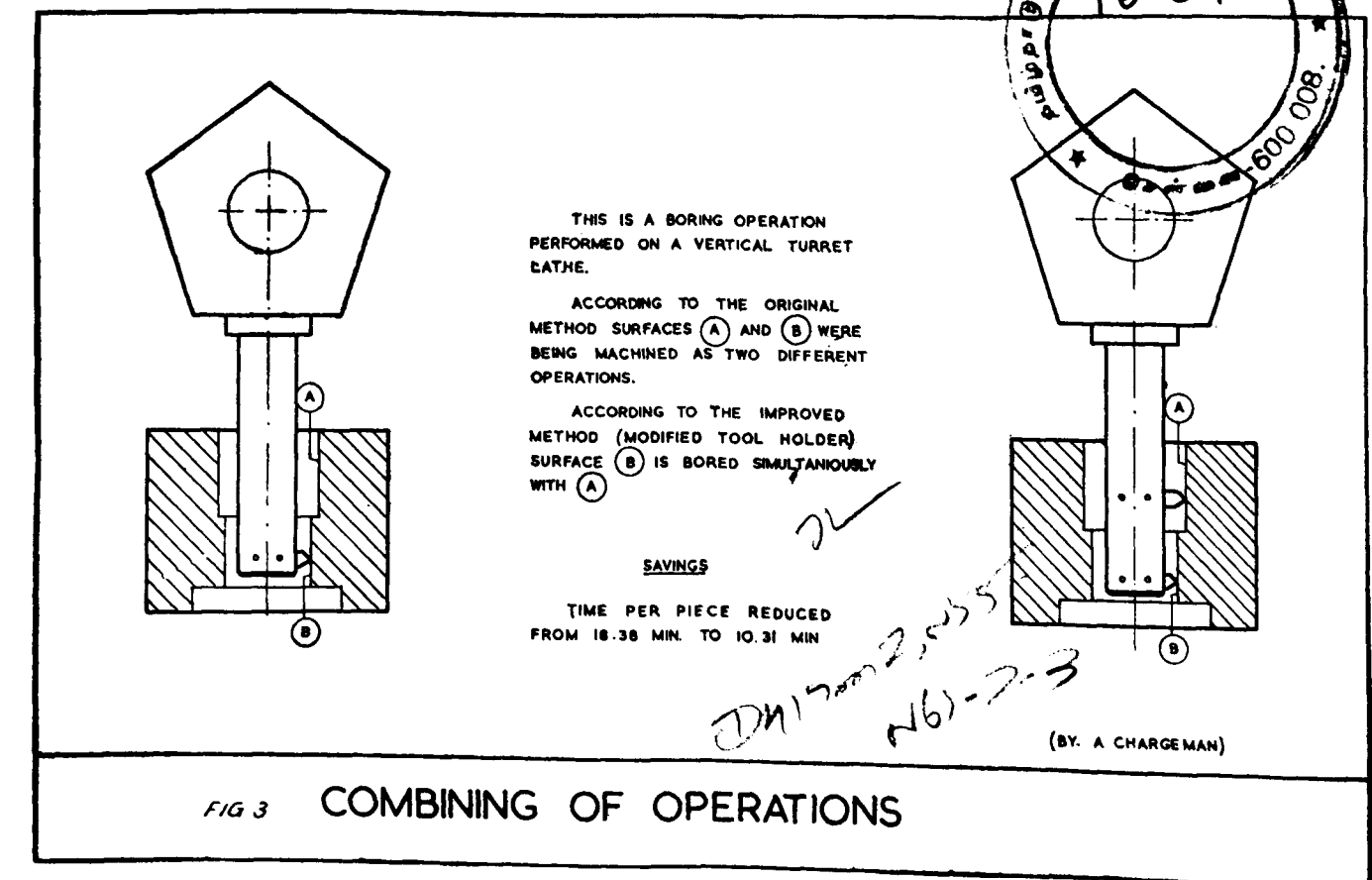
In regard to hand tools, it is essential that the most appropriate are used, being neither too large nor too small and being the most efficient in regard to time and effort. The location of tools is also important so that the operator may reach them without strain or loss of time. Where they are heavy they can also be balanced to relieve the operator of the weight.

(5) *Transport:* This is an item, which lends itself to a great economy through method study since its inefficiency is not readily noticeable. Transport may involve movement of materials from one work place to another or at the work spot itself i.e., from the in-tray to the bench or machine table and back to the out-tray.

For studying any particular case, where the materials move from one place to another, a work flow chart is prepared using either string or line diagrams: the work places through which the job

flows are plotted to scale on a paper and the path followed by the job is represented by means of a string or line. A study of the diagram would reveal whether the path is unidirectional, whether there are unnecessary cross movements and whether the path is too long. It may then be possible to re-route the job to other close-by machines so that transport is reduced and economy achieved. In some cases it may even be advantageous to relocate a work place for this purpose, no doubt taking into account all other jobs also which flow through the same work place. When the transport distance of a single item is considerable or the job is heavy it may be economical to set up an exclusive "belt" otherwise termed a 'Product line'. Several such belts have been organised in the Integral Coach Factory (see Fig. 4) based on the work flow charts and considerable economies effected.

In regard to transport at the work spot itself, it is essential that both the in-tray and out-tray are conveniently located to the operator so that he does not have to strain himself by walking, bending or stretching. A principle of motion economy applicable in this



THIS "BELT" WAS SETUP AS A RESULT OF A STRING DIAGRAM WHICH INDICATED THE WORK FLOW.

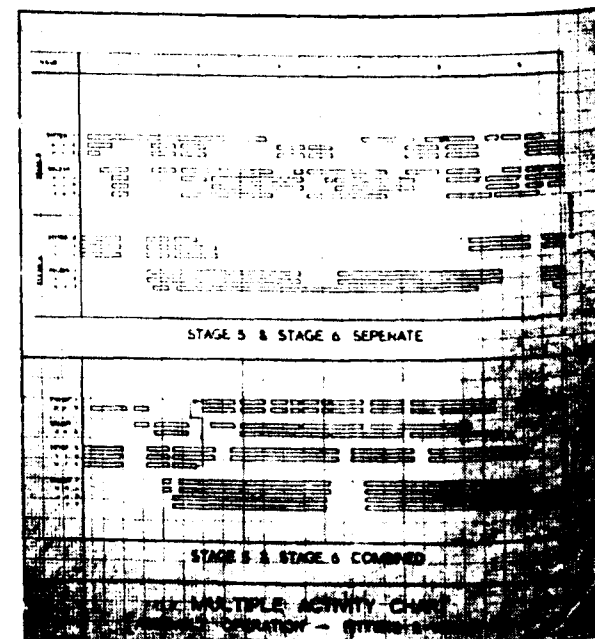


FIG. 4. A BELT FOR AXLE BOX MACHINING.

case is to adopt slide motion, avoiding pick up and carry. To relieve further strain on the operator gravity chutes may be installed both for feeding the job to the work-place as well as disposing of the finished piece into the out-tray.

The first objective of Method Study is to get the maximum with the available facilities and only as the second does it suggest new equipment, here again aiming to get the desired result with the minimum equipment. This applies to machine, tool, transport and all else.

Organisation: In the I.C.F. a separate Work Study Department has been created within which a section is devoting its time to method improvements. In addition to the examples already given a multiple activity chart prepared by it is shown in Fig. 5, by means of which it was possible to increase the activity ratio from 55.5% to 73%. Some officers and staff have received training in Method Study and it is programmed to enlarge this nucleus through inplant instruction. Besides, improvements by shop staff have been encouraged through the suggestion scheme, and prizes have been awarded to good ideas. A section of the staff have also carried out method improvements



in their own sections and work places without looking for any material benefits. In fact, some of the examples quoted in this article have been taken from ideas initiated by such staff.

That Method Study increases the working efficiency

and decreases costs is never a point in doubt, but some hold the view that it is a part of production planning and there is no need for a separate Method Study organisation. In a very general way, this opinion is correct but just as production planning has been separated from Works Management for increasing the efficiency of an organisation, so also should Work Study be separated from Production Planning. This does not mean that the Work Study Department

alone should deal with Method Improvements, but it will be able to bestow full time attention on problems and achieve results through a systematic approach. The Work Study Department will also be responsible for creating method study consciousness amongst all staff, since, the best and quickest improvements can be achieved only if every single individual in the organisation devotes some of his time and thought to Method Improvements.

MAURITIUS MAY GENERATE ELECTRIC POWER FROM INDIAN OCEAN

To reduce its electricity costs, the island of Mauritius is studying ways of using the Indian Ocean rollers which pound its shores to generate electricity. Model tests to assist the investigation have been carried out at the Hydraulics Research Station of Britain's Department of Scientific & Industrial Research at Wallingford, in Berkshire, England.

Mauritius lies in the path of the south-east trade winds, and for the greater parts of the year rollers 4 ft. to 12 ft. high break on the coral reefs on its southern

and eastern coasts. At one point on the coast, at Souillac, the coral reef almost encloses a shallow lagoon which is drained at low tide. If enclosure of the lagoon were completed, the result would be a reservoir constantly replenished by the breakers. The Central Electricity Board of Mauritius is considering proposals to generate power by using this impounded water to operate the turbines. In the first stage of the scheme, an installed capacity of 9,280 kW. is planned, but it is expected that eventually an output of 44,000 kW. could be obtained.

Flame Cleaning

Flame cleaning is the most efficient method of removing rust, scale and old paint from—bridges and binders, ships and shears or tractors and troughs.

The oxy-acetylene flame intimately explores the surface pits and craters in steel and by cleaning and dehydrating, assures an enduring bond between paint and surface. The most intense heat over the shortest period prevents distortion or damage to even taped-seam joints.

Extreme portability and different nozzle-heads make possible extensive application of this protective measure against corrosion, resulting in reduced maintenance costs and sound, long-term economy.

INDIAN
OXYGEN
LIMITED

Picture Story of Integral Coach Factory

By Shri K. T. Jethmalani

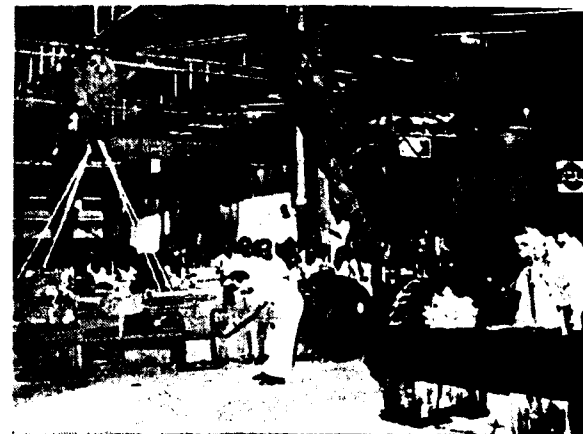
Secretary to the Chief Administrative Officer,
Integral Coach Factory, Perambur

THE State-owned Integral Coach Factory located at Perambur—5 miles from Madras, is one of the largest coach building units in the world. As a commitment under India's first five-year plan,

the shell unit of this factory was set up with a project cost of Rs. 7½ crores to achieve self-sufficiency in matter of passenger coaches for the Indian Railways :



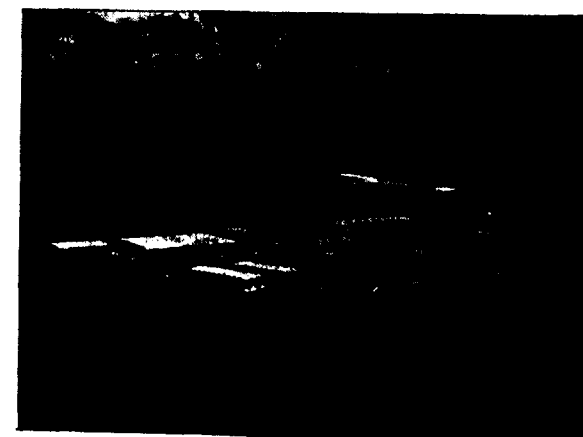
The construction work on the project started with pile foundations in February, 1952.



The first machine was installed by Shri Lal Bahadur Sastri, the then Minister for Railways, on 20-1-1955.



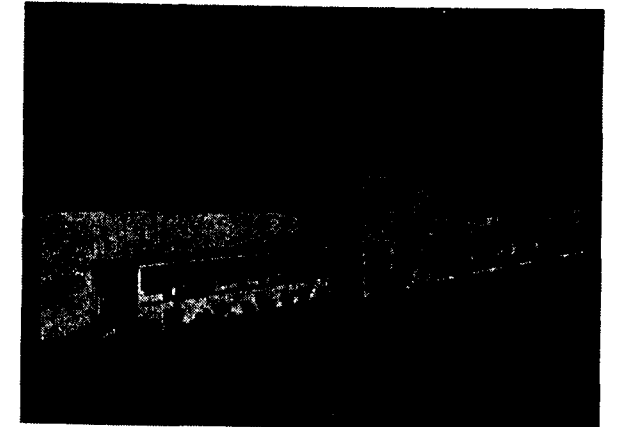
It soon gained momentum and the work was in full swing in September, 1952.



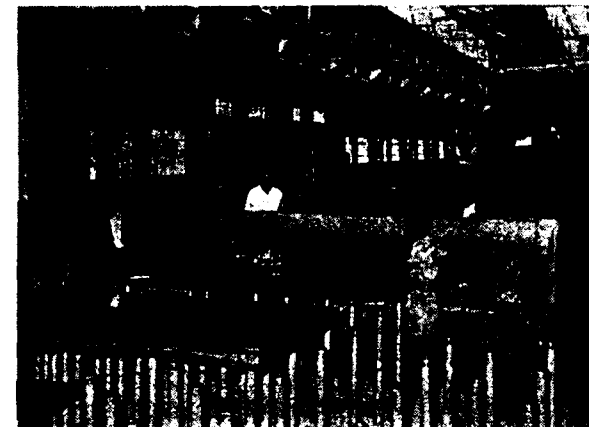
Project thereafter took shape with the completion of the factory.



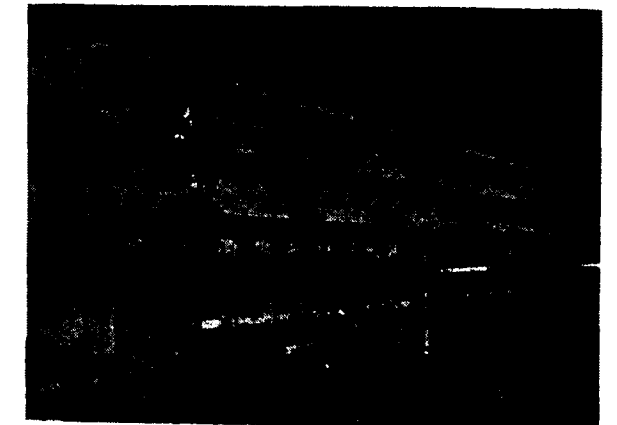
Equipped with, Modern machine tools—



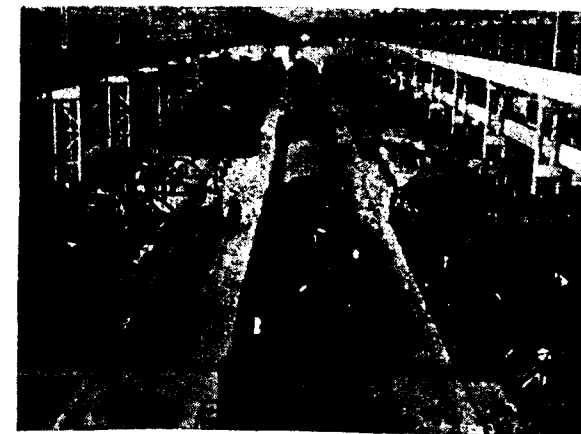
The project also consisted of the Technical Training School.



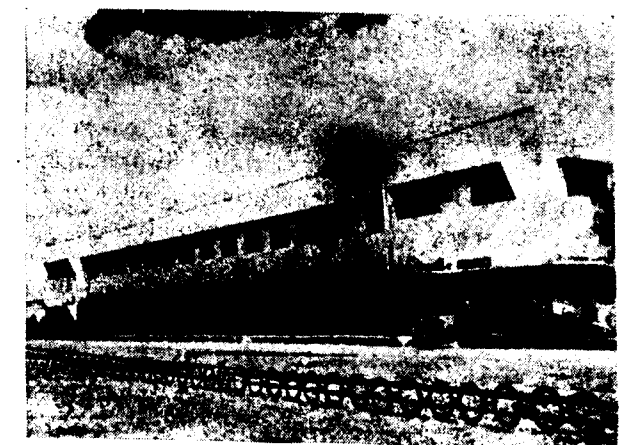
Electric welding machines.



The Administrative Office



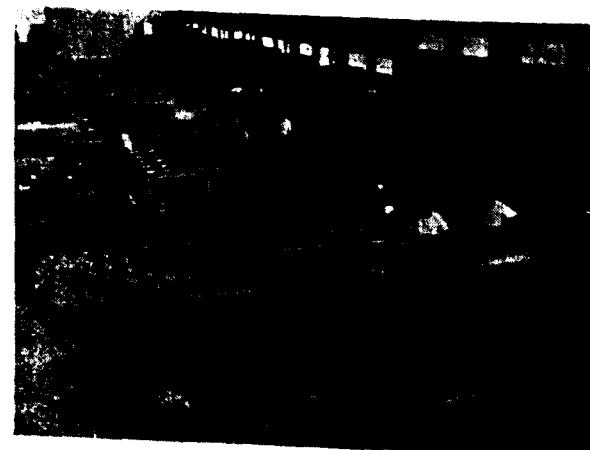
Jigs & Fixtures for unflow production of all-welded light-weight steel coaches.



Canteens



Staff Colony etc.



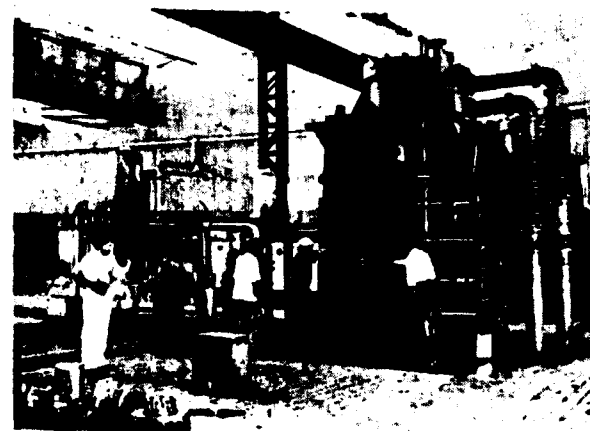
Processing of steel sheets and plates



The production was inaugurated by Shri Jawaharlal Nehru, Prime Minister of India on an auspicious Mahatma Gandhi's Birthday—2nd Oct. 1955.

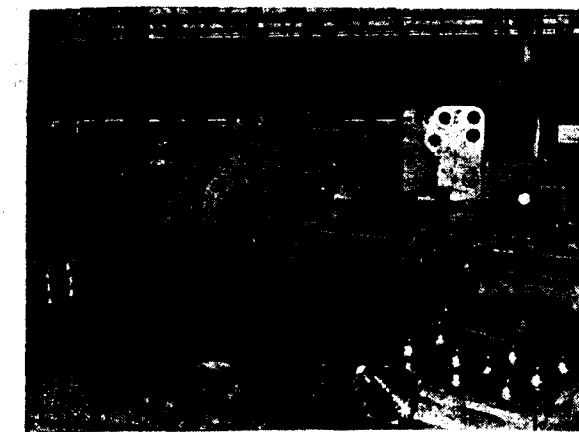


and their assembly by welding.

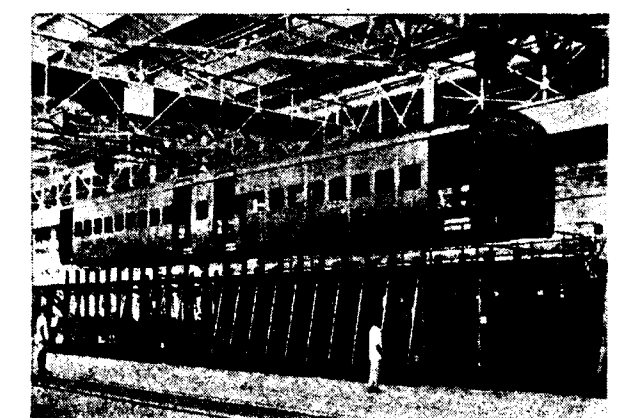


Forging of components from steel sections

Starting humbly with the assembly of coach shells with imported components from Switzerland, the factory took up simultaneously manufacture of Integral Coaches from the raw material stage. This process of manufacture consists of :



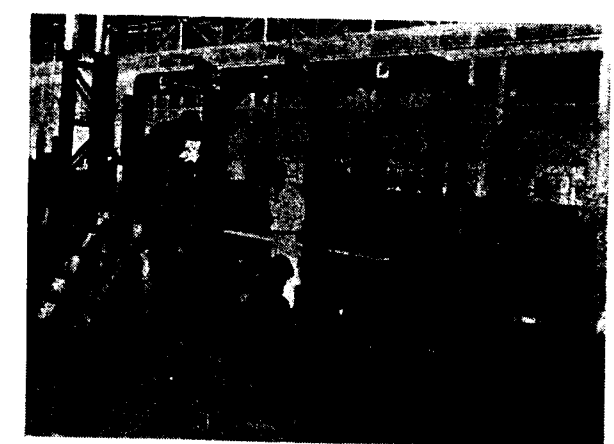
and their machining.



And thereafter the complete body is welded together in the Main Assembly Jig.



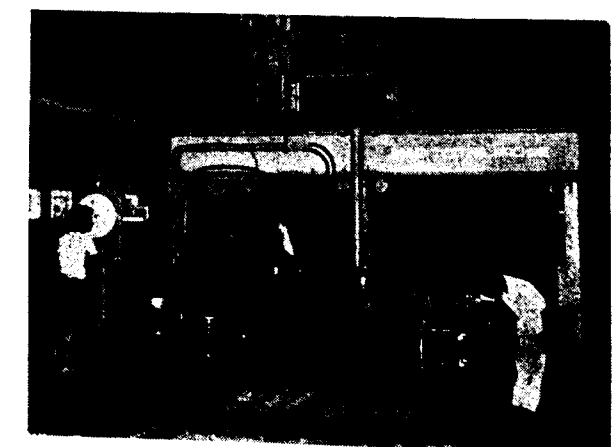
All components are then fed into the Main Assembly Shop where roof is assembled in the roof jig



Bogies are manufactured separately



Assembly of underframe is next stage



And each completed bogie is given a load test to ensure its smooth running and riding comforts.



In the final finishing shop before painting the exterior surface of the coach body is thoroughly cleaned by grit blasting.



The interior surface of the coach is sprayed with asbestos to make it heat and sound proof.



The completed coach shell with body and bogies joined together is thereafter made ready for despatch.



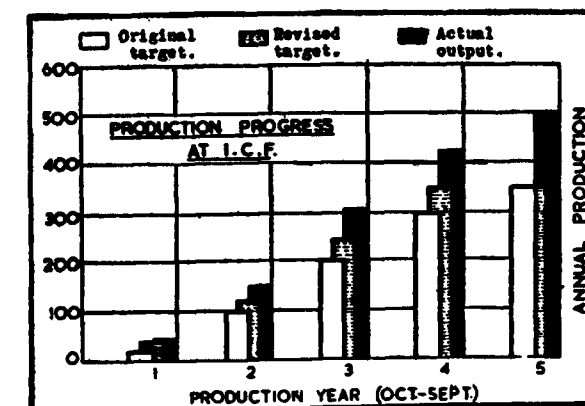
The first such coach produced completely at I. C. F.



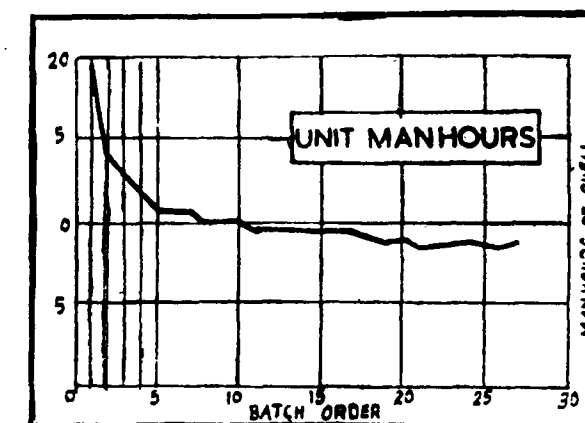
was turned out by President Rajendra Prasad, on 14-8-1956



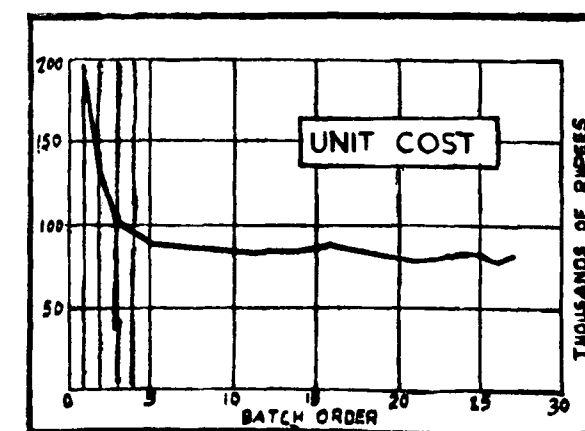
The 1000th Coach was ceremoniously launched on 22nd January, 1960 by Shri S. V. Ramaswamy, Deputy Minister for Railways.



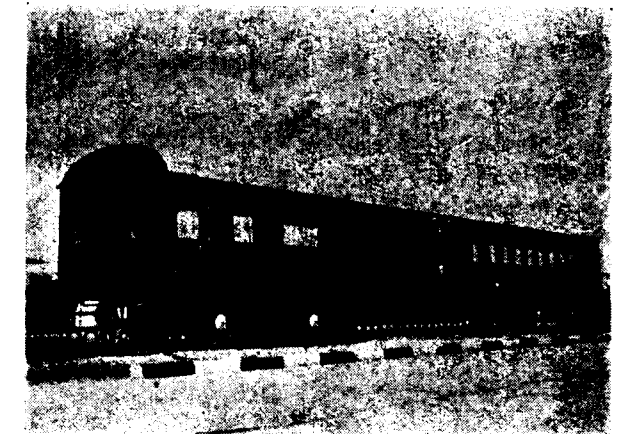
The factory has repeatedly beaten its production targets.



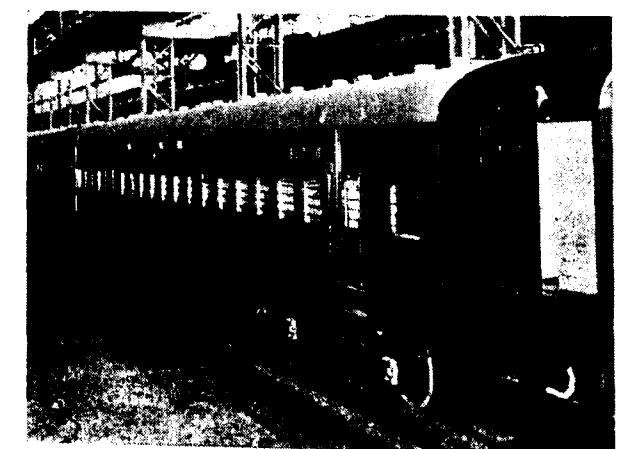
At the same time the unit manhours



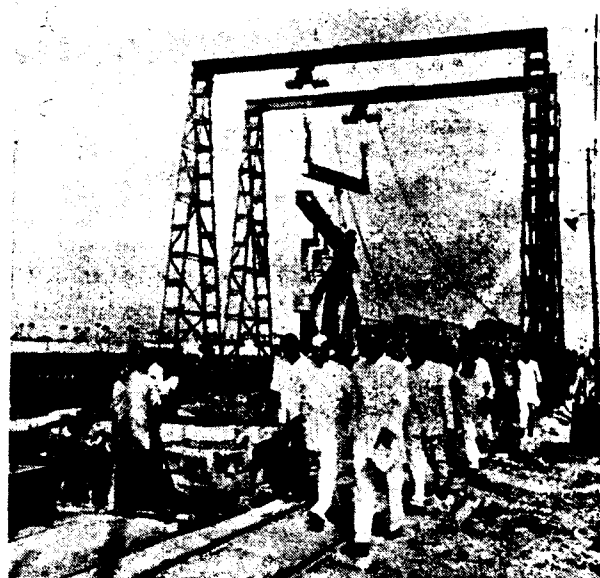
As well as cost of production have come down steadily, the present manufacturing cost at I.C.F. being less than half the cost of similar imported coach.



Apart from increase in production the factory has also diversified its manufacturing activities and has built other types of coaches like Passenger-cum-luggage vans.



Third Class Sleeping Cars and is now geared up to build any type of coach for any guage to suit any particular specification.



A furnishing annexe is also being set up at I.C.F. to enable fully furnished coaches ready for passenger traffic being turned out in the shortest possible time and with maximum efficiency and economy. The work for this Furnishing annexe, with a project cost of Rs. 3.7 crores, is in hand and is expected to be completed in the earlier part of the Third plan period.



In the meanwhile, by providing temporary furnishing facilities Interior furnishing of coaches with seating arrangement.



Train lighting equipment etc., is being done at I.C.F. for about 50% of the coaches produced in the Shell Unit.

Having attained self-sufficiency in matter of passenger coaches for the Indian Railways, the Integral Coach Factory is now looking forward to build coaches for the Export Market.

Famous Company Celebrates Centenary

The Birmingham Small Arms Co.—known all over the world by its initials BSA—celebrated its centenary on June 7.

Established by 14 master gunsmiths in Birmingham, England, in 1861 with a nominal capital of £ 50,000 to make guns by machinery, BSA today heads a group of 29 companies making military small arms, sporting guns, motor-cycles, scooters, machine-tools coal-preparation plants, conveying plant, and metal and plastic components.

BSA made its first bicycle in 1880—a machine with a large wheel on either side of the rider. Today the company is the largest motor-cycle producer in Europe, and supplies machines to armed forces, police forces, and governments in most parts of the world.

During the century, BSA rifles have undergone many changes and developments and are today used by men of many nations in the Commonwealth and in the Western alliance.

India's Bid for Export of Railway Coaches

By K. Swarup

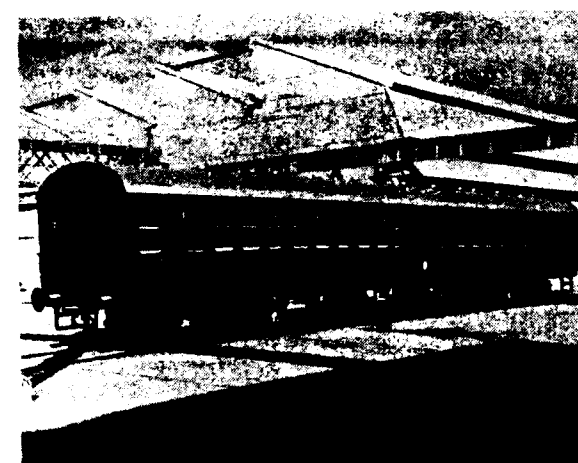
(Chief Administrative Officer, Integral Coach Factory, Madras)

A couple of years ago India was importing Railway Coaches and Underframes from abroad. Immediately after Independence, in the year 1948, the Railway Board in its effort to achieve self-sufficiency in the matter of rolling stock decided to put up a new factory for manufacture of passenger coaches in India. The Integral Coach Factory at Madras was thus set up as a commitment under India's First Five-Year Plan at a project cost of Rs. 7.35 crores. The production in this factory was inaugurated by Shri Jawaharlal Nehru, Prime Minister of India, on an auspicious day, October 2, 1955, the Birthday of Mahatma Gandhi. The progress made by this factory during the last 5 years has been phenomenal and in the 5th production year (October 1959—September 1960) it has produced 502 coaches as against the full production target of 350 coaches according to the Supplemental Technical Aid Agreement of 1953 between the Government of India and the Swiss Collaborators.

TYPE OF COACH

The Integral Coach Factory produces light-weight all-welded steel coaches which have been accepted as the most modern even in the European countries. The advantages of these coaches are :

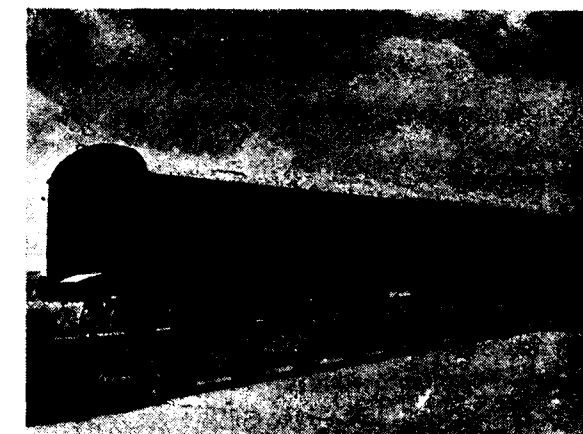
- (i) The light-weight coach has better riding qualities due to unsprung weights having



A T type of integral coach built at ICF.

been reduced to the minimum. This factor also means that the wear and tear on the track will be much less than that in the case of the conventional coach.

- (ii) The operating costs of hauling a light-weight coach are much less.



A Third Class Sleeper Coach built at ICF.

- (iii) The coach possess an extraordinary high compression rigidity, particularly over the entire length of the passenger compartment. This feature ensures greater protection in case of accidents, which is still further increased by the fact that the end sections where the lavatories are located possess lower compression rigidity. In the case of accidents these end sections will absorb most of the collision energy and be destroyed first.
- (iv) The stability of the coach has been considerably increased due to use of well-curved roofs to lower the point of application of the wind pressure.

DIVERSIFIED PRODUCTION

When setting up this Factory original ideas were that only one type of coach shell would be produced

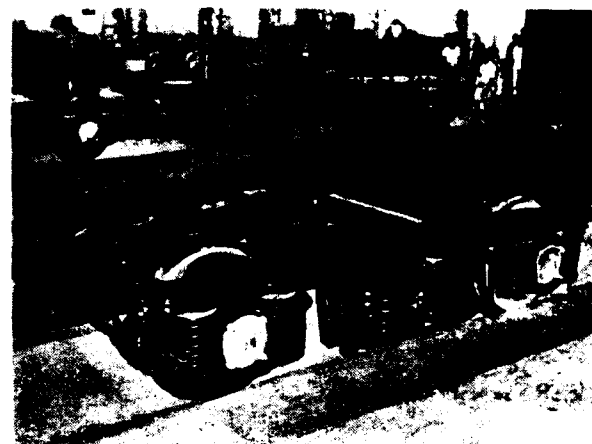
and this would be furnished to the individual requirements of First, Second and Third Class Travel. With the gradual progress in the country this idea however could not be pursued. To provide better and varying standards of amenities and comforts different types of shells had to be designed e.g. First Class, Third Class, Third Class Sleepers and



A TLR type of integral coach built at ICF.

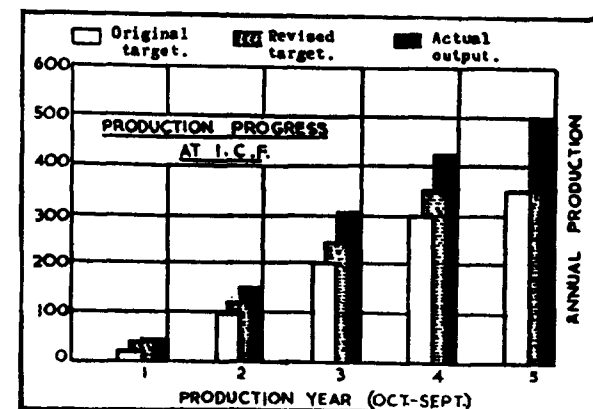
composite Third Class-cum-Luggage & Brake Vans (TLR) etc. In the last 5 years I. C. F. has geared up to design all these types of coach shells and has already produced third class, third class sleeper and TLR coaches in large numbers. The first class coaches are now under production and it is expected that the turnout of fully furnished first class coaches will commence early next year.

The latest all-coil spring bogies with loads on the side bearers instead of on the centre pivot has also been developed in this factory. According to



The latest all-coiled spring bogie.

the reports from the International Railway Congress Association these types of bogies have been reckoned to be better in riding and provide more comfort to the passengers. I. C. F. has designed and produced special bogies for the Refrigerator Fish Vans and also for the high speed deluxe trains.



For the requirements of Metre Gauge coaches setting up of a separate factory in the North was under active consideration of the Ministry of Railways. But with the increased productivity from this factory it has now been decided that I. C. F. will produce also the Metre Gauge coaches required for the Indian Railways. I. C. F. is also working on the plans to manufacture A. C. Electric Multiple Unit (EMU) stock required for the Railway Electrification Scheme in Calcutta area. Both motor units and train units are to be produced in collaboration with A. E. I. who will supply the electrical equipment of such type that will be produced eventually in the country at Heavy Electrical Project in Bhopal.

During the Third Plan period I. C. F. has production programme for a total of 3735 coaches for the Indian Railways as given below :

Type	Gauge	No. of coaches
T	BG & MG	1221
TLR	BG	235
F	BG	462
FT	BG	592
Motor Van	MG	73
Motor & Parcel Van	MG	343
EMU	BG	612
Diesel Rail Cars	BG, MG & NG	197
Total during III Plan		3735

With such diversified production I.C.F. is gaining considerable knowledge and experience towards producing the best among coaches required not only in India but also for the export market.

EXPORT OF COACHES

The Government of India and the Ministry of Railways have been very keen to develop export market for Railway Rolling Stock i.e. steam locomotives, coaches, wagons etc. The capacity for manufacturing coaches in the country is now established as follows :—

I. C. F.	700
H. A. L.	300
Jessops	300 plus 70-75 electric multiple unit stock.

This capacity make us not only self-sufficient for our internal requirements but also enable us to develop export markets for our coaches. Our unit production costs are very competitive and the quality is of a very high standard. The first attempt in

export of our coaches made against the tender for supply of coaches required by Pakistan. These tenders were opened on 28.7.60 and it is a matter of great satisfaction to say that the quotation from India for 60 metre Gauge coaches was the lowest among 7 countries that participated in this Global Tender. In the case of Broad Gauge coaches we were slightly higher than the lowest Japanese quotation due to the fact that several new features, of which we had little experience, were incorporated in the Pakistan specifications.

Delegation have had gone to Ceylon and Argentina to develop export markets for Railway Rolling Stock in these countries. Argentina has published a tender for supply of 300 coaches and against this I. C. F. has quoted for 170 coaches. These tenders were due to open on the 14th December, 1960. The Ceylon Government Railways are also interested in our coaches and we are awaiting their tenders which have yet to be advertised by them.

In the short span of 5 years the I. C. F. has not only increased its production but has also been able

BULLARD Dynamill Horizontal Boring, Milling and Drilling Machine

with precision control.

Main features of the Bullard Dynamill Horizontal Boring machine are its ruggedness and durability for all types of applications, machining accuracy, rapid production, easy operation and low maintenance cost.

**FOR GREATER PRODUCTIVITY,
YOU CAN'T BEAT A 'BULLARD'**

Exclusive Distributors:
KIRLOSKAR BROTHERS, LIMITED
Kirkoskarvadi, Dist. Sangli, Maharashtra State. Offices in Principal Cities.

STUSA

to compete successfully in the world market. This establishes beyond doubt that given requisite facilities our public sector industries in India can come up to the high standards expected of them to bring India in competition with highly developed countries.

DEDICATION

All the workers at I. C. F. from the highest rank to the lowest in the ladder are dedicated to give their best in the industrialisation of the country and

towards raising the standards of living in India. A feeling of oneness—feeling that the workers are the owners of this factory, prevails at I. C. F. and it is this teamspirit that has been mainly responsible for the unique progress of this factory.

I. C. F. has now about 7,000 workers on its rolls and they all take pride in working at this factory and keeping it clean. The factory layout, the production flow, the skill of our workmen and the cleanliness all round in this factory are admired by all people of this country and from abroad while visiting I. C. F.

Cast Iron Fittings for Pressure Pipes for Water, Gas and Sewage

The Indian Standards Institution has just published IS: 1538—1960 Specification for Cast Iron Fittings for Pressure Pipes for Water, Gas and Sewage. The standard is applicable to fittings with sockets for lead joints or flanges and may also be made applicable to other types of joints specially rubber joints where over-all measurements shall be adhered to, to ensure interchangeability.

So far, in India the manufacture of cast iron pipes and fittings for pressure main lines has been generally on the basis of British Standards. However, in view of the decision of the Government of India to introduce, the metric system of weights and measures and the need for co-ordination on international level, the standard has been based on the relevant recommendation of the International Organization for Standardization.

* * *

DIMENSIONS FOR ELECTRICAL INDICATING INSTRUMENTS

With a view to ensuring complete interchangeability among the dimensions for Electrical Indicating Instruments, which are being manufactured in the country in larger quantities, the Indian Standards Institution has prepared a draft Indian Standard which gives sizes of such instruments of flush-mounted round, square and rectangular types.

The dimensions laid down in the draft have been arrived at after considering carefully the data on dimensions available in the country. The draft also gives guidance regarding terminals used with the electrical instruments.

* * *

LAYING OF COMMONWEALTH ROUND-THE-WORLD CABLE

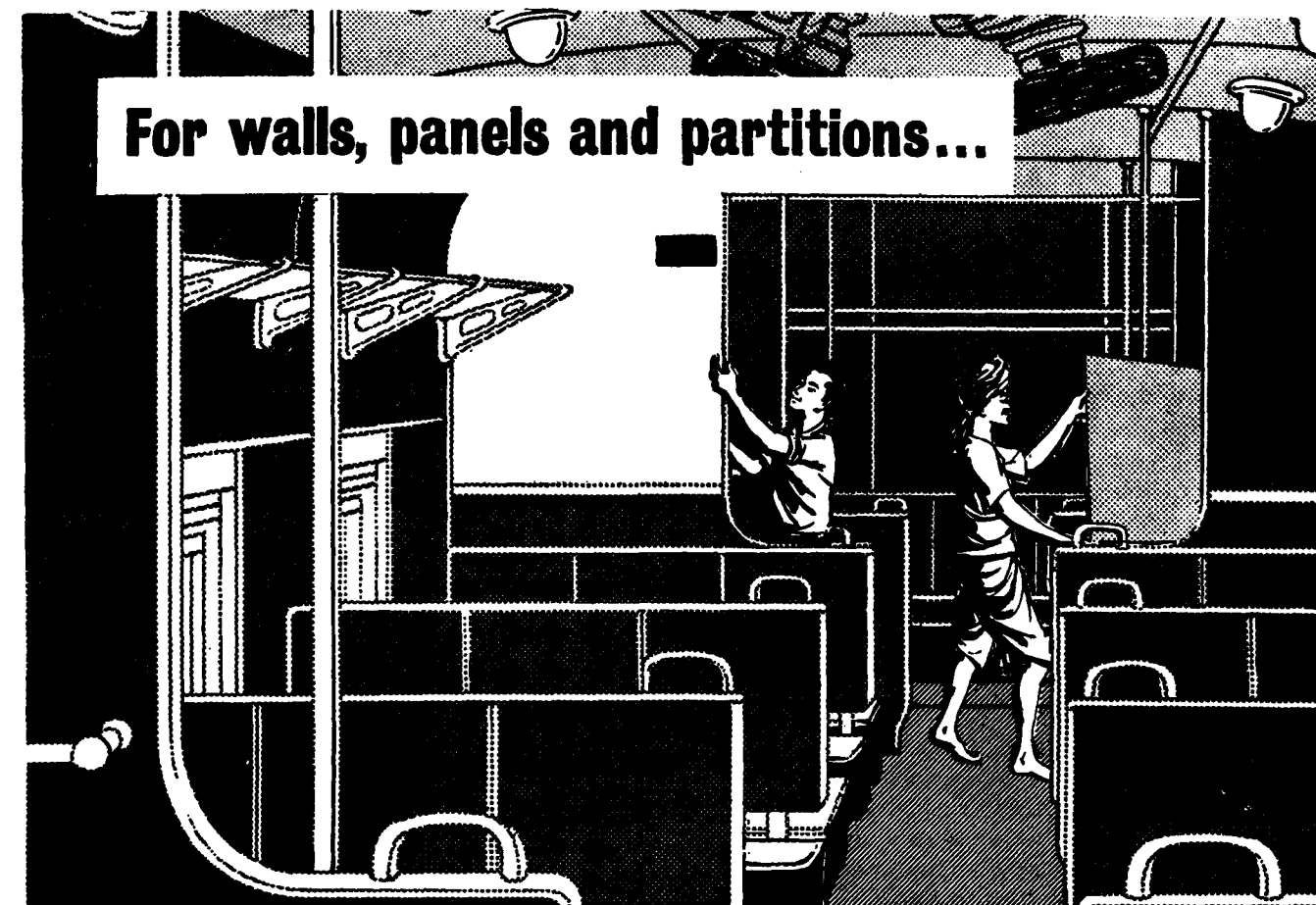
The first stage of the laying of the Commonwealth round-the-world telephone cable—one of the greatest projects of its kind ever undertaken, and estimated to cost £ 88,000,000 in all—has just started from Oban, on the west coast of Scotland. This phase of the operation entails the laying of 2,100 nautical miles of cable between the Scottish west coast and New Hampden, Newfoundland (Canada), with an extension of 450 nautical miles to the mainland of Canada.

The complete world project will involve the laying of some 32,000 nautical miles of cable, and will take 10 years.

Code-named CANTAT (Canadian Transatlantic Telephone), the transatlantic cable has been designed by engineers of Britain's General Post Office. When it comes into use in the middle of this year, it will allow, for the first time, 60 people in Canada to talk simultaneously to an equal number of citizens in Britain. It can also be used to operate up to 48 telegraph channels for each speech circuit. The cost of laying will be around £ 9,000,000.

Plans for the second section of the cable, to link Australia with New Zealand and Canada across the Pacific, are now being made by the Pacific Cable Management Committee, on which all three countries are represented. Australia and New Zealand will be linked in 1962, and New Zealand and Canada in 1964. Australia will then be linked with the United Kingdom via the Pacific section with land lines across Canada and the Atlantic section of the cable.

* * *



For walls, panels and partitions...

JOLLYBOARD India's finest hardboard

HERE's the ideal material for coachwork—JOLLYBOARD! Equal in strength to the world's best hardboards, JOLLYBOARD easily withstands impacts, vibrations, and constant stresses; is lightweight, easy to handle, and available in a wide range of sizes, thicknesses and interesting surfaces.

in full supply—at prices as low as, if not lower than, inferior substitutes



JOLLYBOARD
—wood as you want it

Send for free samples and full technical information today

ANIL HARDBOARDS LIMITED, Lakshmi Insurance Building, Sir Pheroze Shah Mehta Road, Bombay

JOLLYBOARD * Very strong, light and durable; is made from wood-fibre, compressed into solid sheets—to British Standard Specifications. * Comes in many sizes, thicknesses and attractive surfaces; a versatile building and decorating material. * No laminations, plies or knots; won't split or crack. * Easily sawn to any shape, easily affixed to any surface. * Quicker to work with, finer in finish. Takes paint, varnish or polish perfectly. * Certified by the Government Test House, Calcutta.

Thicknesses: 3 mm, 4.5 mm, 6 mm

Sizes: 12' x 4', 8' x 4', 6' x 4', 4' x 4'

Insulation Board will be available soon

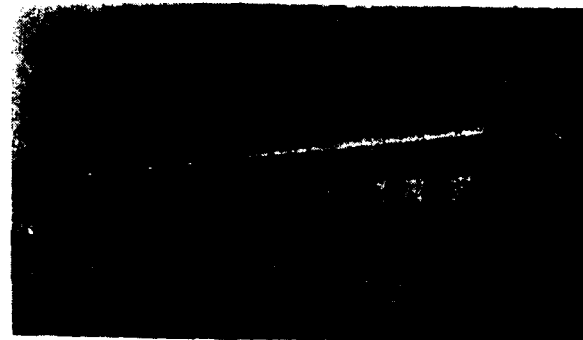
Railcoach Manufacture at Hindustan Aircraft Ltd., Bangalore

Modern Integral Coaches under production

THE year of India's Independence saw the ushering in of the Railcoach Division of Hindustan Aircraft Ltd., at Bangalore. The second world war had ended barely two years earlier; our entire railways system which had stood up so wonderfully to the stresses and wear and tear imposed upon it by the war was in dire need of rehabilitation in many spheres. This was particularly pronounced in the case of passenger coaches. Our coaching stock had dwindled to a parlous state. It was at this juncture that the Hindustan Aircraft Ltd., turned its attention to this form of transport.

NEW CONCEPTION

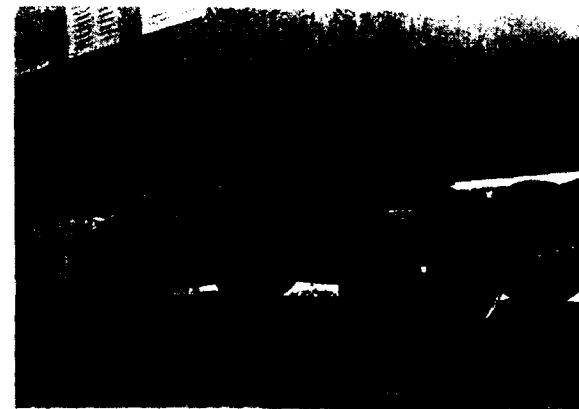
The idea of building Railway coaches at HAL on the same lines as the manufacture of aircraft was conceived and soon it took shape. After preliminary development work in the year 1947, a suitable design for an all metal Broadgauge Class III railcoach was evolved. This design was based very largely on the principles governing airframe design—viz., the greatest strength with the lowest possible unit weight. Thus for the first time in the manufacture of railcoaches in India, the older conception of design was superseded by the new HAL technique of railcoach construction. In collaboration with the Railway Board, the HAL design was finalised and this led to the starting in 1947 of a production line at HAL for railcoaches that have revolutionised Third Class travel in India.



HAL built all metal integral railcoach.

EARLY MODELS

The first HAL designed broadgauge railcoach with an all steel body rolled off the production line on 27—9—1948. It was 100 feet wide, 70 feet long and was built on jigs using cold rivetting and spot welding and erected on the standard underframe supplied by the Railways. The ends of the Coach were reinforced



The new type bogie in the HAL Coach—incorporates hydraulic shock absorbers Helical Springs & Roller Bearings.

to minimise damage in accidents. A three tier arrangement of bunks and seats was provided which enabled passengers sleep during nights. This design was known as model 404. 100 such coaches were built and delivered to the Railways by 1950.

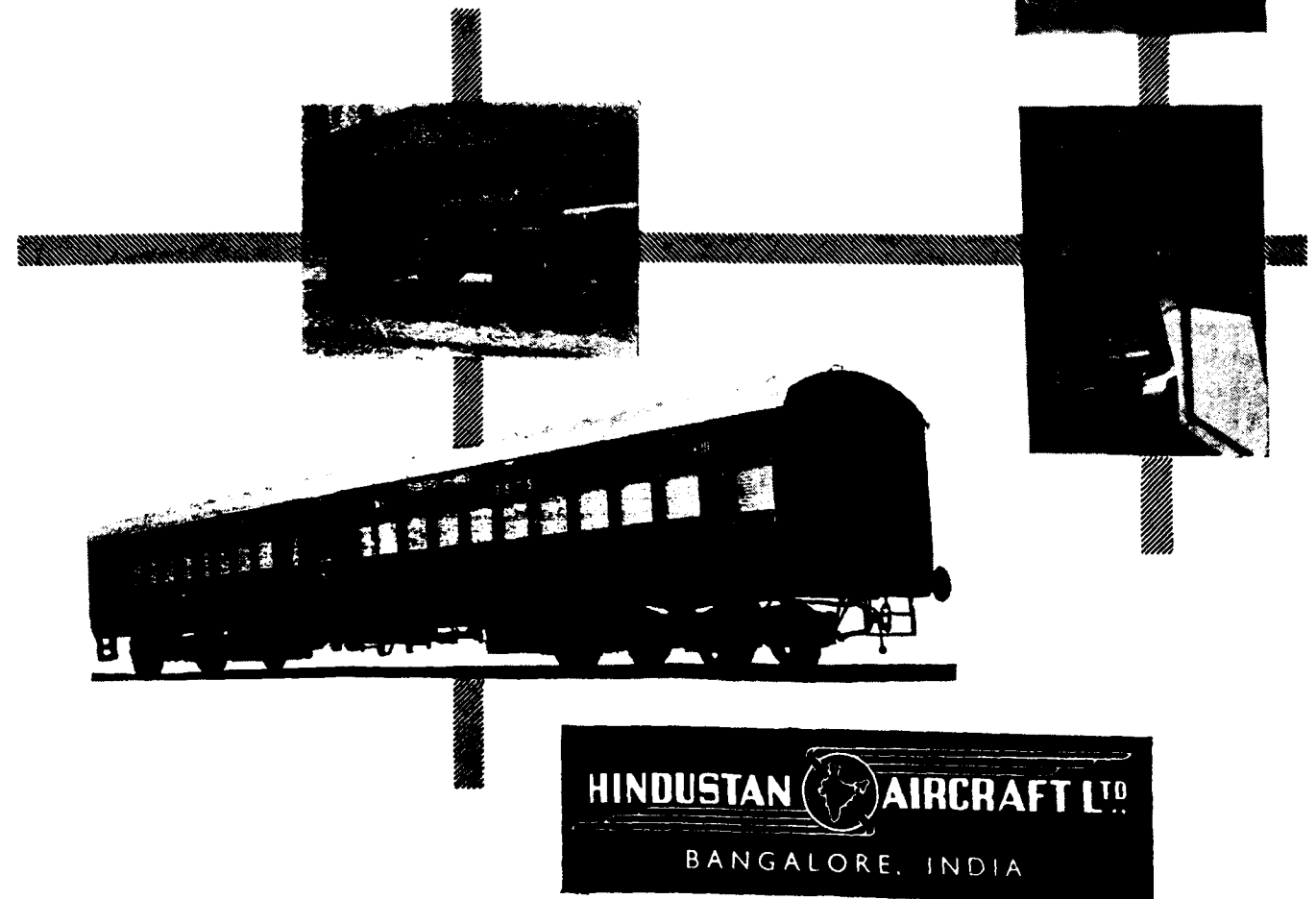
IMPROVED DESIGN

On completion of 100 coaches to Model 404, an improved design known as Model 407 was evolved. In this model the ends of the coaches were strengthened more than in the previous model with anti-telescopic posts. The interior furnishings were improved to provide more amenities to the passengers like the increased number of fans and lights, better ventilation, better lavatory fittings, etc., than in the previous model. The three tier arrangement of seats and bunks was also changed to two tiers in the improved model.

HAL

MADE INTEGRAL COACHES FOR SMOOTH RIDING COMFORT

All-Metal, Integral Coaches
for Luxurious travel of
Class III Passengers,
built in collaboration with
Messrs. M.A.N., West Germany



HINDUSTAN AIRCRAFT LTD.
BANGALORE, INDIA

THE FLOORING of the Compartments is finished with Oxychloride flooring composition of Red Colour.

LAVATORY EQUIPMENT

Two spacious lavatories fitted with necessary amenities are provided per compartment. The fittings and furnishing in these lavatories are of high standard sanitation. Stainless steel lavatory pans with flushing arrangements, polished stainless steel wash basins with push cocks, mirrors with shelves, lotah shelves and towel rails form the lavatory equipment. The flooring of the lavatory is of polished mosaic and the walls are fitted with painted Aluminium panels.

MAJOR FEATURE—H.A.L. INTEGRAL COACH

Structure	All Metal	Flooring steel	...	Oxy-chloride
Construction	Welded	Stainless steel wash basins in lavatories		4
Design type	Skin Stressed type	Stainless steel lavatory pans with all protector & flush head	...	4
Width of the body	10'-8" overall	Mirrors with shelves in lavatory	..	4
Length of the body	70'-0" overall	Towel rails in lavatory	..	4
Length over buffers	73'-1 1/2"	Flushing cocks in lavatory	..	4
No. of compartments	2	I.R.S. Type Push Cocks in lavatory	..	4
No. of lavatories	4	Water tanks (68 glns. capacity each)	..	2
No. of doors	4 on each side	Water tank (139 glns. capacity)	...	1
Seating capacity	80			
Tare weight (water tanks empty)	35.5 tons approx.	Colour scheme—exterior upto Cant rail.		Gulf red—ISC—473
No. of fans	16	Ends	...	Black
No. of lights in compartments	24	Roof	..	Aluminium
Total No. of lights in lavatory	4	All letterings	..	Golden Yellow—ISC 356
Embarkation lights	4			
Max. electrical load	46.5 amps.	Colour Scheme Interior	..	
Equipped with 100 amp. dynamo, 300 amp. hr. lead acid batteries and necessary switch-gear as per I.R.S.5 wire double-battery, block train lighting system.		Floor to waist rail	..	Light Brown—ISC—410
Inside panelling: Aluminium, 'Hylam'		Waist rail to cant rail except places where plastic panels have been used which have not been painted.		Light Buff—ISC—358
Ceukubg: 'Limpet' asbestos	..	Ceiling: Compartment & Lavatory	..	White
Insulation 1/2" thick asbestos spray under roof		Lavatory inside	..	Eau-de-nil, colour shade No. 216 of Specn. IS-5

LIGHTS AND FANS

Two 16" sweep fixed ceiling type fans with close mesh guards and individual switches have been provided in each bay of 10 seats, a total of 16 fans per coach. Each compartment has 10 main ceiling lights. Embarkation lights have been provided on the outside of the coach. They light up when the coach is stationary or when it runs at low speed as when nearing a station. This arrangement facilitates embarkation and disembarkation of passengers during nights.

The COLOUR SCHEME for the interior and exterior has been designed to give a pleasing appearance and to give better effect to the internal lighting.

Toshiba
**NEXT STOP
BOMBAY**



Electric multiple-coach train "Kodama" air conditioned super express.

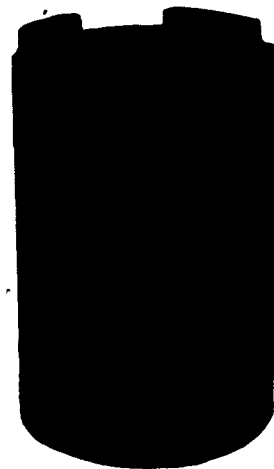
Next stop Bombay—or maybe it's Rio de Janeiro—for there's no way of telling where Toshiba's modern, smartly-designed electric coaches will be going next. Yes, Toshiba is making the kind

of modern electric equipment that is serving to help implement large-scale electrification programs in countries all over the world. Let Toshiba's experience in the field work for you!

TOKYO SHIBAURA ELECTRIC CO., LTD.

2, Ginza Nishi 5-chome, Chuo-ku, Tokyo, Japan.

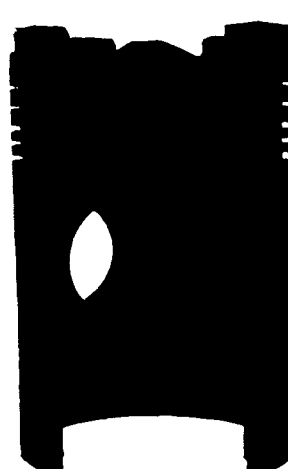
Cable: TOSHIBA TOKYO



MAHLE piston with AL-FIN bonded ring carrier of special cast iron (Ni-Resist) and cast-in cooling serpentine, made of eutectic Al-Si alloy "MAHLE 124".



MAHLE piston with AL-FIN bonded double groove ring carrier of special cast iron (Ni-Resist) and cast-in cooling serpentine, made of eutectic Al-Si alloy "MAHLE 124".



MAHLE closed type piston with cast-in cooling serpentine, made of hypereutectic Al-Si alloy "MAHLE 138".



MAHLE closed type piston with cast-in cooling serpentine, made of eutectic Al-Si alloy "MAHLE 124".

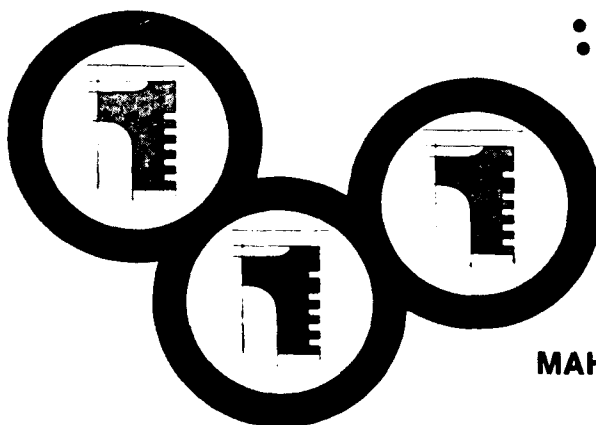
25 USA AND CANADIAN ROADS USE MAHLE PISTONS IN THEIR ALCO AND BALDWIN DIESELS

100 to 200 000 longer operation between overhauls

MAHLE Pistons

MAHLE aluminum pistons, cast or forged, are made of various eutectic and hyper-eutectic silicon alloys combining high tensile strength and resistance to wear. With or without internal oil cooling. MAHLE alloy 124 has 12% silicon content. Due to the structural distribution of the silicon and the careful supervision of all its ingredients, this eutectic alloy offers strength and wear properties superior to standard piston alloys. For excessive loads, AL-FIN-bonded

NIRELIST inserts are available also for Alco 244 and 251 engines. MAHLE first introduced iron ring inserts on aluminum pistons in 1931. MAHLE alloy 138 has 18% silicon content. This hyper-eutectic alloy insures outstanding resistance to wear. Its reduced coefficient of thermal expansion allows for narrowest clearances. Especially recommended for highly supercharged or high bmep engines operated in heavy duty road service. No insert required.



- 40 years of experience.
- Far over 100 million pistons in ALL sizes up to 20" diameter.
- Over 1 million aluminum cylinder liners. All chromium plated Al-liners in Porsche cars supplied by MAHLE.
- 100 European engine builders regularly use MAHLE pistons as original equipment.

MAHLE Komm.-Ges. Stuttgart-Bad Cannstatt

(West Germany)