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EDITOR

THE INDIAN RAILWAY ENGINEER

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Railways and the Indigenous Manufacturer

Judging from the policy statements issued by the Railway Ministry from time to time it would appear that they are anxious that Self-Sufficiency in regard to the items of Railway Stores which are at present procured from abroad should be achieved as early as possible.

The fact that they have been able to put up Industrial Exhibitions or Museums of imported Railway materials in cities like Delhi, Calcutta, Bombay and Madras so soon after the appointment of the Railway Equipment Committee shows that they are in earnest with what they say, if this extra-ordinarily speedy implementation of that Committee's recommendation is any indication.

It must, however, be remembered that " Rome was not built in a day " nor can quality production be expected from indigenous sources overnight.

Foreign firms supplying the Railway materials have reached their present standards after a great deal of experimentation which must have taken them time and probably a great deal of money on research and there is every possibility that in the initial stages of the product it brought them some loss. However, being specialists in manufacture of Railway items, in the end they must have recouped their losses as well as expenses and made handsome profits.

India, which is classified as an Industrially backward country, has not yet the knowledge and experience of other industrially advanced countries in the West, particularly as she was tied to the apron strings of one of them for a century and a half and was not given the opportunity of indicating its genious in many directions.

However, it cannot be denied that much progress has been made since the dawn of Independence much to the surprise and chargin of our erstwhile masters and there is no doubt that given due encouragement much more progress could be expected as far as Railway equipment and materials are concerned and, therefore, there is every hope that the day of Self-Sufficiency in Railway materials is not too far off.

In the past, however, the attitude of the Railway Officials has been most discouraging to the industrialists in the engineering field. It was not at all unusual for a manufacturer to find after he has spent a lot of money, time and energy to produce an article similar to the imported one indigenously that it was summararily condemned for perhaps some very minor defects which could have been rectified and the article utilised and later on the defects eliminated and supplies improved. Very often too the manufacturer has been told to take away his article without being

informed in what respect it fell short of requirements or what were the detailed causes of rejection by the Stores Department.

It was, therefore, extremely refreshing to hear that the Railways are considering arrangements for their technical personnel to visit Industrial units to create spirit of mutual help and understanding between the user and the manufacturer in order to develop indigenous capacity for manufacturing. It looks now as if the boot is on the other leg.

There is no doubt that this step is in the right direction if and when it is implemented. If the Railway Ministry's promises are not to be belied by the actions of their subordinate officials, it is essential that they should be indoctrinated in the principles of Swadeshi. They should learn to say that if the Railway wants material I must give my country the first chance to produce it every time.

While there must be no compromise in the standard of articles produced locally, which would be acceptable to the Railways, a certain amount of patience and tolerance must be exercised by the Railway Officials with manufacturers producing materials similar to the imported articles for the first time.

Patience and tolerance are really negative attitudes, and it would be more positive if the Railway Officials were induced with the spirit of nationalism and of being helpful to the trade and go out of their way to point out any defects discovered and to encourage manufacturers to improve and keep on improving the quality of their products. It was also encouraging to read the statement of the Ministry that they would be prepared to entertain any new products and give them a fair trial at their various testing establishments and if such products promise to be useful for use on the Railways after studying their technical, economical and other aspects they would be introduced as new standards. Here is, therefore, a challenge to indigenous manufacturers to use their brains and to design some items for the Railways of which they may be proud and which will bring them sufficient income. The Railway Ministry now appears to be stretching out its hand to the manufacturers and it is for the manufacturers to grasp this hand and with a concentrated and all-out effort to reduce the gap between Railway imports and indigenous manufacture in the shortest possible time. For the manufacturer who is really keen and means business, opportunity knocks at the door and it is left to be seen if he is wise and courageous enough to grasp it with both hands.

Steam Breakdown Cranes for Indian Railways

IN recent years the firm of Cowans, Sheldon & Company, Limited, of Carlisle, England, have supplied many Steam Breakdown, Bridge Erecting, and Transhipping Cranes to the Railways in India.

The latest orders which have been placed with this Company by the Indian Railway Board are for Steam Breakdown Cranes of 75-tons and 65/40-tons capacity for broad gauge working, and 35-tons capacity for metre gauge operation.

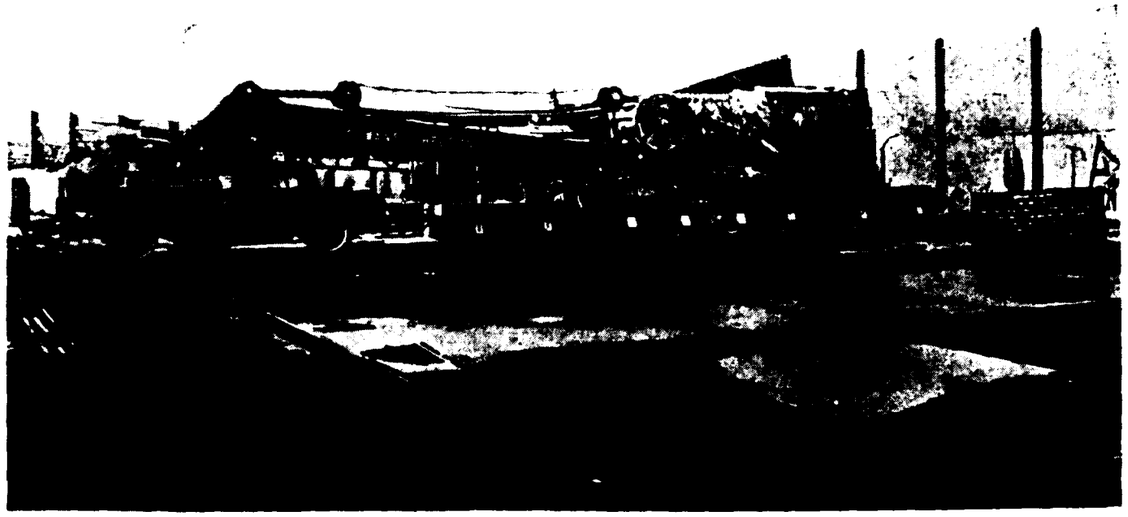
In the case of the broad gauge cranes, the maximum permissible axleload in running condition is not to exceed 16-tons, and to achieve this with the 75-ton crane, relieving bogies are fitted, while the 65/40-ton crane is mounted on two six-wheel bogies. The metre gauge crane has an axleload in running condition not exceeding 10-tons. In this design also relieving bogies are fitted.

In keeping with the latest practice, all cranes are designed for operating on super-elevated track. In the case of the broad gauge cranes stability allowance has been made for a super-elevation of 5-inches, and on the metre gauge cranes 3-inches.

Steam is supplied on the broad gauge cranes by Hopwood coal-fired boilers 6-ft. 6-in. high by 4-ft. 6-in. diameter. The working pressure is 140 lbs/sq. in. A Hopwood coal-fired boiler is also fitted to the metre gauge cranes, and is 6-ft. high by 4-ft. 6-in. diameter, with a working pressure of 120 lbs/sq. in. The engines, which are similar on both broad and metre gauge cranes, have cast-iron cylinders 8-inches diameter by 14-inches stroke. Walschaerts valve gear is fitted in all cranes.

HOISTING SPEEDS

Hoisting speeds of the broad gauge cranes are as follows:— 75-ton crane: maximum lift at 9 ft./min. and 35-tons at 18 ft./min. 65/40-ton crane: maximum lift at 10 ft./min., 40-tons at 15 ft./min; auxiliary lift, 12-tons at 60 ft./min., and 6-tons at 90 ft./min.



The hoisting speeds of the metre gauge cranes are—maximum lift at 20 ft. min., auxiliary lift, 5-tons at 120 ft. min.

The slewing speeds of the broad and metre gauge cranes are one revolution in two minutes, and one revolution a minute, respectively.

PROVISION OF MORE PASSENGER AMENITIES ANNOUNCED BY RAILWAY MINISTER

Sri Lal Bahadur Shastri, Minister for Railways and Transport announced in a recent broadcast that two vestibuled Janatha Trains in which passengers could walk from one end of the train to the other are expected to be brought into service on the Indian Railways within the next few months. Conductors will be posted on these trains to look after the needs and conveniences of third class passengers. The Railway Minister also declared that dining cars on trains were being re-designed on more utilitarian lines and cheap standard menus to suit tastes of regional people were being evolved.

Amongst the other new schemes the Railways were implementing for the benefit of the passengers, the Railway Minister said that mobile cinema vans were being adopted to exhibit selected documentary films, by rotation at important railway stations throughout the country, in order, as he put it, "to usefully fill the time of passengers waiting for trains, and at the same time to give them a visual idea of what was going on in this great country of ours". It was also proposed to help and guide passengers as to how they could take the fullest advantage of the various amenities which the Railways were now providing. Certain minimum passenger amenities had been laid down for provision at all stations irrespective of their size or status. Electricity and telephones would be provided at every station where these could be conveniently made available. 30,000 fans had been fitted in old coaches, while all the new coaches coming on the line were all being fitted with fans. The Minister said that provision of additional amenities for long distance passengers was under consideration and that an improved type of third class sleeper coach was being designed. He also extended the assurance that passenger amenity works would never be allowed to suffer for lack of funds.

SIMMONDS SELF-LOCKING NUTS

THE use of castle nuts and split pins, locking washers and double nuts for secure assembly, has now been widely superceded in all Industries by the application of various types of self-locking nuts, and these give improved performance at considerably reduced production costs.

Three well-known examples are the Fibre Nut, the Pinnacle Metal Diaphragm Nut and the Nyloc Nut. Manufactured by Simmonds Aerocessories Ltd. of Treforest, Pontypridd, Glamorgan, Gt. Britain, these self-locking nuts are absolutely unaffected by vibration and each has a special purpose in its application.

Diesel Loco. General applications.

FIBRE NUT

The Fibre Nut, designed for general external use where a positive lock is required, is a standard hexagon nut with overall height slightly increased to incorporate a special fibre insert. This insert or collar has an internal diameter slightly less than the diameter of the engaging bolt and is not initially threaded.

In assembly, when a bolt passes through the threaded portion of a Fibre Nut and reaches the fibre insert, further advance is resisted. In overcoming this resistance, the nut is forced away from the bolt head, until the sides of the thread are in close contact.

This force distributes itself as a pressure on the side of the bolt thread which will normally carry the load when the nut is drawn home and the pressure results in heavy friction between the sides of the thread in contact. Thus a considerable anti-rotational force is exerted to prevent the nut from moving under vibration.

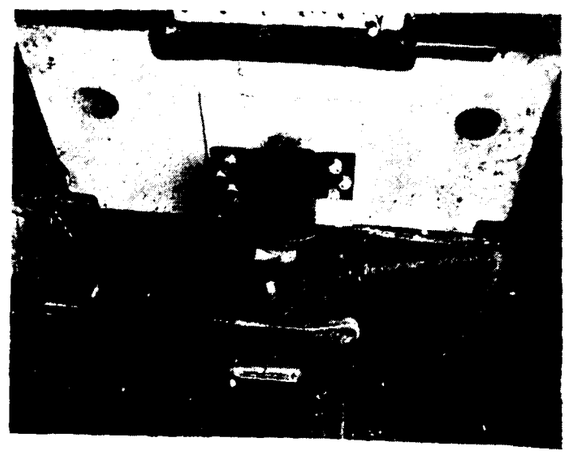
The bolt makes its own thread through the fibre insert and the special elastic properties of the material ensure that no chips are removed when it engages the bolt threads. Pressure between the insert and the bolt further increased the anti-rotational characteristic of the nut.

PINNACLE METAL DIAPHRAGM NUT

The Pinnacle Metal Diaphragm Nut has been developed for immersion in oils and other fluids and where high temperatures exist. In design, the Pinnacle Nut is also a standard hexagon nut and it incorporates a unique non-corrodible spring steel diaphragm or cap which has an inside diameter equal to the core diameter of the bolt. This diaphragm is depitched and on engaging the bolt thread it is deflected by an amount equal to at least half the pitch of the thread. The resulting self-locking action is similar to that of the Fibre Nut.

NYLOC NUT

Constructional dimensions of the Nyloc Nut are similar to the Fibre Nut and mechanically the self-locking principles function in the same way. A special form of



Locomotive coupling.

Diesel Loco. General applications.

nylon has been introduced to bring about this latest development in stiffnut technique.

Nyloc Nuts give improved performance under extremely critical conditions. Comparisons with all-metal nut endurance characteristics show the Nyloc Nut has several considerably advantages, one being its extraordinary ability to adjust itself to bolt thread irregularities. This significant feature is borne out by results obtained from cold flow tests and these properties of rapid recovery show that the nut is not affected by bolt dimensional limits. The nut possesses good dimensional stability under varying conditions of temperature and humidity extremes and it is also impervious to all oils, boiling water and many chemical solutions.

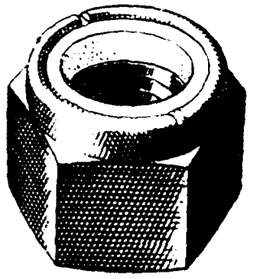
NYLOC CAP NUTS

Another form of Nyloc Nut is the cap nut. In this instance the self-locking insert and cap are one integral moulding and this affords a completely leak-proof seal which is necessary for special applications such as pressurised chambers of various types, fuel tanks, etc.

SELF-LOCKING CHARACTERISTICS

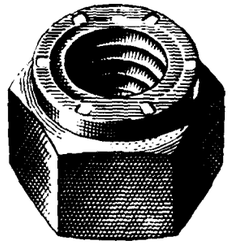
Before a bolt reaches the insert of the Fibre or the Nyloc Nut, or the metal cap of the Pinnacle Nut, each has every advantages as well as every shortcoming of a standard nut, for the play between the threads is to

NYLOC



FIBRE

PINNACLE



specified tolerances. This clearance, necessary as it may be for ease of production and assembly, is the main cause of an ordinary nut loosening under vibration.

The metal diaphragm of the Pinnacle is designed so that the strain due to deflection is still within the limit of proportionality of the material. The self-locking characteristics of all three Nuts are effective on bolts manufactured to all recognised standards in use throughout industry.

Simmonds self-locking nuts possess normal tensile and shearing strength. Under test it has been found that the Nyloc can be used many times and still retain its locking efficiency.

The Nyloc range which includes ordinary hexagon nuts, cap nuts, clinch nuts, strip nuts, single, double and floating anchor types has been fully approved for use on aircraft construction and is inter-changeable with, or alternative to, the existing British Aircraft General Standards range of all-metal self-locking nuts.

APPLICATIONS

Fibre, Pinnacle and Nyloc Nuts are now widely used throughout the world in the automobile and aircraft industries and by manufacturers of railway, mining, agricultural and industrial equipment. Wherever problems of vibration and positive fastening are involved, these Nuts may safely be selected for their superior qualities. Their ability to lock in any position on the bolt makes them ideal where positioning is required as on instruments and appliances, etc. "Fibre", "Pinnacle" and "Nyloc" nuts are specified by leading designers who recognise their technical superiority—production and maintenance engineers welcome them because they are simple and reliable to use.

EXPANSION OF CHITTARANJAN LOCOMOTIVE WORKS—FIRST PHASE SANCTIONED

The Government of India have sanctioned the first phase of expansion of the Chittaranjan Locomotive Workshop, whose target of production has now been raised to 200 locomotives per year and more thereafter.

Pending finalisation of the detailed scheme relating to the proposed expansion and expenditure involved therein, the Government of India have decided that certain preliminary works like construction of additional staff quarters, procurement of building and structural materials should be taken in hand. An amount of Rs. 6,88,000 has been sanctioned for the first phase.

The Chittaranjan Locomotive Workshop was originally designed to produce 120 average size locomotives and 50 spare boilers per year, working on a single shift. This target has already been achieved ahead of time and Chittaranjan is currently producing an average of 10 W. G. locomotives a month.

The Railway Board has given its approval to the working of a second shift at Chittaranjan for implementing the expansion programme.

Railway's Drive for Self-Sufficiency in Production of Railway Stores

THE Railway equipment Showroom at Victoria Terminus, Bombay was formally opened by Shri Morarji Desai, Chief Minister of Bombay in the presence of a large and distinguished gathering last month. The showroom contained over one thousand exhibits of railway equipment either wholly or partly imported from abroad or manufactured indigenously in inadequate quantity to meet the growing needs of the railways, ranging from carriage fittings, electrical switches and signalling equipment to pneumatic machines and intricate steam and electric locomotive parts. The showroom was intended to enable the industrialists more closely to examine and make proposals to the Railway Equipment Committee, recently constituted under the Chairmanship of Shri G. B. Kotak, and to help them in formulating recommendations in respect of the steps necessary to attain self-sufficiency in the production of railway equipment in India to the maximum extent possible.

In his welcome address, Shri M. N. Chakravarti, General Manager of the Central Railway traced the background to the setting up of the Railway Equipment Showroom. The purpose was not to display items for sale, he explained, but to exhibit imported items of railway equipment so that industrialists may come forward with proposals for the indigenous manufacture of these stores. The Chittaranjan Locomotive Works, the Tata Engineering & Locomotive Company and the Integral Coach building factory at Perambur were symbols of the recent progress made in the public as well as the private sectors, in the country's drive for attainment of self-sufficiency. He also drew attention to the new Steel plants which the government were establishing to meet the shortage of steel.

Although much of the Railway's requirements were being met from indigenous sources, Shri Chakravarti stated, importation from abroad had to be resorted to where

The Railway equipment showroom situated between platforms 8 & 9 at Victoria Terminus, Bombay was formally opened on the evening of June 16, 1955, by Shri Morarji Desai, Chief Minister of Bombay.

The Photo Shows Shri Morarji Desai, Chief Minister pulling the electrical lever which parted the curtain across the Main Entrance to the Showroom thus symbolising the Inauguration of the Exhibition. To the Right of the Chief Minister may be seen Shri M. N. Chakravarti, General Manager of the Central Railway.

existing plants and production capacity were inadequate or where the articles were not manufactured locally. This was most pronounced in the case of electrical equipment and train and locomotive lighting plants and material, signalling and interlocking material, carriage and wagon underframes and components, and parts and fittings of steam locomotives and workshop machinery.

The Second Five Year Plan of the Railways, which was being worked out, envisaged tremendous progress on many fronts, he added. More locomotives, more passenger coaches and more wagons would be put on line to augment the transport capacity. In addition, several measures were required to be taken to improve the line capacity on existing routes. Many thousands of miles of new lines would be constructed. While, therefore, expenditure on an unprecedented scale would be inevitable, the Railways would be faced with the problem of procurement of stores required for these schemes of expansion. To reduce the drain on our valuable foreign exchange and to eliminate delays in procurement and also to make India self-supporting, Shri Chakravarti stated, it was most essential that we should reduce our imports and attain a reasonable stage of self-sufficiency in regard to material requirements.

Realizing the importance of this problem, the Minister for Railways announced during his Budget Speech in Parliament early this year, the appointment of the Railway Equipment Committee with Shri Girdharlal Bhawanbhai Kotak as Chairman. The Committee was examining the steps necessary to be taken to attain self-sufficiency in the production of railway equipment to the maximum extent possible and the whole country was looking up to him for a lead in this matter.

The Ministry of Railways were collecting information in regard to the approximate quantities of equipment and stores that might be required in the future including requirements in the Second Five Year Plan period, Shri Chakravarti stated. As the volume of our needs would undoubtedly be very heavy and as the materials would be urgently required, it would need a great deal of effort on the part of the Railways as also of the manufacturers to develop new industries and to expand old ones, so that the volume of imports needed for this purpose might be kept down to the very minimum. The magnitude of the task was indeed stupendous, he added, necessitating a one hundred per cent co-operation of the activities in both the private and the public sectors, if the nation's resources were to be properly harnessed. In fact, the expansion in the two sectors would have to be complementary to each other and would need to be carried out on a co-ordinated basis.

Simultaneously, Shri Chakravarti stated, an all out effort would have to be made avoid waste of any kind, whether in raw materials, man-power or machine capacity. For this purpose, the Railways had taken two positive steps : firstly they had re-orientated the activities of the Central Standards Office for Railways for the standardisation of Carriage & Wagon, track signalling and buildings items at New Delhi and for locomotive items at Chittaranjan. They had also taken a policy decision that they would be prepared to entertain new products as may be of particular use to the Railway and for this purpose arrange for trials of these products.

On the subject of standards, Shri Chakravarti referred to what the Union Minister for Railways & Transport Shri Lal Bahadur Shasti had recently said. On the Railways where certain minimum standards had to be maintained, the need for quality control in the process of manufacture could not be stressed too strongly. While the need for development of indigenous industries could not be over-emphasized, the paramount need for producing goods to specified standards could not be under-estimated. There could be no compromise as regards the quality of articles used on the Railways, as the consequences of the fall in standards could only be disastrous, he added.

Shri Chakravarti concluded with an appeal to industrialists and manufacturers of the Premier State of Bombay to come forward and assist the Government in this national endeavour to achieve self-sufficiency.

After the opening ceremony had been performed by Shri Morarji Desai, Chief Minister of Bombay and the vote of thanks proposed by Shri P. N. Saxena, General Manager of the Western Railway, guests were conducted around the showroom. The exhibits were broadly divided into six sections all neatly laid out in the showroom. The six sections were as follows :

(1) Locomotive parts
(2) Carriage and wagon parts
(3) Electrical, including train lighting, Traction and Air-conditioning equipment
(4) Signal & Tele-communication stores
(5) General items required by all departments
(6) Stores manufactured in Railway workshops in inadequate quantity.

The value of imported railway equipment purchased by all Indian Railways in the financial year ending 31st March 1954 amounted to Rs. 25.6 crores. This represents just over 40% of the total purchases by all railways of equipment and stores (exclusive of fuel,

fuel oil, foodgrains and groceries, and is an indication of the pressing need for progress in the indigenous manufacture of items of railway stores now being imported into the country.

BRITISH EXPERT TO LECTURE AT U. N. RAILWAY TRAINING CENTRE

ONE-YEAR ASSIGNMENT IN LAHORE

Mr. Frederick C. E. Goss, technical assistant and signal engineer of the Westinghouse Brake & Signal Company, London, has accepted an appointment from the United Nations Technical Assistance Administration to serve as the principal lecturer at the U. N. Railway Training Centre in Lahore.

During his assignment in Lahore, Mr. Goss will organize and co-ordinate the teaching and training activities of the lecturers at the centre, supervise the general planning of the facilities at the centre, and undertake responsibility for its general administration. He will also act as secretary of the training centre's advisory board. His appointment is initially for one year.

Mr. Goss has served with the Westinghouse Brake & Signal Company since 1951 in his present post. He was with the same firm from 1925 to 1929 as a technical assistant. From 1929 to 1951, Mr. Goss was a signal engineer with the Buenos Aires Great Southern Railway (now the Argentine National Railway). In this capacity he inaugurated a railway signalling school there, and was the chief lecturer and demonstrator.

FIVE COURSES A YEAR

The U. N. Railway Training Centre in Lahore, opened last April, is sponsored by two United Nations agencies—the U. N. Technical Assistance Administration, and the Economic Commission for Asia and the Far East (ECAFE). The centre is designed to serve trainees from all countries in the ECAFE area. It offers every three courses in railway operations and two in signalling, with about 20 students taking each course. The overall policy of the centre is decided by an advisory board comprising, for the first year, representatives from India, Pakistan, Burma, the U. N. Technical Assistance Administration, and ECAFE.

The latest signalling and other equipment has been given to the centre by the United Kingdom, France, Japan, Belgium, and the Netherlands.

COOLING SYSTEMS IN FACTORIES

By W. P. Niyogi, G.I.Loco.E., M.I.I.S., A.A.R., A.R.E.A., V.D.I.

HUMAN constitution demands on atmospheric temperature of 60 F. to enable it to obtain the maximum energy and to give the topmost output in work. But due to the geographical condition of India, the most parts of the country have a much higher temperature during the major portion of the year. So, the Indian factories, if they desire to have the maximum work out of their employees, should adopt some cooling systems in their buildings to maintain that particular temperature needed.

But, the general practice of refrigeration, as adopted in most of the big factories, is very expensive and, hence, is unsuitable for the smaller ones. So, we should now think of some simpler methods, which may be easily adopted and are effective at the same time. Similar problems are also worrying the American engineers and, hence, the American Railway Engineering Association have had some researches on these problems and have approved of some simple cooling systems.

In general, the cooling systems may be broadly grouped as (i) air cooling and (ii) water cooling. In air cooling, due to a sudden change in the volume of air by expansion and contraction, a circulation of cold air is executed and thus a cooling effect is obtained. Whereas, in water cooling, due to the evaporation of water, heat from the atmosphere is localised to a particular area and, that causes a fall in the temperature of the surrounding air of the atmosphere. Now, I would like to discuss some of those simple cooling systems as mentioned above.

AIR COOLING

Air cooling or air conditioning, as it is generally termed, may be sub-divided in two smaller groups; as (a) Direct expansion mechanical refrigeration, and (b) Indirect mechanical refrigeration.

DIRECT EXPANSION MECHANICAL REFRIGERATION

Direct expansion refrigeration has also four different methods.

Zoned distribution of air—This method requires two air distribution systems, generally running in adjacent ductwork; one for refrigerated air and the other for re-circulated air. Mixing dampers are located at strategic locations; each serve a small portion of the building. Each mixing damper is controlled by a thermostat which may function either by electricity or by compressed air.

Distributed refrigerant under pressure—This method of air conditioning confines compressor and condenser equipment to conveniently isolated spot. A freon-type refrigerant is distributed to fan and direct the cooling coil stations throughout the building. Circulation of air around the coils is constant, and by thermostatic control at the expansion valve admitting refrigerant to the coils, room temperature is regulated. Refrigerant pressure remains constant.

Water cooled 'package type' air-conditioning units—This type of air conditioning can be best described as dividing a building in two or more air conditioning systems. This method of air conditioning is currently popular because of the economies inherent in the mass produced 'package units'. Minimum installation labour is required, depending upon the reduced ductwork requirements.

Window type air conditioners—This method of air conditioning eliminates all piping and ductwork but requires the maximum possible number of air conditioning units. In a large installation this is the ultimate in creating a big number of air conditioning zones, but comfortwise, maximum zoning is not most effective.

Air distribution within a room is difficult with the window type conditioning units. Since the units usually fit about 3 ft. above the floor, cold air must necessarily be directed upward to avoid draughts. Thus it becomes impossible to give air a 'throw' to direct cooling of a remote portion of the room. However, window air conditioning units are useful for minimum cost installations and for installations where cooling water is not available.

INDIRECT MECHANICAL REFRIGERATION

With indirect mechanical refrigeration, cooling is effected by circulation of a chilled liquid, such as water. The liquid is generally chilled close to the compressor and the cooling coils are located at remote points.

Circulation of chilled liquid is generally constant, and control of room temperature is through face and by-pass dampers at each cooling coil. Any required proportion of air, around the cooling coil, between modulating dampers and by-pass, afford a very satisfactory control of room temperature. Operation of blower fans is also nearly constant.

Indirect refrigeration supercedes the direct refrigeration in suitability as that the insulated chilled water

piping is much more dependable than the refrigerant piping, since there is less chance of loss of expensive refrigerant and no necessity for long runs of copper pipes.

WATER COOLING

There are generally three types of systems as adopted in water cooling. They are grouped as (i) once through, (ii) open recirculating, and (iii) double recirculating.

Once through system—In the once through system, the water passes through the heat exchanger equipment, absorbs heat, and then discharges as waste. Where the plant is relatively small, or in large plants where the available water supply is unlimited, this type of system is preferred. It is economical to install and produces less difficulty from corrosion and diposits in the heat exchanger than the circulating system. No evaporation or concentration of solids takes place because the cooling water passes through only once.

Open recirculating system—The open recirculating systems are installed using spray ponds or cooling towers to release the absorbed heat to the atmosphere by evaporating a portion of the cooling water. This system saves water, as the only losses are those caused by evaporation, wind and blowdown. Evaporation of water results in the concentration of the dissolved and suspended solids present in the make-up water.

Double recirculating system—Double recirculating systems are installed where the available water is very limited in quantity, or where it contains an excessively high concentration of solids. In such systems, the primary water that absorbs heat from the plant equipment is kept in a closed cycle and is not exposed to the atmosphere. The warm water in the closed system is cooled by secondary recirculating water passing through a heat exchanger and the open cycle water is cooled by a cooling tower or spray ponds. A double recirculating system avoids evaporation and concentration in the closed cycle. The amount of make-up water for the closed system is thereby negligible, and condensate or properly externally treated water may be employed.

The above systems may better be described in the following different ways of operation, which are termed as follows:—

COOLING BY CHILLED WATER FROM NATURAL RESOURCES

Underground springs or wells with water colder than 52°F. may be availed for such cooling purposes. Such water in sufficient quantity will help in solving the cooling problems; however, the hardness of such water should be ascertained and necessary treatment to the water should be done. Mineral encrusted cooling coils become most inefficient. Ocean water is difficult to use in small diameter cooling coils because of salt encrustation and its corrosive action.

EVAPORATIVE COOLING

The evaporative cooling has two ways. Air passes through an open spray of water and air passes through a loosely packed water saturated material. The principle is that, air, in taking up water vapour, loses 'sensible heat', which causes a drop in temperature and is proportionate to the dryness of the surrounding air.

STEAM-JET VACUUM COOLING

This system depends upon chilled water produced by creating a vacuum in a partially filled tank of water. As the pressure of the atmosphere is reduced, a low boiling point is reached, causing a loss of heat as the water vapourises. A steam jet maintains this vacuum in the chilled water tank, and it is the resulting steam wastage from this jet which makes for excessive cost of operation.

ABSORPTION COOLING

In this system, cooling is obtained from a heat transfer process accomplished under two different stages of high vacuum. A solution of lithium bromide and water is heated while under a pressure of about 1/15th of an atmosphere, and much of the water distills off and is condensed. The resulting concentrated chemical solution overflows and is utilised. The condensed water vapour becomes the refrigerant which passes to expansion coils under a vacuum of about 1/75th of an atmosphere and flashes into vapour in the presence of heat to be extracted. The water vapour then flows to the absorber where it is quickly taken up by the concentrated lithium bromide solution, having a great affinity for water.

SCALES

In the above discussed cooling systems, ofcourse, there are some draw-backs which need a good attention. They are the formation of scales in the coils and the corrosion effects on them. In general, the following scales are found to form in the water circulating coils:—(a) Calcium carbonate, (b) Calcium sulphate, (c) Iron oxides and hydroxides, and (d) Mud and silica.

Calcium carbonate is formed due to the decomposition of calcium bicarbonate present in water with the effect of heat. Reactions take place as follows:—

$$Ca(HCO_3)_2 + Heat = CaCO_3 + H_2CO_3$$
$$H_2CO_3 + Heat = CO_2 + H_2O$$

Calcium sulphate is formed only in special sulphur rich water or when sulphuric acid is used to remove the temporary hardness of water.

Iron oxides scale is formed by the decomposition of ferrous bicarbonate in iron-bearing well water as follows :-

$$Fe(HCO_3)_2 = FeCO_3 + CO_2 + H_2O$$
$$4FeCO_3 + O_2 = 2Fe_2O_3 + 4CO_2$$

Iron oxide may also be formed from corrosion in the cooling system.

Mud and silica are formed due to the presence of suspended solids in the make-up water or dirt and dust contamination from the atmosphere. These can be removed by external methods, as coagulation and filtration.

PREVENTION OF SCALES

The formation of scales can be prevented by the addition of any sequestering agent, as polyphosphates and tannins. The addition of 3 to 5 parts per million of polyphosphates will prevent any deposition of salts in ordinary water in once through system. If the water is too hard, addition of sulphuric acid will remove the carbon hardness.

The prevention of scale formation in open recirculating system is more difficult. The water is concentrated as a result of evaporation loss, which increases the mineral solids content. While calcium carbonate is the principle offender, it is also possible to encounter other scaling solids due to calcium and magnesium silicates and calcium sulphates. For this reason, excessive concentrations in the water system must be avoided by blowdown process.

The formation of scales can also be prevented by some external methods, as (a) Cold line treatment, (b) Zeolite treatment, (c) Acid treatment, or (d) Blowdown control. Of these the zeolite treatment is very effective on ordinary hard water. The hard water is softened by the addition of sodium zeolite. In the acid treatment, sulphuric acid is used to convert calcium bicarbonate to calcium sulphate with the evolution of carbon dioxide as follows :—

$$Ca(HCO_3)_2 + H_2SO_4 = CaSO_4 + 2CO_2 + 2H_2O$$

While preventing the scale formation, it should also be remembered that the presence of scale provides a protection against corrosion of ferrous heat exchange surfaces.

CORROSION

There are several types of corrosion which take place on the system. 'General attack' is a type in which the entire surface of the metal is corroded. Attacks of this type are generally due to low pH value or acid water, e.g., from sulphur gases or carbon dioxide. 'Pitting' is a form of attack which is localised. Attacks of this nature result wholly from the presence of dissolved oxygen or some other localising effect. In many cases, pitting is accompanied by tuberculation. 'Micro-biological attack' is sometimes referred as sulphate reducing bacteria. This type of corrosion generally occurs in the form of pits. 'Stray current electrolysis' is an attack in which the metal is eaten away, specially where the current leaves the system.

PREVENTION OF CORROSIONS

There are quite a number of chemicals which may be used as inhibitors for preventing corrosions. Though none of them is 100 per cent effective, but one may be better than the other on a particular aspect. So, a good deal of attention has got to be paid in determining the right inhibitor, by studying the individual cases.

Soda ash and caustic soda are used to reduce the corrosiveness of various waters. These chemicals and many others, as lime, alkaline phosphates, silicates and borates, are utilised to neutralise acidity. By neutralising corrosion can be lessened but it is never stopped. An objection to soda ash is the danger of building too thick a carbonate layer on the heat transfer surface or clogging the narrow passages.

Sulphites have been reported to reduce some forms of corrosion. Molecularly dehydrated phosphates are also very good inhibitors which prevent harmful deposits. They have cleaning actions which tend to remove deposits and surface incrustations. They help to keep the water clean in appearance by eliminating 'red water'.

One of the best phosphates for this purpose is sodium hexametaphosphate. It may be used in two ways. The first is the threshold treatment which introduce 1 to 10 parts per million of phosphate. The second method is to introduce a much larger amount, in excess of that required to hold in solution all metal oxides. Intermediate proportions may cause precipitation of insoluble phosphates. In recirculating systems, the lower pH values are advantageous, not only in changing the form of corrosive attack, but also in permitting the use of sufficient polyphosphate treatment to overcome the most severe corrosion problem without danger of the polyphosphate reverting to orthophosphate form. The best results are obtained by maintaining the pH value of the water in the range of 6.0 to 7.0 and the polyphosphate concentration at from 70 to 80 parts per million at all times.

Borates have softening and sequestering properties, but less pronounced than phosphates. They have neutralising properties but a bigger amount of borate is required for the purpose than soda ash. The advantage of using borates is that even a large excess of it is harmless to certain metals which would be easily attacked by an overdose of any other caustic compound.

Sodium silicates function in somewhat the same manner as soda ash to neutralise acidity, but they have the additional property of forming siliceous compounds which may be deposited to form protective films. They also possess desirable cleaning and sequestering properties. Unlike other inhibitors, sodium silicates may be prepared in slowly soluble form, making their use desirable in small units which are serviced at long intervals.

Chromate inhibits corrosion by forming a thin passivating film on the surface of the metal exposed to chromate solutions. This treatment is usually employed where ferrous metals must be kept entirely free from scale, and at the same time, be protected from corrosion. A concentration of about 300 to 500 parts per million of sodium chromate maintained in the circulating water forms a uniform thin barrier between the metal and the oxygen in the water. Unlike the phosphate treatment, the water used in this treatment should be slightly alkaline, and the concentration of dissolved salts should be less than 1000 parts per million.

Sodium nitrite inhibits corrosion through anodic polarisation in much the same manner as chromates. In protecting the metal the nitrite serves as an oxidant, being reduced to ammonia. Organic chromates, as chrome glucosates, are true passivators, inhibiting corrosion through anodic polarisation very much the same as inorganic chromates. Their effectiveness is roughly proportional to their hexavalent chromium content; but since they are a little less reactive than inorganic chromates, they last a little longer, particularly when hot. These organic chromates tend to produce an adherent film which may be very dark in colour, sometimes black.

These are, ofcourse, only a few aspects of the cooling systems discussed herein. The reader has to consider something more while installing a system.

Economical Efficiency of Double Acting Swage Forging Hammers Versus Conventional Drop Stamp Hammers

By V. Smeiser, Service Engineer, Francis Klein & Co. Ltd. Calcutta.

ONE of the principal aims of applied Mechanical Laws is to achieve a maximum effect with a minimum effort and thus to attain more economical efficiency, irrespective of work involved.

Whilst this aim had been eagerly followed up everywhere in the metal cutting machine tool line, the same had not been so carefully exploited by works engineers in the case of swage forging plants, which have always been, and are still today, the neglected department in many workshops.

The reason for this policy may perhaps be due to the fact that most of the engineers connected with production of components from die forged steel do not care to consider the swage forging operation sufficiently important, and, therefore, in many instances wrong equipment and wrong methods are applied in the process of swage forging.

Such practices will inevitably affect the production output as well as the quality of die forged products. After all, swage forging represents the first step in the sequence of a number of machining operations, and, therefore, should be treated on equal level with any subsequent milling, boring, turning or grinding operation, whichever of them may be required to finish the die-forged component.

In order to improve the production output and the quality of swage forgings, Messrs. Beche & Grohs G. m. b. H. of Huckeswagen, Germany, have developed their line of Double Acting Hammers to such an extent that their Counter Blow Principle is today recognized by all modern smithy shops as leading swage forging method.

The above drawing indicates the difference in the flow of material and production output in the manufacture of railway draw hooks as obtained on Conventional Drop Stamps of 40 cwts. capacity and BECHE Double Acting Hammer Model DGH-s of 58000 ft. lbs. capacity. The production data was taken as an average output obtainable on equipment arleady installed in India.

No doubt, not only every engineer but even laymen will appreciate the possibilities of larger output and better flow of forged metal as can be achieved on double acting hammers.

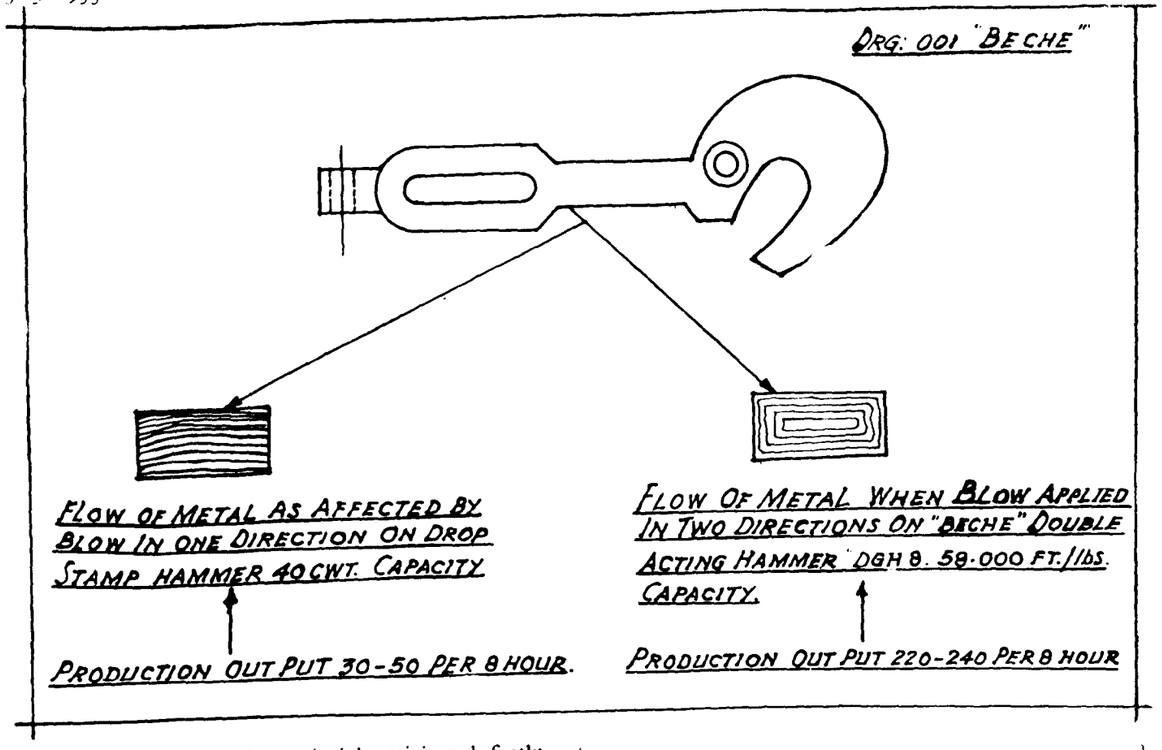
A NEW ZONAL RAILWAY

Shri Lal Bahadur Shastri, Minister for Railways and Transport, announced at a Press Conference at New Delhi on June 16, 1955 that the present Eastern Railway would be divided into two separate zonal systems, Eastern and South-Eastern, with headquarters of both at Calcutta.

Shri Shastri stated that this step had become necessary, as the administrative machinery on the Eastern Railway, already considerably strained, would become unmanageable with the developments envisaged in the Second Five-Year Plan. The Eastern Railway at present carries 48 percent of the total goods traffic on the Indian Railways. At the end of the Second Plan Period, the increase in traffic on this Railway was expected to be 75 percent over the tonnage handled by it at present. There was also another consideration—three new steel factories each producing about one million tons of steel per year would be set up in the area covered by the Eastern Railway. A number of ancillary developments must inevitably follow the construction of these steel factories and such a rapid rise in the traffic naturally requires considerable expansion of Railway facilities. The main brunt of this development will fall on the Eastern Railway, which serves the area rich in mineral resources.

The second zone would begin functioning from 1st August.

Referring to the other Zonal Railways, the Minister stated "Experience of working indicates the necessity for certain adjustments within the existing organisational set-up of some of the Zones and necessary adjustments would be carried out as and when required".

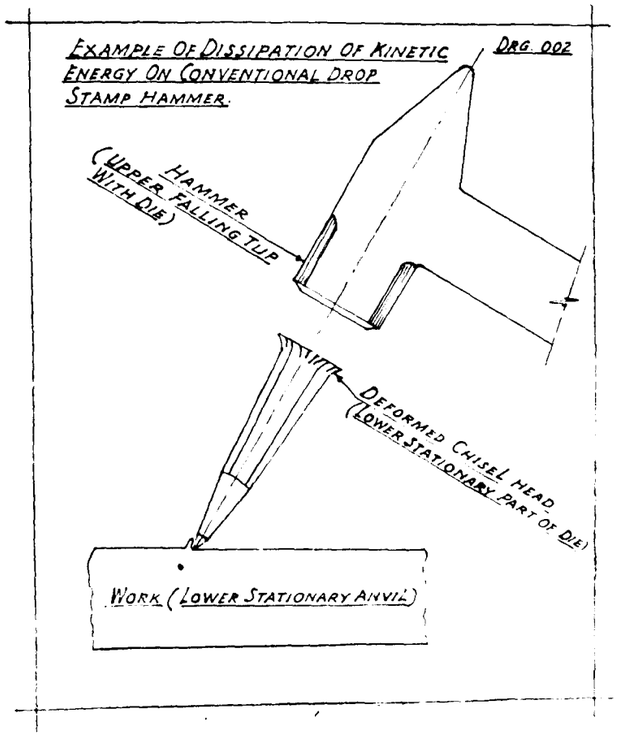


The idea of counter blow principle originated firstly from the necessity of avoiding the vibration of the blows, transmitted through the foundation in the case of conventional drop stamp hammers, and secondly to utilize the available effect of blow to maximum capacity, without the use of unusually large anvils, which are impracticable for transport and cumbersome during installation.

Another important point, which has also had to be pursued during the years of development, was to render increased life to the forging dies.

It is a well known fact to smithy engineers that dissipation of Kinetic energy, produced on falling tup meeting the lower anvil, primarily affects the life of forging dies, because in case of conventional drop stamps, only one part of die is a moving factor. The dissipated Kinetic energy usually affects the lower stationary die in a similar manner as a chisel head gets deformed under the impacts of a hammer.

If it would be possible to move both the chisel and the hammer against each other at same speed, on their meeting the deformation of chisel head could be prevented to a considerable extent, just the same as the life of forging dies is prolonged when used on counter blow system.



To explain further the advantages of Double Acting Hammers over the Conventional Drop Stamps, I wish to outline briefly both the afore mentioned practices.

1. The conventional drap stamp hammers operate on a principle wherein the upper falling tup of a certain given weight is lifted to a certain height from where the same is dropped by gravity in order to obtain the required effect of blow.

The capacity of the drop stamp hammer, therefore, is derived from the weight of the falling tup multiplied by the height from which the tup is dropped. The following formula is generally applied :

Falling tup weight plus weight of top die multiplied by falling height—mkg (or ft./lbs.) less 10% frictional losses.

The above formula, however, covers the approximate theoretical capacity of the drop stamp forging equipment per each single blow only and since the output of the die forged components depends mainly on the frequency of the blows or the so-called effect of blow per second, actually a formula according to the following example should be considered

Example : A conventional drop stamp of - cwts. has a falling weight of approximately 450 kgs. (comprising 350 kgs. of tup weight and 100 kgs. of top die weight. The dropping height is 1.5 metres about 5', and thus the effect of blow is :

450 kgs × 1.5 metres 675 mkg. less 10% dropping frictional losses.

Total theoretical effect of blow is the equal to 615 mkg per each single blow. The maximum number of blows obtainable on a 7 cwts. drop stamp hammer is upto 40 per minute. Therefore, the maximum theoretical working effect of blow per second is equal to :—

$$\frac{40 \times 615 \text{ mkg}}{60} = 410 \text{ mkg (per second)}$$
OR 2972.5 ft. lbs. per second.

It must also be noted that from the above mentioned theoretical effect of blow per second, approximately 30 to 40% is absorbed by the stationary anvil and hammer foundation and, therefore, only 60 to 70% of the available theoretical effect of blow is actually transmitted into the workpiece.

2. The Beche double acting (counter-blow) method represents a system wherein both the lower and the upper tups are used as striking factors. They move coupled together and strike against each other in order to achieve the maximum effect of blow. The impact capacities of this type of hammers, i. e. the kinetic energy developed on the two tups meeting, range from 2000 mkg (14500 ft. lbs.) in the case of the smallest Beche double acting hammer and upto 1,25,000 mkg (9,06,250 ft. lbs.) in the case of the largest Beche double acting hammer so far built.

The lower and upper tups are driven against each other at the same speed, resulting in no losses on their meeting and the swage forging operation on the double acting hammers will, therefore, need essentially less mkg (ft. lbs.) striking power, and consequently, less number of blows than as required under the stationary anvil block type of hammers of similar mkg capacity.

The drive of Beche double acting hammers may be effected either by steam or by compressed air pre-heated to 160 deg. C. The velocity of the blows is controlled through a hand lever operated valve gear, thus enabling application of light touching or heavy racking blows, according to particular swaging work requirements.

Steam or compressed air, whichever is used as the driving factor, is conducted upon the top surface of upper tup piston for actuating the blow and under the same piston for separating the anvils.

When effecting the blow, the lower tup (anvil) is drawn upward against the upper tup by means of a double sided coupling and thus accomplishing the counter-blow. On the return stroke, the lower tup drops down by its own weight, assisting thereby the rising of the upper tup.

The tups of Beche double acting hammers, upto 30,000 mkg capacity, are coupled mechanically by means of steel bands passing over pulleys. The steel band coupling consists of 20 to 30 steel plate leaves, each about 1/32" thick. Normally 3 to 4 of these leaves would be sufficient to operate the hammer but for safety's sake and also for long life of the coupling, a larger number of leaves is used. The design of the mechanical couplings is illustrated in fig. 1 of the attached bulletin.

Beche double acting hammers over 30,000 mkg are provided with hydraulically operated couplings. With this system, plungers leading from the left and right hand sides of the upper tup on downward movement are immersed into oil cylinders. The displaced oil is transferred to the plunger of the central cylinder and by driving the same, the bottom tup moves upwards against the upper tup to accomplish the counter-blow.

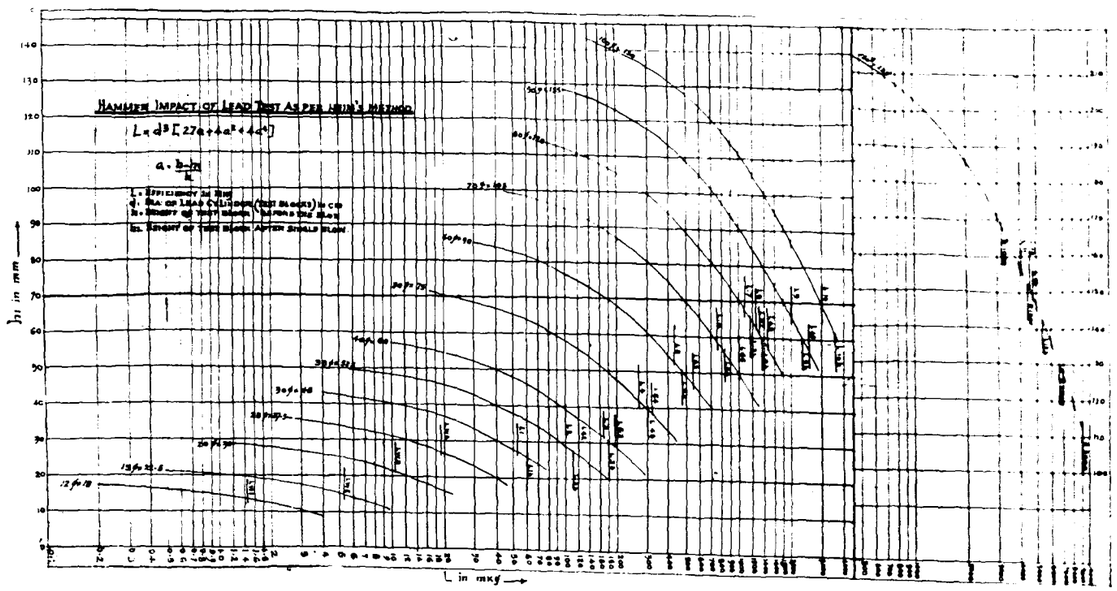
To economise on consumption of steam or compressed air, the Beche double acting swage hammers work on the expansion principle. By this method a saving of about 40% is possible as against the system of Full Pressure. During the forging operation, because of the counter-blow principle and the pressure factor, dies on Beche double acting swage hammers are under constant pressure and, therefore, re-coiling of the tups is completely eliminated.

Apart from better production output, the most outstanding of the many advantageous features of the Beche double acting hammers is the elimination of the heavy anvil block and the reduction, consequently, of the required foundation. Beche double acting hammers need only approximately one eighth of the size of foundation as may be required by a similar capacity drop stamp hammer.

The economical efficiency of Double Acting Method can best be proved by submitting the double acting hammers to Heim's Lead Cylinder Test, as utilized for measuring the capacity of Pneumatic hammers. The principle of this test is shown in the enclosed diagram.

Before concluding the paper, I would like to review the main features of the double acting principle.

(1) Possibility of installing double acting hammers on soil where otherwise conventional drop stamps could not be erected.
(2) Low cost of foundation
(3) High production output
(4) 4 to 5 times longer life of forging dies.



(5) Possibility to control the effect of blow at will, i. e. to apply light touching or heavy racking blows according to requirements.

(6) Economical consumption of compressed air or steam.

(7) Elimination of heavy anvil blocks.

Whilst the initial cost of a double acting swage forging hammer is slightly higher than that of a drop stamp, the small cost of foundation and the considerably higher production output that can be obtained on the double acting hammer, outweigh many times the small difference in the initial cost, between these two types of hammers.

ELECTRIC TRACTION EQUIPMENT FOR INDIA

£ 900,000 ORDER PLACED WITH U.K. FIRM

Two oversea orders, together worth about £ 8,000,000 for British electric rolling stock and equipment have been announced in London.

Electric traction equipment worth about £ 900,000 has been ordered from Associated Electrical Industries (India) by Jessop & Company, which is supplying 104 coaches for broad-gauge multiple-unit trains for the Calcutta suburban railway electrification scheme.

The new rolling stock will comprise 34 three-coach units, each consisting of two driving trailors with a motor coach in between. Two spare motor coaches have also been ordered.

The bulk of the electrical equipment will be made by Metropolitan-Vickers Electrical Company and its work at Sheffield and Trafford Park, Manchester. Approximately 10 per cent. will be manufactured in India.

The South African Railways and Harbours Administration has placed an order for 349 electrical railway coaches with Metropolitan-Cammel Carriage & Wagon Company to the value of £ 7,200,000.

DREDGER FOR SERVICE ON THE HOOGHLY

A £ 1,000,000 order for a dredger for Calcutta has been secured by a British firm. An announcement by the company says that the order was obtained in the face of competition from European and Japanese shipyards.

The vessel has been ordered by the Calcutta Port Commissioners and is intended for service on the River Hooghly.

A spokesman of the firm said that the contract would provide nearly two years' work for all trades in their shipyard.

MECHANISATION OF GOODS TRAFFIC

By R. T. Shahani

THE handling and transport of goods traffic has assumed considerable importance on the European Railways. The movement of freight traffic both in wagon loads and 'smalls' is involved. So far as traffic of the first type is concerned, a fixed pattern has been laid down on the European railways which has been made possible by the scientific scheduling of fixed train paths following a rigid availability of traffic based on master charts which have been prepared in advance. On the other hand, the movement of 'smalls', hitherto the 'traffic orphan of the railways' has assumed serious proportions consequent upon the in-roads made by severe road competition. In consequence, this too has been standardised and the method which is responsible for its successful operation is the following of the dictum " all of today's moves today ". Concentration of traffic in a few large handling centres, the preparation of detailed master charts accelerated movement of this traffic so far as day 'A' day 'B' schedules are concerned make it possible to move this traffic in as scientific—and consequently as expeditious—a manner as possible.

However, the most important single factor which has contributed towards a success in this direction is the use of mechanisation in handling goods traffic both so far as wagon loads as also smalls traffic is concerned. At the outset, it may be stated that so far as mechanisation is concerned, we have a certain amount of prejudice in this direction in this country as it is felt that with mechanisation comes a certain amount of unemployment so far as personnel is concerned. However, so far as Western countries are concerned, increased mechanisation is assumed at each stage as playing a vital role and the objection has been overruled completely. Emphasis has been laid completely on efficiency first and last, more so as man power in certain fields of industry is already limited. To that extent, mechanisation is a natural corollary of the Industrial Revolution which came to England, for example, in the 18th century. We in India never had an industrial upheaval in the sense in which some of the European countries had it and we are, therefore, naturally shy about the results. The greatest stress on mechanisation is laid in the United States of America where shortage of manpower experienced first in the early stages of emigration from the mother country has not yet caught up on the demands of industry in all its ramifications.

There are a number of items so far as mechanisation of goods traffic is concerned. Principal mention may, however, be made of the use of instruments like Pallets, Containers and Fork Lifts. Some of the pre-requisites of the use of items of this nature are elementary but must necessarily be mentioned e. g.—(1) the goods sheds should have very quality flooring so that the movement of these implements could be effected smoothly without any damage either to the consignments or to the instruments utilised; (2) floors are at wagon level at goods sheds. In European practices, these two items are assumed as essential. With us however, while the latter has found general favour, equal emphasis is not laid on floors in goods sheds and tranship sheds. The writer who visited a number of handling centres in Pakistan recently was disagreeably surprised to see feeble attempts at mechanisation without the pre-requisite of good flooring. This had disastrous effect even on the use of simple ordinary wheel barrows which were soon condemned as the pot holes in the floors caused a severe strain on the use of these weapons.

Let us now give a brief idea of the use of Pallets. We find that now-a-days increased use of pallets is being encouraged by what is known on the continent as the National Palletisation Commission. It is understood that today there are more than 80,000 pallets in use on the European railways. The usual idea is that small objects which can be easily contained in pallets are utilised for the transport of this kind of traffic. For example, the conveyance of tins and tin goods alone constituted a traffic of over 90,000 tons in one year so far as France was concerned.

The advantages of this mode of transport are obvious. There would be considerable increase in the amount of merchandise which can be stored, which would avoid manual operations, which would curtail saving of handling costs and also bring about a curtailment in the transit time for handling goods.

One of the basic factors of pallets is the problem of standardisation. Attempts are afoot on the continent particularly to have pallets of a standardised nature. By the way, in the modern pallets, a weighing device is also fitted to the fork lifts which go side by side with pallets so that the pallets loaded could be weighed at the same time as they are being lifted. This keeps the question of standardisation within excellent limits.

The British Railways were one of the first to adopt pallets, the standard measurements adopted in that country being of two types, viz. (1) 36"×40" and (2) 40"×40". The production of larger capacity vehicles of an unusual design helped the carriage of these pallets. It was soon found that the main advantage in the use of pallets was to increase the mobility and fluidity of traffic and to enhance the capacity for transferring traffic from one depot to the other, without causing any damage to the consignments handled.

What about the cost of handling and transport of goods by palletisation? The Swiss for example add a percentage to the costs of their own accord. The Swiss it may be remarked are very much 'pallet conscious' and it has by now been understood that the transport of goods by pallets brings great value to Swiss economy in the long run, besides bringing about ultimate savings to traders and manufacturers. The Swiss Federal Railways lend pallets from their own pool. The exchange of pallets is restricted to internal traffic. Schemes are afoot to utilise them internationally. By the way, the Swiss Railways own over 25,000 pallets and another 10,000 or so are at present with the traders. The popularity of pallets can therefore be readily imagined. Also, the Swiss have one uniform type of pallet, 4 ft.×2 ft. 8 inch.

The Germans employ both flat and box pallets in the ratio of 50 : 50. The German Railways handle a higher proportion of smalls and parcels traffic, almost 10% of the total goods traffic. This lends itself most conveniently to palletisation. They also have containers of small dimensions. Here, as in some other countries, the functions of the pallets and containers overlap. The German pallets have generally fixed dimensions of 1000 m.×1000 m. As a necessary corollary to operation of pallets, for platform movements, fork lifts and foot-operated lift trucks, the former moving quite speedily, are in constant use. However, the transfer work is rather complicated due to the presence of a large body of traffic which is non-palletable.

The second feature which is of interest to us is the use of fork lifts, an essential corollary to pallets. In modern railway working, the fork lifts have a lifting capacity of 1000 pounds, the operation is either electrical or battery operated, low dimentions for the fork lift trucks are advocated so as to help in their manœuvrability. Some of the fork lifts in use in England have a wheel base of 30", length measured from the heel of the fork 47", overall width 32" and permit the truck to operate in narrow passages also. The electric drive of the fork lifts is preferred as it provides smooth silent movement. It has been the past experience that when Diesel or petrol operated fork lifts have been worked, the exhaust fumes have caused difficulty amongst the staff, particularly covered goods sheds and complaints in operating the fork lifts have naturally arisen. The electric drive has overcome this particular difficulty.

This notwithstanding, one of the most interesting types of fork lifts being operated recently in Britain is the heavy duty fork lifter, model 60 DH Statcrec which is diesel operated. This has a maximum capacity of 7000 pounds and is designed at the same time to function in restricted places. Models with heights of 6.9, 12 and 14 ft. have been in practice. Two to three ton trolleys can be handled with ease so far as these lifts are concerned. One of the most interesting features of the design is the split-chassis construction which makes all internal working parts readily accessible for maintenance and servicing. Further these include a compensated rear-steering axle together with a 14" clutch. Lockheed hydraulics are fitted and the mast assembly is of robust construction.

One other device which has been used in the control of the fork lift recently is radio telephony. As far back as two years, this was experimented in some of the States where the operating of fork lift trucks in industrial undertakings particularly on the railway has been successfully experimented and trucks are now fitted with radio receivers which in turn are connected to a central office from which the movements of fork lifts are checked and controlled. The extention of radio telephony for controlling the movement of these vehicles in large industrial undertakings cannot be sufficiently emphasised.

While visiting the Karachi harbour and the godown installations, the writer saw a successful operation of fork lifts which had considerable manœuvrability and flexibility. The godowns in the port area had beautiful floorings and the process of stacking goods was most acinating to watch. The movements were smooth, efficient and expeditious.

Coming now to containers, we find that Britain is once again a pioneer in this field. Every year sees increasing use of containers, particularly for the transport of things like frozen meats, fresh meats, ice-creams, frozen fruits, dry ice etc. for which highly insulated types of containers are being utilised. An attempt is made in Britain to standardise the types of containers and to limit the containers to 19 types. Till last year, Britain had a stock of more than 29,000 containers. Two-thirds of these were the covered types with a capacity ranging from 90 to 755 c.ft. Special containers are also devised for different requirements, e.g. for machinery, cycles, etc. Then there are the so-called 'travelling ward robes for clothiers' requirements, containers whose dimensions are 8 ft. 2 in. x 6 ft. 9 in. x 6 ft. 6 in. The possibility of light weight containers is also under investigation.

One of the most important results of containers has been the minimising of damages and pilferages, along with the curtailment of costs at transhipment points. While the problem is, therefore, not so difficult in countries which are utilising one gauge throughout, in a country like India, where the Broad Gauge is interspersed at different points with the Metre Gauge, and at some places with the Narrow Gauge, the question of transhipment with its attendant costs plays a very vital role and any action taken to augment the transhipment capacity and curtail costs and pilferages would be a step in the right direction. Containers obviate the transhipment of goods enroute as they are fully packed up for destinations and no handling takes place, except at destination.

One of the most interesting developments in this line has been the use of collapsible containers. For commodities such as coal this kind of container is particularly ideal. For the movement of postal bags also it has been observed that collapsible containers, particularly of the variety which are used in the States—4-steel wire mesh containers—have been particularly useful. So much of the time which is wasted today at many of our stations could be saved if postal bags were conveyed in this manner. On the other hand, the return of empty containers of the collapsible variety do not require any space at all and can be sent back quite easily.

Finally, it may be stated that the use of these various mechanical devices is widespread so far as various foreign countries are concerned. Every day, more and more mechanical improvement are being effected and as soon as a new model is brought up in the market, the older model is scrapped. This has assumed a kind of a craze in the States. To that extent, European practices are more orthodox and steady. Taking only two or three illustrations, we find that so far as France is concerned, goods sheds, further to the use of devices mentioned above, also use the conveyer belts and tractors as also travelling cranes for loading and unloading of the goods traffic. For example, at the premier goods shed of Paris—Tolbiac, there are four conveyer belts, 280 stillages and 88 petrol tractors in addition to three travelling cranes and two overhead transporters. On the other hand, in Britain, in addition to the extensive use of both flat pallets and box pallets, power lift trucks—another British invention—are used extensively in addition to the conveyer belt which however unloads only one wagon at a time. Britain has also employed the use of small mobile cranes quite extensively in their various goods sheds. So far as the Belgians are concerned, they also have made use of a number of flat and box pallets and fork lifts.

There is no need to comment on mechanisation so far as the European countries are concerned. It is a matter of regret that in this particular field we are still at a stage which cannot be considered to be advanced by any means. As said above, one of the principal reasons which has been hindering progress in this connection is the fear of unemployment. Judging by the experience of other countries, this, however, cannot be considered a very serious threat in the long run.

IMPROVED BATHING FACILITIES AT STATIONS

Amongst the several amenities the Railways are providing for the convenience of the travelling public, are bathing facilities at stations including the supply of hot water to passengers. Bathrooms attached to III class Waiting Halls both for men and women have been provided at eight important railway stations, viz., Jhansi, Nagpur, Itarsi, Banda, Katni, Pachora, Bina and Amraoti. Five more stations—Secunderabad, Satna, Mathura, Sholapur and Jubbulpore—are to be provided with similar facilities in the near future. As a further convenience to travelling public, bathing places on passenger platforms are being provided for the use of male passengers only at eleven stations namely, Bhusaval, Itarsi, Manmad, Khandwa, Badnera, Purna, Parbhani, Nizamabad, Jalna, Murtazapur and Mudkhed. Passengers can obtain hot water for bathing purposes at all stations on the Central Railway where Refreshment Rooms are provided at the rate of four annas a bucket. In order to ensure prompt service, passengers may give previous intimation of their requirements to the guard of the train which will be transmitted onwards to ensure compliance.

EAST AFRICAN RAILWAYS 59th CLASS

By A Special Technical Correspondent

IN 1892 a survey was carried out for a railway to be built between Mombasa and Lake Victoria to assist in the suppression of slave trading, but it was not until 1898 that the first section of the line from the coast to Voi was opened to the public and at that time there were 24 locomotives.

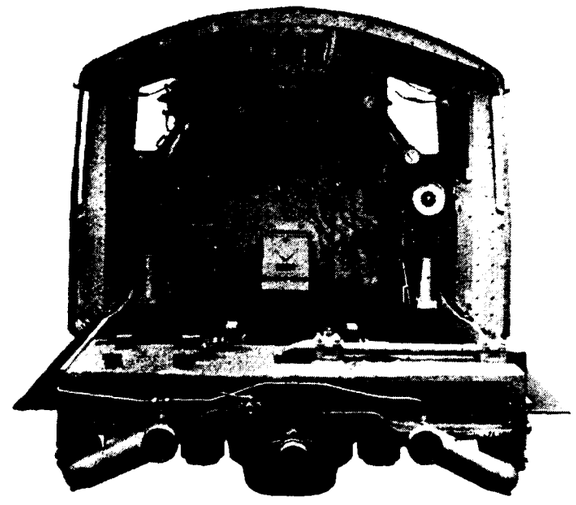
In 1901 the Uganda Railway as it was then called, was opened for traffic having reached Kisumu on Lake Victoria, 585 miles from Mombasa, and the gauge of the railway although originally planned to be 3'–6" was actually built as metre gauge, partly as a result of a misunderstanding. The construction of the line due to the heavy terrain through which it traversed, had necessitated extensive earthworks, which were equivalent to a 4½ ft. embankment throughout the whole 585 miles.

In 1948 the Kenya and Uganda Railways and the Tanganyika Railways were amalgamated to form part of the East African Railways and Harbours Administration and today there is a total route mileage of 3,100 miles of metre gauge. The main line of the Kenya and Uganda section between Mombasa to Nakuru climbs to over 9,000 ft., Nairobi, the capital, being at an altitude of 5,600 ft., so it is not surprising that 541 miles of this line have gradients of 1 in 66 or steeper.

In 1926 the first Beyer-Garratts were introduced on the Railway with an axleload of 10 tons, and they immediately showed their suitability, so that by 1938, thirty-six locomotives of the Beyer-Garratt type were operating about two thirds of the main line traffic. During the war and after, further Garratts have been supplied to assist in moving the traffic, which greatly increased during the war and has continued to do so ever since, so that with the completion of the delivery of the 34 locomotives which comprise this present order, the railway will have 149 Beyer-Garratts in service.

The original line was laid with 50 lb. rail and today a considerable amount of the total route miles are still of this weight. On the main line improvements have been made to eliminate the momentum gradients and re-alignment of the track between Nakuru and Mombasa has been carried out. Extensive relaying of the line has also been undertaken with heavier rail of 80 lb. and 95 lb. sections. This coupled with investigations carried out on rail stresses has resulted in greatly increased axleloads being permitted on the main line.

This increase in axleload opened the way to the employment of even more powerful locomotives, and the 59th Class Beyer-Garratts are the first locomotives to be designed to meet these new conditions, they have a tractive effort of 83,350 lb. on a maximum axleload of 21 tons. They will operate on the 329 mile Mombasa—Nairobi section which carries the greatest density of traffic in East Africa and will be used for hauling loads of 1,200 tons over the 1 in 66 gradients; this load is a 71% increase over the present permitted maximum of 702 tons.



These Beyer-Garratt locomotives which are the most powerfull metre gauge locomotives in the world have been designed to the requirements of Mr. G. Gibson, the Chief Mechanical Engineer, East African Railways and built under the supervision and inspection of the Crown Agents for Oversea Governments and Administrations.

It is only when one sees the actual locomotives that one realises their massive size, no photograph really does them justice. The overall length is 104'–1½" and the total weight in working order is 252 tons, which includes 8,600 gallens of water and 2,700 gallons of oil fuel.

THE BOILER UNIT

Ample steam production is ensured with the boiler which is 7'-6" diameter and has a grate area of 72 sq.

ft. and the length between the tubeplates is 15 ft. The boiler is of all steel construction, the firebox is of the round top type with radial roof stays, the front three rows being flexible and the inner firebox is of Colvilles "Double Crown" brand plates, whilst the firebox stays are of "Dunic" steel. All the stays are riveted over on the fire side.

Although the fire hole door is of the usual type used on oil fired locomotive, the fire hole in the boiler back plate is large enough to accommodate a mechanical stoker, should the need arise to convert this class to coal burning, provision is also made for fitting five arch tubes if needed to support a brick arch.

The firebox back plate has plate gussets, which are also used for staying the smokebox tubeplate, this being of the drumhead type. Cross staying of the outer wrapper plate is provided above the inner firebox.

Dry steam is ensured by using a "Melesco" Steam Dryer in the dome and the superheater header in the smokebox combines a multi-valve regulator, the 50 superheater elements are $1\frac{1}{8}$" o. d. x 9 s. w. g. thick, all this equipment being supplied by the Superheater Co. Ltd.

The flue tubes are $5\frac{1}{2}$" outside diameter and the small tubes of 2" diameter, all tubes being made of "Aquacidox" steel.

In the smokebox the chimney petticoat can be easily adjusted for height, while four "Goodfellow" tips are fitted to the blast pipe.

The flame pan is of ample size and is fitted with two burners which are accessible for servicing below the front of the firebox. The oil firing equipment is to the Railways' standards and incorporates a heating coil in the oil tank and a secondary heater alongside the foundation ring. A thermometer being provided to show the oil tank temperature.

Ample washout facilities are provided on the boiler and one Everlasting blow-down valve is fitted on the firebox throat plate and one on the mud collector under the boiler barrel. Alfloc continuous blow-down equipments is fitted.

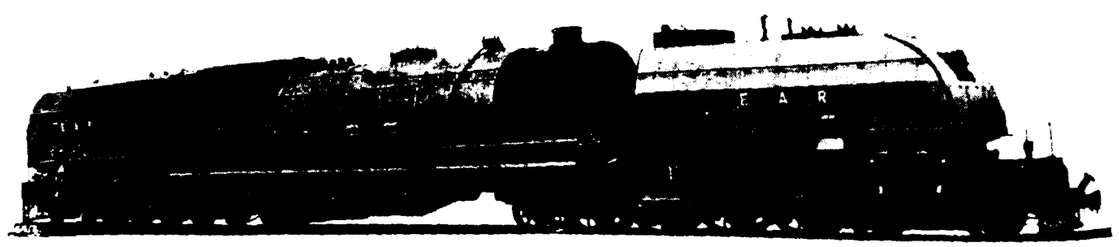
To feed this boiler, two Davies & Metcalfe live steam injectors are fitted on the fireman's side of the boiler, and one on the driver's side, each operated by a quick acting steam valve fitted in front of the cab, the injectors feed into a treble clackbox mounted on the top of the boiler in front of the dome. A steam turret is fitted forward of the cab together with three 3" Ross pop safety valves.

The boiler is lagged with Fibreglass mattresses supplied by Messrs. W. Gilmour-Smith & Co. Ltd.

ENGINE UNIT

The bar frames of the Engine units are $4\frac{1}{4}$" thick, Machined from rolled steel slabs, forming a rigid foundation with the cast steel stretchers.

The cylinders are of cast iron, each pair being bolted together on the engine centre line to form a rigid stay. The cylinders and valve chests have cast iron liners, and the pistons are of cast steel with cast iron peripheries and three narrow rings. Wota N.C. type bypass valves together with anti-vacuum valves are fitted on the cylinders. The cylinder drain cocks are operated by a steam serve cylinder on each unit. The cylinder and main steam pipes are lagged with Fibreglass. Britimp packing supplied by the British Metallic Packing Co. is used on the piston rods. Cast steel crossheads of the Laird type with the arms cast integral are used, the slippers being of cast iron with whitemetal linings.



A Hadfield Precision Power Reverser is used to operate the reversing gear. This patent reverser with fingertip control has proved itself in over 700 applications to give positive selection and to retain the desired cut-off with complete absence of creep. The valve travel is 6 11/16" and the valve liners are 10" bore, the Walschaert valve gear being arranged so that the dieblocks for both units are in the lower portion of the link for chimney first running. Case hardened motion pins of adequate size are used in conjunction with bronze bushes to give generous bearing surfaces. The fixed pins are in bushes of hard cued steel. Skefko self-aligning roller bearings are used on the main driving crank pin and for the return crank. The remaining coupling rod bearings are of bronze, whitemetal lined, the bushes being pressed into hard steel bushes fixed in the rod eyes.

To enable the locomotive to negotiate 350 ft. radius curves without gauge widening, the intermediate and driving wheel tyres have thin flanges whilst all the other wheels have normal tyre profiles. It is of interest to note that although the locomotive has been designed for metre gauge, provision is made so that if at a later date the gauge of the railway is altered to 3'-6" then the locomotives can be converted with a minimum of trouble to the new gauge by the fitting of new tyres together with some machining of the wheel centres.

The locomotive is fitted throughout with Timken Roller bearing axleboxes of the cannon type, those of the inner trucks being of a special design to accommodate the bridle bracket and oil baths for the bearing spring shoes and side control spring gear brackets.

The coupled wheel axlebox guides are to a special East African Railway's design, which eliminate the normal adjusting wedges. The faces of the guides and axleboxes are fitted with manganese liners to give long life and reduce wear.

The outer bogie frames are one piece steel castings made by Beyer, Peacock & Co. Laminated springs are used for the suspension and for the side control, in conjunction with two pin swing links.

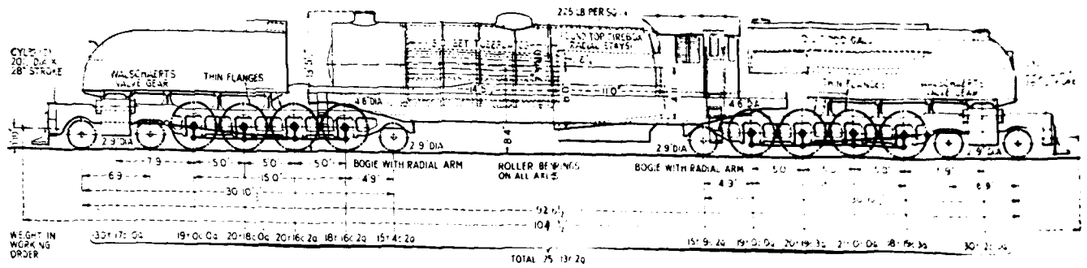
Compensated springing is divided in two groups on each side of the engine units, one group being the outer, intermediate and driving coupled wheel and the other being the inner coupled wheel and inner truck. As mentioned before care has been taken to provide adequate staying of the engine units, cast steel and plate stretchers being used. The pivot centre cast integrally with the frame stretcher is of the patented Beyer, Peacock self-adjusting type, which has been so outstandingly successfull since its inception and has proved to be one of the most important items contributing to the success of the Beyer, Peacock design of the Garratt locomotive.

LUBRICATION AND ACCESSORIES

Each engine unit is fitted with a 12 feed Silvertown mechanical lubricator for feeding the piston rod glands, steam and exhaust pipe ball joints, cylinders and valves and on each unit an 8 feed lubricator of the same disign feeds the pivot centres and slide bars. The horn cheeks are syphon-fed from oil boxes as are also the walschaerts gear, connecting and coupling rod bearings, except those on the driving crank where the SKF bearing is grease packed. Ajax soft grease lubrication is used for the brake gear, and for the pins of swing links on the bogie.

The locomotive is fitted with a steam brake on both units, whilst a hand brake is fitted in the cab which controls only the rear unit. For braking of the train a Westinghouse automatic brake is used; twin air compressors being fitted on the left hand side of the smokebox, the steam cylinders of which are lubricated from the cab by a 2 feed Wakefield "AC" type hydrostatic lubricator with a separate condenser, a Gresham & Craven proportional steam brake valve is fitted for use in conjunction with the air brake. Compressed air sanding is provided to the inner and outer coupled wheels of each unit, so that adequate sanding can be provided for running in either direction, this equipment also is supplied by Messrs. Gresham & Craven.

ABC couplers of the M. C. A-P. H. type are fitted in conjunction with Spencer-Moulton rubber draw gear,



provision being made for replacement of this drawgear if required at a later date by the Alliance type of automatic knockle couplers. The small steam pipes between the boiler and engine units are fitted with "Flexstel" flexible joints.

The oil fuel tank is of all-welded construction and is fitted in the space provided in the rear unit's water tank for a coal bunker should the occasion arise to change over from oil fuel. Space has also been left to accommodate a mechanical stoker complete with conveyor through if required at a later date.

The two water tanks are of robust design with riveted joints and are secured to the engine units by the Beyer, Peacock patented method of flexible fastenings. To provide quick levelling in the tanks when high speed filling is used on the Railway, two large bore equilibrium pipes are fitted. In the curved portion at the outer ends of the tanks, provision is made to carry lifting jacks.

CAB AND FOOTPLATE FITTINGS

In the tropics a large cab of ample size with an insulated double roof and plenty of ventilation is a necessity, these cabs conform with these requirements and are provided with comfortable seats upholstered with Dunlopillo for the engine crew. A tip-up seat is provided for the inspector. All the controls come conveniently to hand, the regulator as can be seen, is fitted with a handle on each side of the cab. The oil burning controls are suitably positioned in front of the fireman, and provision is made for presteaming. A Smith's Stone electrical speed indicator is fitted in a convenient position, and two Klinger water gauges of the reflex type, which are marked to show the minimum water level on various gradients, an important consideration on a railway with heavy gradients. Electric lighting is provided in the cab and current is produced by a Turbo-generator, type LBB, supplied by J. Stone & Co. the equipment includes a headlight on the front unit, a back-up light on the rear together with classification lights and the illumination of the value gears, plug points being provided for an inspection light.

The locomotives will be painted on their arrival in Kenya in the railway colours of maroon and black with yellow lining and red bufferbeams, and will be numbered 5901 to 5934 inclusive.

These Beyer-Garratts, descendants of a long line of this type of locomotive, should prove a welcome addition to those already in service in the Colony, being economical and reliable in operation, and low in first cost.

The Principal dimensions are as follows :—

Cylinders (4) dia. by stroke	20½ in. × 28 in.
Coupled wheel dia.	4 ft. 6 in.
Bogie wheel dia.	2 ft. 9 in.
Axleload maximum	21 tons.
Length over buffers	104 ft. 1½ in.
Total weight in working order	252 tons.
Boiler pressure	225 lb. / sq. in.
Heating surface	
Tubes	3,313 sq. ft.
Firebox	247 sq. ft.
Total evaporative	3,560 sq. ft.
Superheater (inside)	747 sq. ft.
Total	4,307 sq. ft.
Grate area	72 sq. ft.
Tractive effort at 85% B.P.	83,350 lb.
Tractive effort at 75% B.P.	73,540 lb.
Oil capacity	2,700 gal.
Water capacity	8,600 gal.

"RUBBER IN RAILWAYS"

By A. C. Bhattacharya, A.M.I. Prod. E.

IN a world of mechanisation rubber has grown up with industry. A frail and unstable substance in nature has been transformed by human ingenuity into a versatile raw material with a thousand uses in the home and industry. No other material can equal it in its adaptability to so many purposes with its unique elastic properties, its combination of flexibility with resistance to abrasion, and the ease with which it may be moulded into various forms. It is no wonder therefore that every industry needs rubber in one form or another—hose, tubing, belting, mouldings or extrusions, linings, coverings, seals, rubber-metal mountings, tyres etc.

Thirty years ago the pneumatic tyre was restricted to passenger vehicles; to-day it is the riding medium for all fast and heavy goods traffic on our roads, and threatens to take a definite place on the railways of the world for light, fast passenger services. Furthermore, rubber is taking an increasing share in the construction of all types of railway rolling-stock, where it is used in buffing and draw-bar springs, to protect the vehicles from external shock, in auxiliary springs and cushioning, to contribute directly to the passengers' comfort, and in many other ways. A review of the services thus being rendered by rubber in its many forms, therefore, proves a most stimulating study, and one which may be suggestive to many technical readers of other fields of service. Notwithstanding the fact that much has already been accomplished, its maximum value to the engineer is far from being realised and there is still clearly a wide field ahead for the application of rubber specially in railways both for improving the amenities of the passenger and in protecting both mechanism and structures from the effects of vibration and shock.

PRODUCTION AND MANUFACTURE

Before proceeding further it is proposed to describe briefly the process involved in the production of raw rubber and its conversion into the finished product.

Although rubber has been known for well over 400 years, until the early part of the present century supplies were chiefly obtained from South America. The rubber that was collected and manufactured under primitive conditions proved to be very expensive for the rubber manufacturers as it had to be further purified before being rendered suitable for use as a raw material for subsequent conversion into the finished article. Since 1839 there has been an almost continuous development

Sri A. C. Bhattacharya.

of the processing of rubber, and things started improving from that time.

The history of rubber plantation industry dates back to 1873. During that year a small consignment of *Hevea Braziliensis* seedlings were brought down to India with subsequent despatch of about 2000 seedlings to Ceylon from the Amazon valley. These were the beginnings of the vast rubber planting industry of to-day covering the vast areas of planted rubber throughout the tropical and sub-tropical regions of the Far East. This planted rubber has almost entirely displaced the original "wild rubbers" which although formerly constituted the main source of supply, contained as a rule a high proportion of impurities. The plantation product is however carefully and uniformly prepared and available in standard grades ready for processing, to a large extent without further purification.

Rubber is obtained from the juice of the tree in the form of a milky substance known as 'latex'. Latex is obtained by making deep vertical incisions in the bark of the tree, which comes into bearing in the fifth or sixth year after plantation. Latex in its purest state is milk white and coagulates when it comes in contact with air. The latex on being collected is taken to the factory where it is passed through filters to relieve it of impurities.

It is then coagulated by means of dilute acid and rolled out into strips or sheets to form either standard crepe or standard sheet. The sheet is dried in a chamber, known as smoke chamber, specially constructed for the purpose having outlets only on the top. Smoke is allowed to pass through the sheet which is hung up in the chamber and after the operation is completed we get smoked sheet, the form in which rubber is available in the market.

Rubber has very little use when in raw state as it is plastic then and also very much susceptible to changes in temperature. To make it suitable for various uses, it is necessary therefore to incorporate other materials in a mixing process in a manner analogous to the alloying of metals. By incorporating what are termed compounding ingredients into the mix prior to vulcanisation, the properties of rubber can be varied almost at will. The modification of the physical properties of rubber is one of the most important features of the product, as depending on the requirements of industrialists, it may be manufactured solid or porous, hard or soft, elastic or plastic, and resistant to oils, alkalis and dilute acids. Suitably compounded and vulcanised rubber can be manufactured with a tensile strength and resistance to abrasion comparing favourably with mild steel.

To get rubber in various shapes, the method involves extrusion, rolling, stamping or cutting. Some rubber products are made by moulding and these receive an additional forming under high pressure during the cooking process known as vulcanising or curing. If required in sheets, the rubber is passed between horizontal steel calender rolls steam-heated internally. Thickness are built up by successive passings of the sheet through the rolls. Sheet rubber is vulcanized or cured between the heated plates of hydraulic presses. Extrusion is achieved by forcing material through specially formed dies. The rubber as it emerges from its dies is in the form of continuous strips, which may be either coiled or laid in lengths or large flat trays and vulcanized in open steam heaters.

The major portion of the rubber articles used in railways are from 'mechanical' rubbers which are produced by (a) breaking down the raw material to a plastic mass,

(b) mixing sulphur and other necessary ingredients, (c) shaping and assembling the semi-manufactured compound and finally, (d) vulcanizing by a heat process.

STRENGTH OR RUBBER

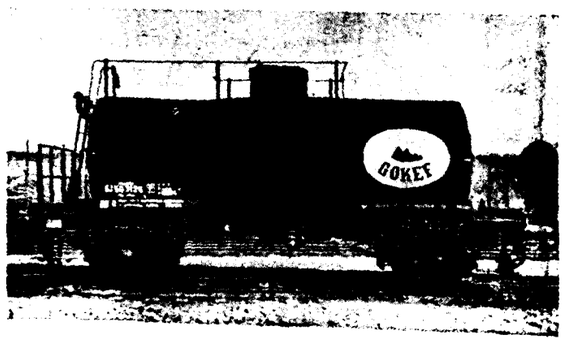
Pure soft rubber may be strong enough to withstand a breaking load of approximately 20 to 25 Cwts. per square inch and may have an ultimate breaking elongation of nearly 900 per cent. It is also possible by suitable compounding to alter these strength figures so that there may be an increase in breaking strength of 50 per cent with a lowered elongation value at break. For example by reducing the rubber content and increasing that of the pigment (carbon black) the rubber will lose almost the whole of its elastic qualities, and will resemble leather more closely. Such material generally replaces leather in various applications.

Rapid strides have been made in recent years in the art of bonding rubber to metals and to metallic alloys, especially so in the case of iron alloys. Adhesion which sometimes is very strong can be obtained in various ways :

(i) By employing a hard rubber (or vulcanite) next to the metallic surface.

(ii) By coating the metal with a resin.

(iii) By using a layer of electrically deposited brass as the bonding medium.



Rubber insulated, all-welded tank wagon built by A. B. Christian Olsson, Falkenberg, Sweden.

In actual practice it has been found that an adhesive strength exceeding 1500 lbs. per square inch can be obtained. From experiments it has been found that bending can be made so perfect that when a bonded unit is tested to destruction it is either the rubber or the metal fails while the bond remains perfect.

Onazote insulated fish Van built at Swindon for the Western Region, British Railways.

The commonest rubber-to-metal product are rubber-lined pipe, rail tank for transporting fluid chemicals in bulk, motor mountings, vibro-insulators, springs, steel pickling tanks, electro-plating tank, rubber cored fan blades, and numerous other metallic products covered with rubber to resist corrosion or abrasion or to prevent contamination.

PROPERTIES OF RUBBER

The properties of rubber and rubber like synthetics can briefly be stated as follows:—

Deformability—Tremendous rate of deformability with relatively low load application, no other known substance than rubber can be deformed and then recover without permanent set.

Resilience—Almost instantaneous recovery of all deflections after removal of the applied load. Its ability to change shape under load, to resist this changing of shape and subsequently to recover from the change imposed upon it, makes it suitable for use as a buffer springs in railway rolling stock.

Abrasion.—Highly resistant to most forms of abrasion.

Action—Silent and smooth.

Hysteresis—Low, can be controlled and is sufficient to prevent "build-up" of amplitude at resonance.

Heat and Electricity—Low conductor of heat and electricity and can be made non-conducting when required.

Chemicals, oils etc.—Can be made to resist most of these for which rubber-lined tanks are in extensive use to-day for the conveyance of Liquid chemicals.

Rubber fittings for Vacuum Brake.

RUBBER BELTING

The use of rubber in belting for the transmission and distribution of motive power is by no means a modern innovation. Like other factors, railway workshops too, are greatly dependent on rubber transmission belting as it ensures less belt slip with increased power transmission, a longer life, and lower maintenance costs.

The essential service qualities controlling the development of transmission belting are (a) Flexibility, (b) Frictional grip and (c) Fastener-holding capacity.

When a belt bends round a pulley, the outer layers must stretch more than the inner layers, and were it not for the rubber, the belt structure would not readily accommodate itself to this deformation. The impregnation of the rubber into the cotton fibres and the elasticity of the rubber bond insulates the fibres and helps them to extend and recover, so reducing internal friction and preventing breakdown of the fibres.

Belts drive purely by the frictional contact between the belt and the pulley, hence the higher the co-efficient of friction the less will be the tension required in the belt to drive without slip, with less wear on the bearings and greater life of the belt. Rubber gives a relatively high co-efficient of friction, so that a belt which retains its rubber surface will maintain good gripping properties.

The weakest part of belt is always the joint, when joined by a fastener, the stiffness of the belt is usually increased at that point and this increase in rigidity, with continued bending, may cause local failure, apart from the fact that the strength of a belt at the fastener is always reduced. The use of an endless belt, in which the inner portion of the belt consists of one length of cord wound round and round to form an endless band and embedded in rubber, is therefore always an advantage wherever possible or practicable; and, of course, an endless belt eliminates the noise caused by the fastener striking the pulley.

The use of cabled steel wire as the tensile component, which has only been made possible by the development methods of bonding rubber to steel, has been found to provide a belt which has virtually no stretch over long periods of running.

With the gradual development of the technique of rubber manufacture and compounding, the standard of rubber belting has also improved considerably and there are various types and grades of rubber transmission belting now available to satisfy the power transmission requirements of industry wherever it is possible for a belt drive to be used.

RUBBER DIE PRESS

Some 15 years back, the rubber die press was introduced to the engineering industry. It is very suitable for such operations as forming, blanking, piercing, shearing, flanging drawing, etc., of light alloy sheet, such as aluminium alloys. Since the present trend of rolling stock design is towards large scale use of aluminium alloy sheets and components made therefrom, the rubber die press is sure to become a standard unit in almost all the railway factories. The greatest advantage of the rubber die press is that it is worked with simple and inexpensive tools.

The essential components of the rubber die press include a thick rubber pad supported by a stout steel container which is sufficiently strong to withstand the maximum pressure exerted by the press platen. The

Rail car Seats incorporating Dunlopillo.

thickness of rubber is about two-thirds the depth of the container. Dies for this press are usually made from seasoned hard wood or red fibre and faced with metal. They are also made from zinc alloys. When in operation, the platen of the press is moved by hydraulic pressure to force the dies and light alloy sheet against the rubber pad. As the rubber becomes compressed, it compels the metal to shear, bend, or form to the shape of the die. The frictional properties of rubber in this

case are responsible for doing this work. Both small and large presses have come out in the market having ranges of pressures from 500 Tons to 2600 Tons for the former and 5000 tons to 10000 tons or more for the latter.

VIBRO-INSULATOR

As already mentioned earlier, vibro-insulator represents one of the commonest forms of rubber-to-metal products and is chiefly used as an anti-vibration machinery mounting to eliminate wear, noise, vibration and maintenance costs. In this case rubber is used in shear and not under compression for the absorption of unwanted frequencies. As a result of experience gained in bonding tests and usage, it has been observed that while rubber is employed in shear, its powers of deformability under close control can be fully utilised.

Vibro-insulator machinery mountings are rubber springs bonded to metal supports and give spring deflections far greater than hitherto achieved. They are manufactured in a range of sizes and designs to make them suitable for applications ranging from light delicate instruments to massive machines, such as air compressor, mixing mills, rotary driers, diesel generators, mechanical presses, etc.

It is apparent therefore that vibro-insulator mountings provide designers with a range of easily-applied resilient elements and have therefore manifold uses in railway workshops where costly deep foundations can be avoided in installing heavy machinery and plant whose life is also increased due to vibrationary forces set up within the mechanism being completely cushioned. Apart from this, they can also be used with advantage for mounting auxiliary installations on railway coaches and locomotives.

RUBBER IN ROLLING STOCK

Rubber applications in railway rolling stock can generally be grouped as follows :—

(1) Rubber buffing and Draw-bar springs.

(2) Auxiliary bearing springs.

(3) Bogie Bolster mounting rubbers.

(4) Railway Rubber Hose.

(5) Vacuum Brake Cylinder rubbers.

(6) Rubber in coach work.

(7) Pneumatic tyres to Railway wheels.

Buffers are used in railway rolling stock for twofold purposes, the first to prevent them being free to oscillate independently while negotiating a curve which is done by establishing a considerable frictional pressure between the buffer ends and the second to mitigate the effects of collisions.

In providing against collisions, the main point aimed at, is to provide an elastic medium in compressing which, the momentum of the train should as far as possible be absorbed. There should, however, be no recoil of the compressed medium which in a collision often does a great deal of damage. Since rubber is very sluggish in recoil, and an ideal medium for shock absorption, rubber springs are extensively used as buffer and draw bar springs. Further the chief advantage in the use of rubber lies in the moderation of the intensity of the stress producing acceleration and in the effect of blow. When rubber springs are compressed they expand radially so that there is a dispersal of lateral effort, or cross-component, which in a rigid train of metal work would produce vibration.

Since for bearing springs, the springing material should have a very high co-efficient of restitution and be very rapid in recoil, rubber is not considered suitable for this purpose, although it is useful in small quantities, to eliminate vibration when used in addition to steel springs. It is on this consideration that rubber auxiliary bearing-springs first came into use. With its advent the great benefits derived were smoothness of running due to the reduction in the possibility of horizontal and vertical shocks being transmitted to the body, and freedom from spring breakages. There is however still further scope for the extended use of rubber to conventional suspension systems as mentioned below to attain comfort, silence and freedom from spring-leaf breakage.

1. Use of rubber insulated horn-plates to check noise transmission.
2. Axle Box rubber cap cushion insulated by asbestos for cushioning the vertical shocks received by the axle box itself.
3. Rubber interleaving of suitably tapering thickness to the full length inserted on assembly of laminated spring.

BOGIE BOLSTER SPRINGING

Comfortable riding depends to no small extent on satisfactory bogie springing. In this connection also rubber plays a very important role. In current British Practice, in addition to the bogie centre-pivot being cushioned by means of rubber from the body, anti-friction rubber pads are also used at times to maintain constant, cushioned contact between bolster and body.

Here is an extract from an article by Mr. Graff-Baker to show the attempt that is being made now to use

rubber in bogie bolster springing for improving the riding qualities of a coach.

"A set of bogies is running experimentally on London Transport in which the bolster springs, spring plank, and hangers are replaced by a pair of rubber springs in shear, disposed at appropriate angles between an extended bolsters and the outside of the bogie frame. These springs are proportioned to give the same characteristics as their more normal predecessor and the riding is the same. The springs deflect vertically to correspond with the bolster springs, and horizontally to correspond with the effects of the bolster hangers with their normal centring action".

RUBBER HOSE

Rubber hoses are made by impregnating cotton with plastic rubber on frictional rolls under pressure. Successive plies are laid together, and the completed structure vulcanized in moulds between press plates or in cloth wrappings. Under the heat of vulcanization, the rubber softens enough to flow between the fibres of the fabric to form a strong union.

Railways throughout the world use large quantities of rubber hose particularly for the braking and heating system between carriages. There are also numerous types in service between engines and tenders. Further its use for general engineering services as boiler washing hose, as compressed air hose for driving pneumatic tools, etc.; in Workshops is however a common feature.

Hose pipes in common use in railways, contain a helical coil of tough galvanized steel wire finished off square and with ends soldered to the adjacent wire. Around the wire is laid one ply of 8 ozs. duck over which there is rubber of suitable thickness with one ply of 12 ozs. duck throughout the length.

The vacuum braking system is dependent to a very great extent on rubber for operating its cylinders. It is mainly the different rubber fittings e. g. rolling ring, joint rings, gland packing rings, release valve and van valve diaphragms and release valve and gland box joint washers, which have made the working of vacuum brake in railways possible.

The application of rubber as used in railway coach body work is exemplified in the following types of rubber fitments :—

(a) As body pads between the underframe and the coach body to ensure cushioning effect for better riding.

(b) As floor covering in upper class coaches to take advantage of its noise and vibration-absorbing properties.

(c) As window frame rests to cushion the frame when dropped.

(d) As anti-rattlers for door and window frames, and

(e) As dust excluding devices and door stops.

EXPANDED RUBBER

Rubber in form of a gas expanded compound of unique cellular construction and marketted under the trade name of "Onazote" has been used for the insulation of railway vans for the transport of food and other perishable commodities like fish etc. Its weight is approximately 3½ to 4 lbs. per cu. ft. with a thermal conductivity figure of 0.20 B. Th. Us. per square foot per hour for material one inch thick. Its composition makes it proof against the effects of damp and bacteria. Supplied in slab form, this insulating material has been in use in fifty insulated fish vans built at Swindon and running on the Western Region of British Railways. These vans are insulated by the inclusion of 3 inch of Onazote between the inside and outside panels. They have been cut to the size required and fixed into position with a solution of Gilsonite and tar.

RAIL CAR SEATS—"DUNLOPILLO"

Rubber has, with advantage, been in use in railway coach seats for increased comfort. "Dunlopillo" cushioning, a material invented by Dunlop in 1928, is now almost a standard practice with the British and other continental railways. In Indian Railways too, air conditioned coaches which are being built in Khargpur Workshops are being with "Dunlopillo" seats and sleeper beds.

Made from carefully selected latex, the natural milky juice of the rubber tree, it, in finished form is a tough yet soft material honey combed with innumerable interconnected air cells which give it true sponge like qualities. It retains all the 'nerve' and life of rubber in its purest form.

"Dunlopillo" units are available in standard moulded shapes to suit railway seatings. They can also be readily built up into straight and curved units to suit special requirements.

The action of light is often an important cause of rubber perishing. In use "Dunlopillo" is protected from light by a fabric of the moquette type and therefore is not subjected to deterioration in this way.

Rubberised hair introduced in the market under the trade name "Hairlok" has also found considerable favour for use in rail car seatings. In this case hair is treated with rubber in such a manner that the hairs adhere whenever they touch each other, resulting in a cushioning material having lightness combined with remarkable resilience.

ELASTIC RAIL FASTENINGS

Growing practice of using welded long-length rails requires special provisions for fastening the rail in order to neutralise the pressure caused by temperature variations. To this end wooden sleepers are often replaced by concrete ones which however have not the necessary elasticity to deaden vibration. Application of rubber pads underneath the rails is an answer to this problem. The current French practice has been to place the rubber rail pads and fasten them with elastic steel clips, which press the flange of the rail on the sleeper. Lengths totalling 1,500 km. of track have thus been dealt with, mainly on straight stretches and slight curves. After two years of service about three million rail pads in use on the lines are still in excellent condition.

PNEUMATIC TYRES FOR RAILWAYS

The Michelin Co., of clermount-Ferrand, France, are the pioneers in introducing pneumatic tyres in railway traffic. The project was commenced in 1929 and since then it has made rapid and continuous progress.

The principle involved is more or less on the lines of automobile engineering practice and comprises:—

(a) the fitting of the wheel with a rim on which the tyre and tube are mounted, the rim being fitted with a guiding flange made of steel. The distance between the internal faces of the flanges is kept the same as that used for the ordinary steel wheels of railway rolling stock.

(b) Inflating the tyres with air in the same way as the tyres of a motor car.

The advantages claimed for fitting pneumatic tyres to railway wheels are:—

(i) Increased comfort in the way of easy riding achieved through reduction of 'hammer' at rail joints and crossings, by absorbing the shocks at the point of contact.

(ii) Reduction in the tare weight of the car resulting in increased haulage capacity. This lightness along with high adhesion of the pneumatic tyres contribute to smooth and efficient acceleration and braking.

(iii) Increased life of rolling stock and less maintenance cost.

(iv) Less wear and tear of the mechanism and structure.

(v) Reduction in noise.

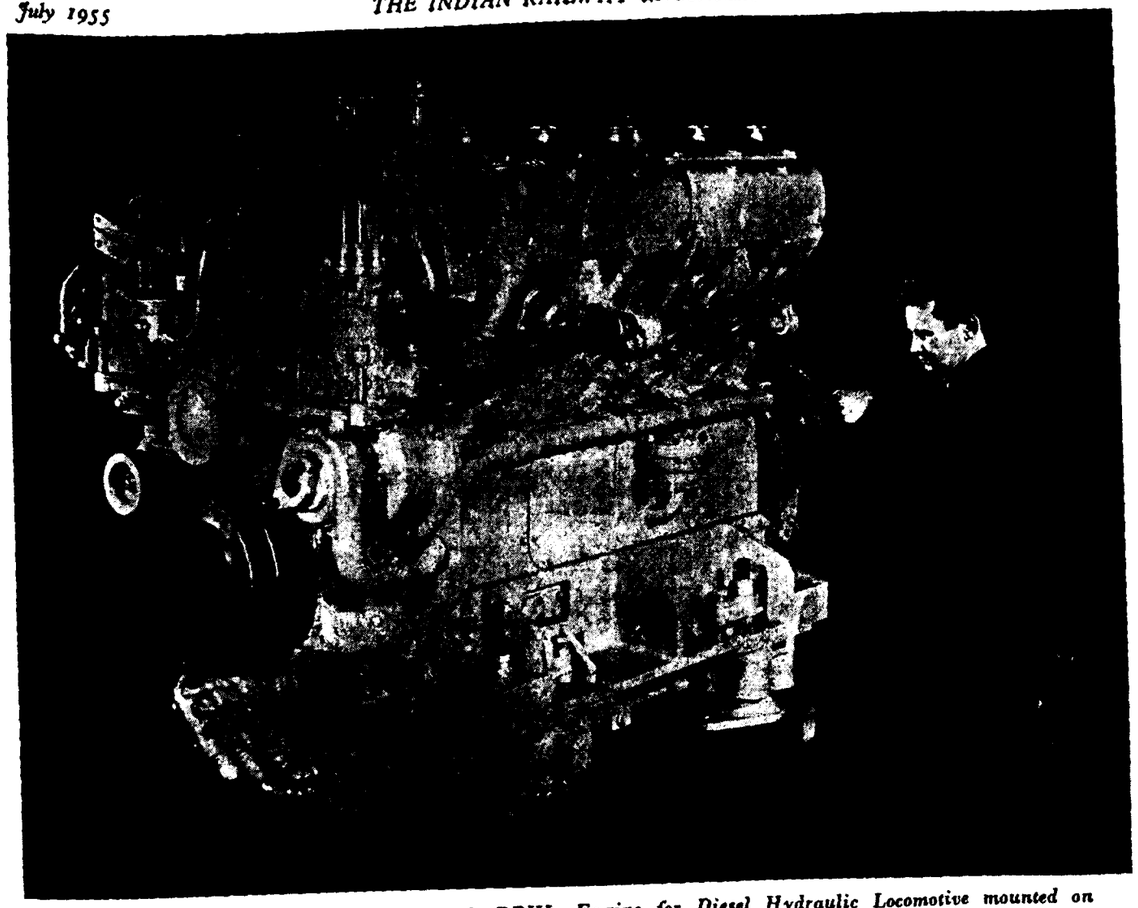
The use of pneumatic rubber tyred wheels has certain limitations too and is still therefore on an experimental basis. The limitations are:—

(a) The wheels are very expensive.

(b) The wheel load in this case should be limited to 1.2 tons thereby these are only to be used in light weight coaches.

(c) Precautions are necessary in relation to their liability to punctures.

As a compromise, the resilient wheel has been evolved in which the tyres carries a thin inner steel flange on either side of which is mounted a pair of heavy rubber rings. The rubber rings are bonded to the inner flange, and the tyre is held in position by through bolts and dowels on to the wheel centre, but is completely insulated from it. Such wheels are in use with the American P.C.C.



Photograph shows the Davey Paxman 8 RPHL Engine for Diesel Hydraulic Locomotive mounted on Vibro-Insulators Manufactured by British Tyre & Rubber Co., Ltd. These engines are now being supplied to the Indian State Railways and some of them are already in service.

Car, and the underlying principle in designing these wheels is the same as that for the pneumatic rubber tyred wheels, viz: absorbing the rail-joint shocks at the point of contact between the tyre and rail.

It will thus be seen that rubber holds in store tremendous possibilities in railway engineering. Much has already been accomplished but there is still a wide field ahead for the application of rubber. The necessity for rubber has extended with the increase in average railway speeds and also on the consideration of reduced maintenance costs.

In no other country than in India to-day there is greater need for wider applications of rubber, not only for the purpose of improving the efficiency of rolling stock but also for conserving steel of which the country is short at the present moment.

INDIAN RAILWAY ELECTRIFICATION SCHEME

BRITISH FIRM TO SUPPLY EQUIPMENT

A contract to assist the electrification scheme of the Indian Railways has been awarded to a British firm. The contract, which involves about £ 300,000, covers converting plant, switchgear and control gear for the first stage in the mainline electrification of the Eastern Railway of India.

The contract covers six sub-stations and three track section cabins on the main line from Howrah, Calcutta, to Burdwan (a distance of 66 miles) and one track cabin at Kamarkundu, which is on the branch line to Tarakeswar.

The converting plant consists of 12 mercury arc rectifiers. The D. C. switchgear for the rectifiers, track feeders and track section cabins comprises high-speed circuit breakers which, with their associated control gear, are mounted on withdrawable trucks. These will be housed in concrete cells.

The contract also covers low-tension switchgear and certain sub-station auxiliaries.

* * *

NEW DUAL PURPOSE ELECTRIC LOCOMOTIVES

Seven dual purpose electric locomotives each costing about Rs. 10 lakhs, which were ordered in 1951 have started arriving in India and so far five have been received. Out of these, three have already been put into regular service. These locomotives would enable the Central Railway to meet the demand for additional transport capacity in the Bombay area during the next busy season.

This type of locomotive has been designed for use both on passenger and goods service. It is capable of hauling a trailing load of 560 tons at 65 miles per hour for passenger, mail and express train service and 2,000 tons at 40 miles per hour for goods service on a level track.

These locomotives, each rated at 3,600 H.P. and weighing 123 tons, are the most powerful to be used on the Indian Railways. At present, the maximum number of coaches in a passenger train on the Bombay Division is limited to a maximum of 12. With the new locomotives in service, it would be possible to attach an additional coach.

* * *

LOCOMOTIVE ERECTION AND NEW COACH-BUILDING PROGRAMME

The first two new W. P. Broad Gauge Steam Locomotives out of a total of 30 to be erected by the Central Railway's Locomotive Workshops at Parel have been received in a knocked-down condition. These powerful stream-lined locomotives are utilised for hauling Mail, Express and Passenger trains on the Broad Gauge. The first three have been allotted to the Western Railway and the remaining 27 will be put into service on the Central Railway. This instalment of 30 locomotives forms part of 120 such locomotives being built in Canada for the Indian Railways under the Colombo Plan.

The Central Railway's Carriage & Wagon Workshops at Matunga are now busy furnishing 50 steel shells which are to be fitted out as new third class coaches, whilst the construction of 24 more new air-conditioned coaches has also been taken in hand under the building programme for the year 1955-56.

Speed Indicators and Recorders for Railway Service

SINCE the earliest days of rail transport, continuous efforts have been made to reconcile two basically opposed factors. On the one hand the greatest possible speed and regularity of services has been sought within the limitations of rolling stock and track layout, whilst opposing this always is the need for maintaining the highest possible standard of safety.

Probably the only common ground on which these two opposing requirements meet, is the need for accurate control in all circumstances of the speed of trains to ensure not only that time is not being unnecessarily lost, but also that the maximum safe speed for a train of a particular type and weight and on a particular section of line is not exceeded.

Although the variables which determine these maximum safe speeds are comparatively complex, they are well enough known for the answers to be obtained with accuracy and, consequently, for efficient and safe operation, the method of determining the actual speed must also be accurate.

It may be thought that the foregoing is sufficiently obvious to have been left unsaid but, despite this, it is a fact, surprising to the layman, that a very high percentage of locomotives on the world's railways are not equipped with any form of speedometer gear whatsoever.

The answer to this, of course, is that locomotive drivers and motormen are, in general, highly skilled in their craft and that an experienced man can at any given time tell with a fair accuracy the speed of his train, perhaps not in miles per hour, but at least in terms of the maximum safe speed.

However, the only scientific and which he has in these circumstances is his watch, with which—using landmarks, signal boxes, etc.—he can with accuracy tell whether or not he is running on time.

Looked at dispassionately, however, the only information which he obtains by this means is his average speed between one check point and the last and as this average can be achieved by an infinite number of combination of speed, there is no evidence to show that it has not been arrived at by exceeding the safe maximum at some point in order to make up for delay at another point.

One therefore returns again to dependence upon the skill of the driver or motorman in judging his speed without the aid of instruments. This adds vastly to the already heavy burden of responsibility borne by him and to the fatigue to which he is subjected, especially on long runs in arduous conditions. It should not be forgotten that however skilled and conscientious, a tired man can make errors of judgment.

Some form of speedometer equipment should, therefore, be regarded not as a slight on the skill of the driver and not as a luxury but as an intelligent and essential contribution both to efficiency and safety.

Speedometer equipment for locomotives falls generally into two classes, non-recording and recording. The non-recording equipment consist of a simple indicator, whilst the recording type, in addition to having a dial and pointer for speed indication, also produces a permanent record on a special diagram chart of the speed at any point in the journey. Recording instruments can also show the length of standing time, brake applications, the switching of current on or off (for electric locomotives) and the positions of signals where such signal equipment is used.

The fitment of recording speedometer equipment raises even more controversial points than the use of simple speed indicators. There have been numerous cases of drivers refusing to ride with recorders and also many instances where the recorders have met with "accidents" with such frequency that their use has had to be discontinued.

Drivers have said that they will not be "supervised by a machine" and that the use of such equipment implies complete lack of faith in their skill. They fear that they may incur disciplinary action through the examination by the management of the records and that the presence of such equipment lowers their status.

The only instance where such arguments have any validity is with a driver of below-average skill or conscientiousness when his lack of ability and prudence will be made abundantly clear, but a driver of this class could not in any event hope to escape detection for long in an efficiently run railroad company and, if the recording speedometer discourages this type, it has benifited his more desirable fellows.

It would be more profitable to consider the advantages and protection which can be bestowed on the driver, the railway companies and to the public by the use of such equipment.

Let us suppose that there is a derailment on a curve and the resultant damage to the track makes it impossible to establish whether or not a track defect was present. Witnesses (frequently unreliable in such matters) state that the train was travelling excessively fast and the driver consequently is up for censure. The only utterly irrefutable evidence for his defence is the recorder which shows that he was within the allowable maximum for the conditions and his complete exoneration is a foregone conclusion.

There have been actual instances where such things have happened and where, as a result, drivers refuse to take trains out if they are *not* fitted with recorders.

A part from the accident aspect, however, the drivers benefit in other ways. They have concrete evidence to support explanations for delays and time lost which cannot safely be made up. If there is discussion on tightening up schedules they have a positive basis for showing if, how and where this can be done with safety. particularly they are protected where locomotive crews are changed.

From the management point of view, the advantages are more obvious. A complete and scientific record of all routes in all conditions is available to them for present and future planning. They have evidence of where undue delays take place which can thus be overcome. They can see where schedules can be improved and economies effected. Additionally, the regularity and safety of a good driver is brought home to them.

For the public, the recorder offers the quickest, safest, and most regular railway services.

The Swiss Company of Hasler were amongst the first instrument manufacturers to realise this, and as long ago as 1889 were producing a speed indicator and recorder specifically designed for Railway Service.

From this original instrument which embodied design of the German Railway Engineer Hausshalter of Dresden, Hasler have developed over the years a series of instruments which have been applied on a virtually world-wide basis.

The heart of any instrument of this kind is the measuring mechanism. In its simplest terms this may be said to comprise the means whereby the speed of rotation of a spindle is converted into deflection or displacement of a pointer against a graduated scale and of a recording stylus against a graduated record chart.

It is interesting to note that although the mechanisms themselves have changed and developed out of all recognition, the basic engineering principles lying behind the latest Hasler measuring mechanisms are exactly the same as those employed some 65 years ago.

There are many different ways in which this conversion of the rotational speed of a shaft into proportional deflection of pointer may be achieved. Amongst the commonest are the exploitation of the laws of centrifugal force or the application of electromagnetic means in various forms. All these methods have one common drawback which is that they depend eventually upon the strength of a restraining spring to provide correct readings. Any variation in the strength of this spring due to any cause whatsoever will cause faulty readings, and by the same token any variation in the friction involved in moving the pointer or the recording stylus will have the same adverse effect.

The only system which is not in any way dependent for accuracy on the strength of a spring and which is within very wide tolerances independent of friction effects is the cinematic or periodic coupling measuring mechanism. It is this method which is common to all Hasler instruments.

The basic principle behind this type of mechanism is quite simple. If a rotating spindle is connected by a clutch and through appropriate gearing to a spindle carrying a pointer for a given length of time, say one second, and is then disconnected, then the displacement of the pointer will always be in proportion to the speed of the spindle. For example, if the gear ratio between the driving spindle and the pointer is 40:1 and the input spindle is rotating at 600 r.p.m. (10 revolutions per second), then in the period of one second during which the clutch is engaged the pointer spindle will be driven round 1/4 of a turn. Similarly if the input spindle is rotating at 1200 r.p.m. then the pointer spindle will be driven round 1/2 turn.

The periodic coupling measuring mechanism does exactly this, alternatively clutching-in and declutching on an exact time basis the input spindle to the pointer mechanism. However during the time that the clutch is disengaged, the pointer is held steady and the measuring mechanism resets itself ready for the next measuring period. At the end of each measuring period the pointer is released and will adopt the position dictated by the last measuring period. Consequently, the pointer reading at any time shows a reading proportional to the number of turns of the input spindle during the measuring period just completed.

This type of mechanism is seen in its simplest form in the Hausshalter mechanism employed in the original Hasler instrument.

This mechanism is shown in figure 1 and consists of an input spindle (1) which is connected through suitable gearing to one of the wheels of the locomotive. The

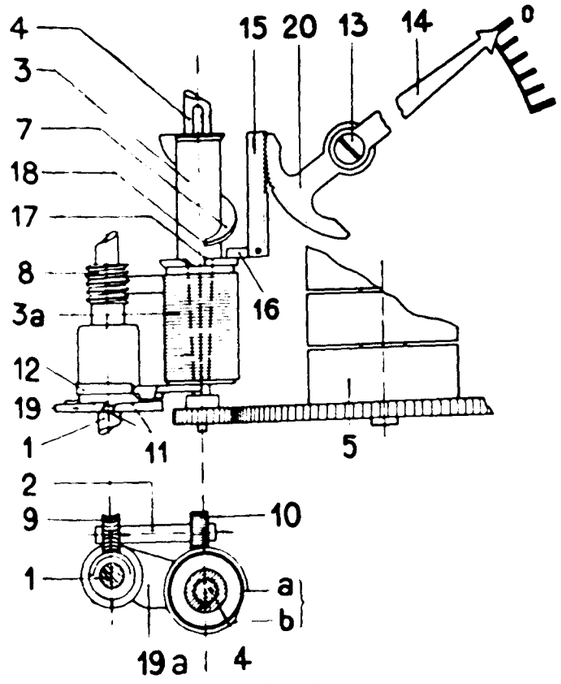


Fig. 1.

speed of rotation of this spindle is thus proportional to the forward speed of the locomotive. Carried on spindle (1) is a worm (8) which engages with a wormwheel (9) on spindle (2), which also carries a gear-wheel (10) having fine teeth. This gear-wheel is arranged to mesh with a series of grooves on the lower cylindrical portion of the measuring unit (3). This measuring unit is keyed to spindle (4) so that it is driven round by it but is free to slide axially up and down it. Spindle (4) is driven from the mainspring assembly (5) through a clock-type escapement which is not shown but which ensures that spindle (4) is always driven at the same rotational speed. The mainspring unit (5) is kept continuously wound up through a form of friction clutch which is not shown but which is driven from the upper end of the input spindle (1) such that whenever the input spindle is rotating, the mainspring will be wound up sufficiently to ensure that spindle (4) will be driven round by the clockwork at its set speed.

The grooves in the lower portion (3a) of the measuring unit (3) do not extend all the way round the cylinder, but a vertical slot (a-b) is cut through them, the width of this slot exceeding the width of gear-wheel (10) by a predetermined amount.

It will be seen that during the time that the gear-wheel (10) is engaged with the grooves on part (3a), due to its rotation it will lift the whole measuring unit (3) upwards. When the measuring unit (3), which is continuously rotating as it is being lifted, reaches the point where the slot in the grooves (a-b) coincides with the gear-wheel (10) the complete measuring unit, no longer supported by the engagement between the gearwheel and grooves, will be allowed to fall to the original position. Since the measuring unit rotates at a constant speed and since the speed of rotation of gearwheel (10) is proportional to the speed of the vehicle, then the amount by which the measuring unit is lifted during each turn is a measure of the speed of the vehicle.

The lifting of the measuring unit is transmitted to the speed indicating pointer by the means illustrated, and the pivot (13) of the pointer embodies a spring friction device so that the pointer will not move under its own weight but will respond only when the pin (16) is moved by the measuring unit.

In this connection it will be seen that the pin (16) bears against the top of the cylindrical portion (3a) of the measuring unit and is then carried upwards by the measuring unit as it lifts under the influence of gear-wheel (10). Consequently the pointer will record the highest point reached by the measuring unit between the time that the gear-wheel first engages with the grooves and the time when the measuring unit has completed one revolution so that the gear-wheel registers with the slot in the grooves and allows the measuring unit to fall. This time is known as the measuring time. With this particular mechanism the gear-wheel is in engagement with the grooves for 10-2/3 seconds and is out of engagement for 1⅓ seconds thus giving a total measuring time of 12 seconds for the full cycle.

The system is arranged such that when to gear-wheel is just coming out of mesh with the grooves, the pin 16 is in a position between points (17) and (18). Point 18 represents the beginning of a coarse spiral (7) cut on the upper portion of the measuring unit. By this means the measuring unit may fall back to zero position without moving pin (16) or the pointer.

However if the speed during the next measuring period is less than that achieved during the previous one it is evident that the measuring unit will not move up

sufficiently for the top of the cylindrical portion to reach pin 16. In these circumstances this pin comes into contact with the spiral (7) which forces it and the pointer back until it again reaches a position between points 17 and 18.

In order to ensure correct engagement between the gear-wheel (10) and the grooves on part (3a) a lever 19 (a) attached to a collar (12) which is free to slide up and down shaft (1) is provided and forms the bottom stop for the measuring unit (3). A face cam (19) which is integral with shaft (1)has four protruberances the height of which correspond exactly to the pitch of the grooves on part (3a). As it rotates, this cam imparts a regular up-and-down movement to lever (19a) and hence to the complete measuring unit when resting against this lever in the zero position. This slight oscillation ensures that the teeth on gear-wheel (10) can line up with and enter correctly the grooves on part (3a).

The main objection to this system was the rather excessive measuring time of 12 seconds and a modification was later introduced whereby two measuring cycles took place within this time.

The record from this instrument was made on paper rolls by means of a pointed stylus connected to part (15) which perforated the roll once every measuring period. The paper was fed on a distance basis and no provision was made for recording standing time.

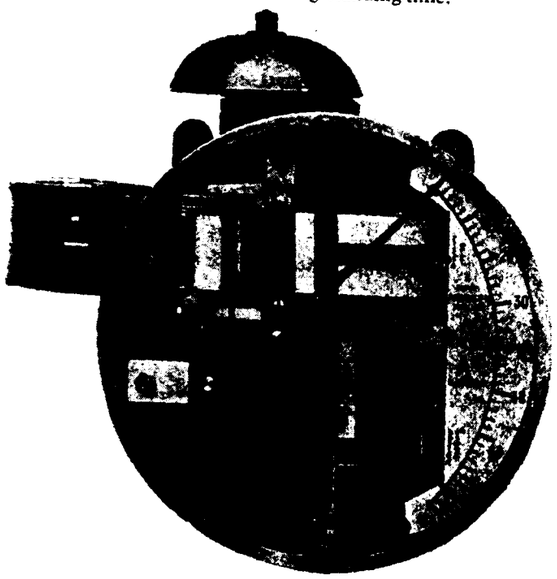


Fig. 2.

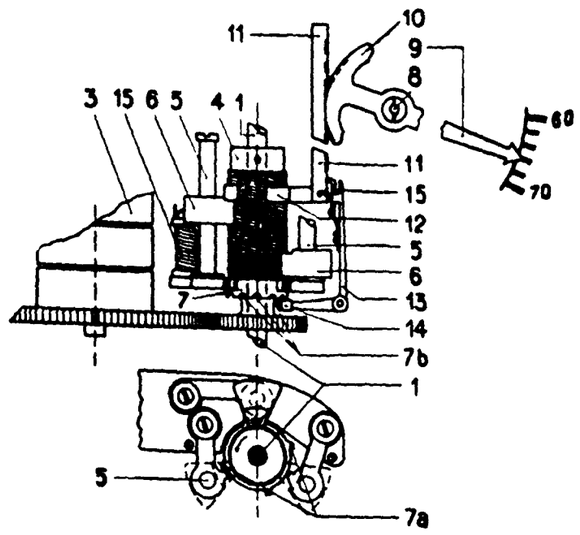


Fig. 3.

The instrument into which this mechanism was fitted is illustrated in figure 2.

In 1901 whilst the appearance of the instrument remained almost identical, the Hausshalter measuring mechanism was superseded by a new Hasler type which is illustrated in figure 3. This mechanism had the advantage of a much shorter measuring cycle time of only 3 seconds allowing a quicker response.

In this mechanism, spindle (1) is driven from the locomotive wheel at speed proportional to it and carries a cylinder (4) which has cut on it a fine screw thread. Disposed radially around this cylinder are three swinging arms each carrying a spindle (5). These swinging arms are spring loaded towards the cylinder and are controlled by the protuberances on camwheel (7) which alternately force them away from and allow them to spring back towards the cylinder. Each spindle (5) carries a slider (6) which has cut on one side a section of screw thread corresponding to the thread cut on the cylinder. The movement of the swinging arms thus allows the threaded portion of the sliders (6) to engage with the screw thread on the cylinder (4). When this happens, due to the rotation of the threaded cylinder, the slider will be carried upwards for so long as it is engaged with the thread on the cylinder and at a rate proportional to the speed of rotation of the cylinder. As they move upwards these sliders (6) bear upon the collar (12) attached to the rack (10) thus moving the pointer (9) by means of the segment (11). When the sliders are moved out of engagement they fall back to a zero position.

The engagement of the sliders (6) with the threaded cylinder (4) is controlled by the cam (7). This cam is driven round by clockwork via an escapement powered by the mainspring assembly (3). As with all these mechanisms the main spring is kept wound by means of a friction device from the main input spindle (1). In this way the sliders are alternately engaged and disengaged with the threaded cylinder for a set time and hence the amount by which they are driven upwards during this set time is a function of the speed of rotation of the threaded cylinder. The sliders are engaged and allowed to fall to zero one after the other carrying the collar (12) with them. In this instrument the pointer is arranged so that unless otherwise restrained it will fall to zero. For this reason a ratchet (15) is provided which can engage with the rack (11) and hold the pointer steady. This ratchet is also operated by cam (7) on a time basis and is arranged such that it releases the rack just as each slider comes to its highest position and then holds the rack steady exactly as each slider falls back to zero. In this way the pointer is free to register the height attained by each slider after its measuring period, whether this height be greater or less than that achieved during the preceding measuring period.

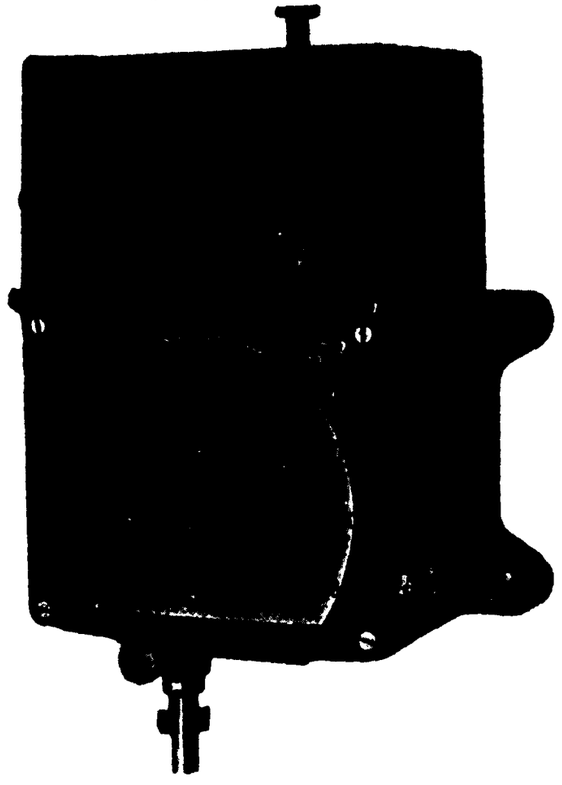


Fig. 4.

The stylus for marking the paper diagram roll is attached to the rack (11) and is arranged, by means of a cam, to produce a regular series of punctures in the paper.

This instrument was also adapted to have a bell which sounded when a predetermined speed was exceeded or to have a supplementary stylus to record the pressure in the brake pipes and hence to show brake applications. Later versions were equipped with clockwork such that the escapement continued running for a normal period of 30 minutes after the locomotive had stopped thereby recording standing time.

Instruments of this type are even now being manufactured and a comparatively large number are still in service.

The next most important development for railway service was the Hasler Teloc 220 instrument (figure 4). Originally designed in 1911, it still finds favour with many railways and many examples are in service in India on up-to-date locomotives. The measuring movement of this instrument is illustrated in (figure 5) and the function of it is described hereafter.

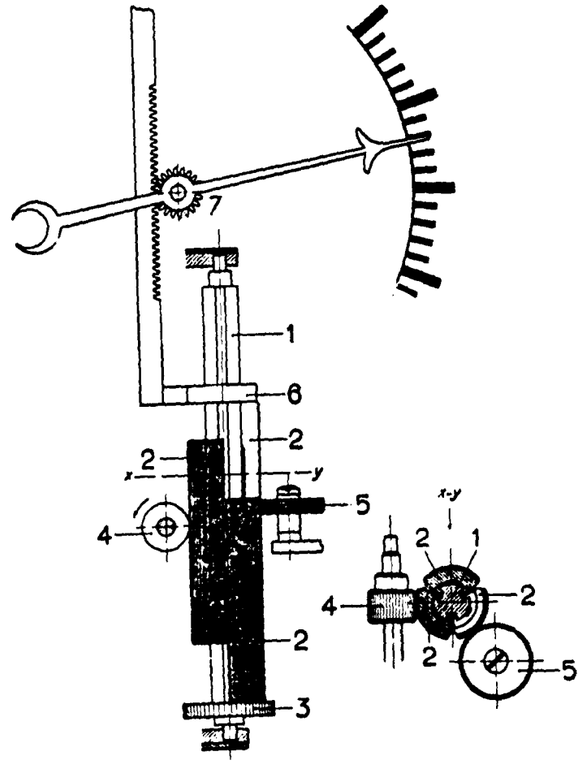


Fig. 5.

A spindle (1) is caused to rotate at a constant speed, being driven by clockwork through an escapement in the normal manner. Keyed on to this spindle are three segments (2) which all together from a cylinder having fine grooves cut round its periphery. However each of these segments is free to slide vertically along spindle (1). Meshing with the grooves in these segments is a finely toothed wheel (4) which is connected to the locomotive wheel and which rotates at a speed proportional to the forward speed of the locomotive. As this wheel (4) rotates it will lift the particular segment (2) with which it happens to be in mesh. As the spindle (1) and hence the segments (2) are rotating at a fixed speed it follows that each segment (2) will only mesh with wheel (4) for a given period of time and, consequently, the amount that each segment is lifted is a measure of the forward speed of the locomotive. As each segment passes out of mesh with the wheel (4) it passes into mesh with the holding wheel (5). This latter wheel which also has circumferential grooves cut in it serves to retain the segment in the position that it attained due to the lifting action of wheel (4). During the remaining 1/3 of a turn of spindle (1) the segment is not in mesh either with wheel (4) or with the retaining wheel (5) and thus is free to fall back to its zero position prior to coming once again into mesh with wheel (4).

In this way whilst the locomotive is running, at any one time one segment is being lifted by wheel (4), one segment is being held by retaining wheel (5) and one segment is free to fall back to zero.

A ring (6) bears on the top of the segment and its position depends upon the either of the segment in mesh with wheel (4) or of the segment held by the retaining wheel (5).

As spindle (1) rotates at a speed of 3 seconds for each revolution each segment moves from one condition to the next in one second which is the measuring period of the instruments.

The stylus is connected to the rack which drives the pointer and was originally designed to mark on specially prepared chrome paper by means of a silver tip to the stylus. Later instruments of this type use a stylus having a ball tip which records on a wax impregnated paper living a white line on the blue tinted diagram roll.

This instrument is equipped with a separate 24 hour clock mechanism which operates a separate stylus as well as a punching device which serve to record the minutes and hours of standing time up to a maximum of 24 hours.

The paper feed is worked at a rate proportional to the distance travelled and stops completely when the locomotive itself stops.

The latest range of Hasler Tel and Teloc instruments embody quite a different form of measuring mechanism which is shown diagrammatically in fig. (6).

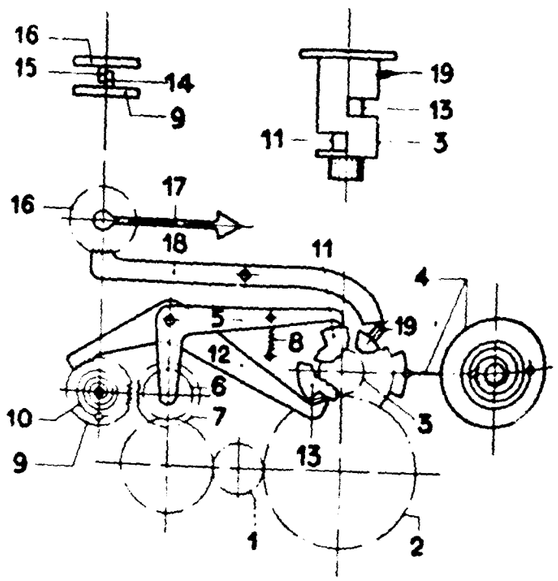


Fig. 6.

Spindle (1) is driven at a rotational speed proportional to the forward speed of the locomotive. This spindle drives wheel (2) which by means of a form of friction clutch keeps the mainspring of the clockwork mechanism which is located inside it, fully wound. This spring drives part (3) which is caused to rotate at a set speed by means of the escapement device (4). Part (3) which is illustrated separately carries three cams on it, numbers (19), (13), and (11). Bearing on these cams are cam followers respectively (18), (12) and (5). Wheel (3) carrying the cams rotates once per second and thus each cam follower is actuated once in the same period.

Cam follower (5) carries on the end of it a double gear-wheel (6) and (7) designed such that gear-wheel (7) is always in mesh with a wheel driven from spindle (1) and thus rotates at a speed proportional to the forward speed of the locomotive. When the cam follower is actuated by the cam, gear-wheel 7 remains in mesh but gear-wheel (6) moves alternately in and out of mesh with the measuring wheel (9). When wheel (6) is engaged with wheel (9) it will drive it round against the action of spring (10) and since the duration of engagement of

these two wheels is arranged on a strict time basis (1/2 second), the amount that wheel (9) is driven round is proportional to the speed of the locomotive. On the same spindle as wheel (9) but not attached to it, is wheel (16) which drives the pointer and recording stylus. A peg (14) attached to wheel (9) bears against a similar peg (15) in wheel (16) such that wheel (16) is carried round by the rotation of wheel (9). In this way a pointer deflection proportional to the displacement of wheel (9) and hence proportional to the speed of the locomotives, is obtained.

The other two cam followers (12) and (18) operate ratchets which engage respectively with wheels (9) and (16).

The function of this mechanism is thus on a sequence as follows :—

Spindle (1) begins to turn thereby winding the clockwork and causing camshaft (3) to rotate once per second. First of all, cam (11) causes cam follower (5) to engage wheel (6) with wheel (9) thereby linking wheel (9) to spindle (1). Wheel (9) is carried round for half a second. Immediately before wheel (6) is disengaged from wheel (9) cam follower (12) causes a ratchet to engage with wheel (9) whilst it is still being driven round. Whilst this ratchet is still engaged such that wheel (9) cannot slip back under the influence of spring (10), cam follower (5) disengages wheels (6) and (9) and exactly simultaneously cam follower (18) momentarily disengages the ratchet from pointer wheel 16. When this ratchet is re-engaged, cam follower (12) releases wheel (9) which springs back to the zero position. It will be seen that if the speed during the next measuring period is greater than that achieved during the preceding period, wheel (16) will be carried round even further by wheel (9) but that if the speed is less, then wheel (16) will be allowed by the momentary release of ratchet (18) to fall back to suit the new position of wheel (9).

In addition to this new mechanism the paper feed arrangement is different in the current series of instruments. Whilst the locomotive is in motion the paper feed is arranged to be at a rate proportional to the distance travelled (normally 5 mm per mile). When the locomotive is at rest, a 24 hour clock mechanism (hand wound) takes over the paper feed which is then normally arranged to be at a rate of 5 mm per hour.

In order to record the standing time with great accuracy, a separate stylus is arranged to move up and down the diagram chart once every ten minutes whilst another mechanism arranges for the hour of the day to be punched in the diagram roll at the appropriate time

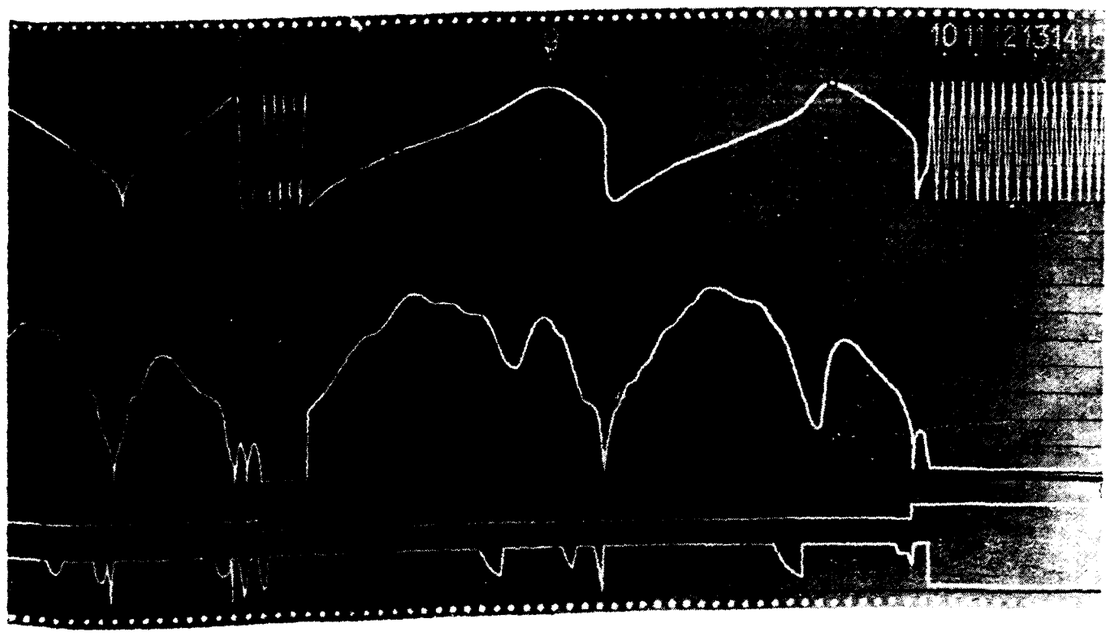


Fig. 7.

Figure (7) shows a portion of diagram roll removed from a Hasler RT 835 instrument which illustrates how both the time, speed and distance records are made.

A slightly larger instrument, the RT 935, is also equipped to record brake pressure, direction of travel, or whether the current is switched on or off for electric locomotives.

All the present instruments may be equipped with contacts which can be preset to close such that a bell or warning light can be arranged to operate when a certain speed is attained.

Various methods have been employed for driving these tacho-meters. On steam locomotives the original practice was to amount a gearbox near the coupled wheels such that a slotted crank on the gearbox engaged with a peg attached to the coupling rod of the locomotive. The slotted crank was thus driven round one revolution for each turn of the driving wheels of the locomotive. The instrument was coupled to the gearbox by means of rigid shafting running in bearings and bevel gearboxes were employed to effect changes of direction of the shafting. The shafting was generally arranged so that a maximum rotational speed of 75 r.p.m. was seldom exceeded, thereby giving the longest possible life.

Another method which is in common use is to mount a gearbox on the cover of an axlebox (where outside bearings are employed) and to take the drive from the end of the axle either by means of a peg and slotted crank or by fixing a slotted plate to the end of the axle and having a screwdriver-shaped projection on the gearbox spindle which engages with the slot in the plate. In both these instances the ratio of the gearbox is arranged to suit the diameter of the wheel from which is it driven to ensure that the input spindle of the instrument rotates

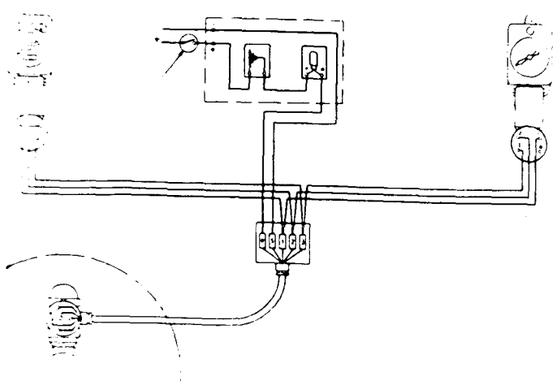


Fig. 8.

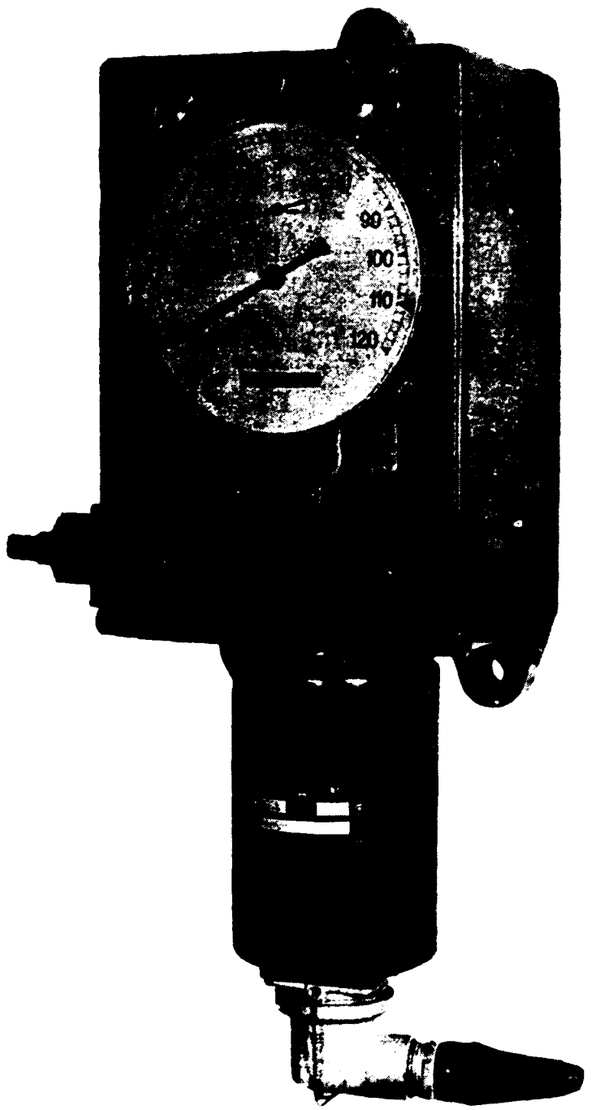


Fig. 9.

at the correct speed. In all cases the diameter of the instrument is calculated on the mean diameter between the new and scrapping size of the tyre. If it is desired to employ rigid shafting with this type of gearbox, a cardan shaft must be used between the gearbox on the axlebox cover and the shafting which is laid on the locomotive frame. This cardan shaft is telescopic and has a universal joint at each end to accommodate the movements between the sprung and unsprung portions of the locomotive.

Another form of transmission between the gearbox and the instrument is by means of heavy duty flexible cable. This may either be run direct in one piece between instrument and gearbox or may be split by the use of an intermediary bearing such that the lower portion nearest to the gearbox which is usually subject to the greatest amount of wear and tear, can be replaced independent of the other half. The latest types of flexible cable can have steel lined outer covers and be completely sheathed in rubber to ensure against the entry of dirt, etc.

In cases where a large amount of travel occurs between the gearbox and the frame of the locomotive either due to the movement of springs or the turning of bogies, or both, it is common practice to use a telescopic universally jointed cardan shaft in addition to the flexible shafting laid in the frame of the locomotive or vehicle.

The most modern form of transmission devised by MM. Hasler is their Electric Remote Drive. With this system a gearbox/transmitter unit is driven from the wheel of the locomotive or vehicle and is connected by electric cable to a receiver motor which is attached to the instrument.

(Continued on page 60)

The transmitter unit is fed with direct current which it then breaks down, by means of a face commutator having different resistances between the segments, into three phase alternating current.

This 3 phase A. C. is fed to the stator coils of the receiver motor and causes a rotating magnetic field to be set up. This field is followed by a rotating powerful permanent magnet which drives the instrument. Figure (8) shows the diagrammatic layout of the Electric Remote Drive. Figure (9) shows an RT 935 instrument fitted with receiver motor.

This system has the advantage that the connection between the gearbox and the instrument can be effected far more easily than by any other means and also that two instruments can be driven from one transmitter. This is of particular value where double-ended locomotives or railcars are concerned when it is common practice to mount a speed indicator and recorder in one cab and a simple speed indicator in the other.

In this article an endeavour has been made to show the advantages which can be gained by the use of speed

Modern Articulated Train of Germany

By H. Sreenivasiah, B.E. (Mech.); Grad.I.E.; VDI.
Hindustan Aircraft Limited, Bangalore.

AS the problem of quick transport is increasing, speedy changes and improvements are going on in every kind of transport such as automobile, aircraft and railways. There is a lot of changes in construction of railway trains when compared to the position of railways, 50 years ago. Every day the speed is increasing with the reduction in weight of train. With the increase of speed and reduction in weight, the technique of rail coach construction is completely changing. Aluminium and its alloys are used instead of steel and wood, to reduce the weight of the coaches. Therefore, many experiments are being conducted in various parts of the world. After the introduction of Aircraft for the transportation facilities, the technique of aircraft construction is also being adopted in rail coach construction. Since 1924 German Aircraft designer Dip. Ing. Franz Kruckenberg aided by his experiences in aircraft industry has experimented many times to increase the speed and efficiency of the railway transport. He designed and conducted experiments in various kinds of railway transport including Zeppelin train (propelled train) with a speed of 130 miles per hour.

Sri. H. Sreenivasia.

After the war, for the first time, German Federal Railway and German sleeping car and Restaurant car company arranged for the construction of two light alloy multiple unit articulated diesel trains on the lines of a wholly modern conception; one of these is intended exclusively for a day service train, while the other represents a sleeping train which may also be used for day service.

The Day service train was designed and constructed by Railcoach factory Famas L. H. B. and the sleeping train was in the hands of Wegmann and Co. These factories were assisted by Dipl. Ing. Franz. Kruckenberg and a committee of experts appointed by Bundesbahn and coach-building factories.

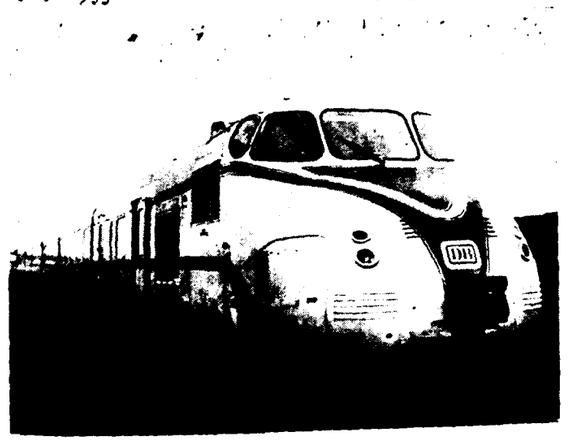
At present this article will deal with day service train only. For a new design various considerations are to be thought over. Corrosion, lightweight, material required, material available; strength of material, and technical details of various materials that are to be used, are the points to be considered in a new design. With all these considerations 'Famas-Linke Hofmannbusch' designed and constructed this articulated train with the help of the experts who had worked in aircraft industry.

The train of seven units consists of two head units, one on an either end connected by five intermediate units. The head units houses the mechanical equipment which furnishes the motive power, and all auxiliary machinery.

(Continued from page 59)

indicators and recorders for railway service and also some of the problems involved in the design and application of these instruments and the manner in which these problems have been not over a continuous development period of 60 years.

It is interesting to reflect that the present series of instruments which would appear to present all possible facilities to users may, in another 60 year's time, appear as elementary as the original instrument listed by Hasler in 1869.



Seven unit articulated Diesel train for Day Service.
(Photo by courtesy "Werkfoto; Linke-Hofmann-Busch")

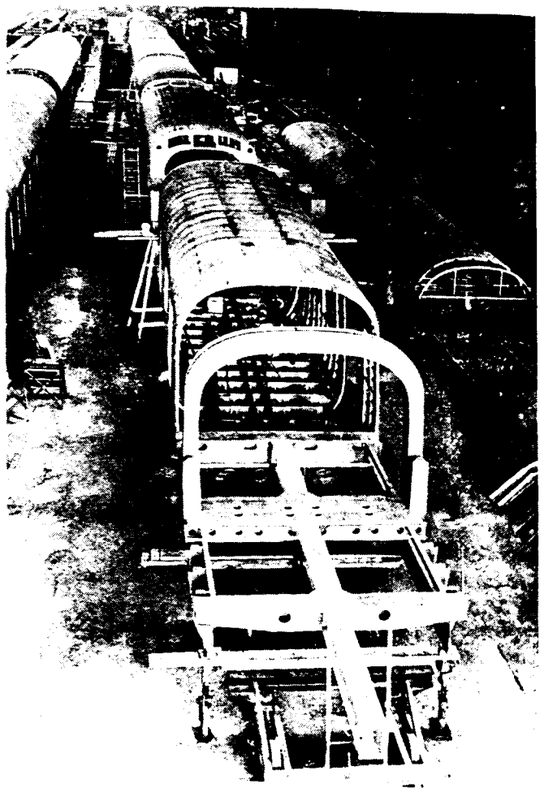
Seating arrangements in the coach.
(Photo by courtesy "Werkfoto; Linke-Hofmann-Busch")

Inside view of the train.
(Photo by courtesy "Werkfoto; Linke-Hofmann-Busch")

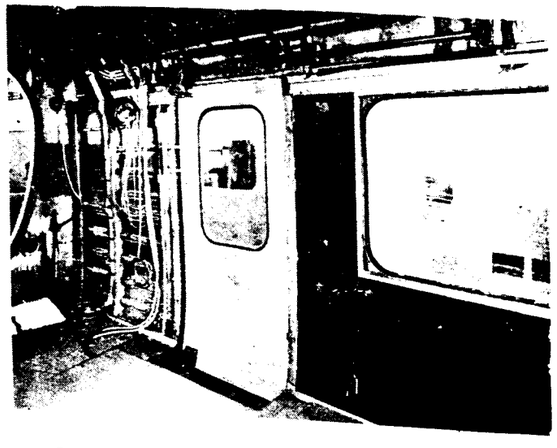
All units are articulated over their respective running gear. Maximum speed for the train will be 120 Kilometers (75 miles) and can be increased to 150 Kilometers (93 miles), when the pressure changed diesel engines have been installed in the set.

Technical details for the seven articulated train set consisting of seven units are given below:—

External Dimensions	
Overall length	96200 m.m. (316 Ft. Approximate)
Length of head unit	17600 m.m. (58 Ft. „)
Length of intermediate units	12200 m.m. (40 Ft. „)
Body width	3024 m.m. (9.9 Ft. „)
Body height above rail top	3525 m.m. (11.5 Ft. „)
Interior Dimensions	
Floor level above rail top	860 m.m. (2.82 Ft. „)
Interior body width	2884 m.m. (9.55 Ft. „)
Seating accommodations seats arrangement in open compartment	1 Plus 2 and 2 plus 2 in a row III in total
Second class inclined seats	24
Total passenger accommodations	135
Running Gear type	6 single-axle running gears with 2 traction bogies under both end units.
Wheel base of traction	2200 (7.24 approx.)
Wheel base of single-axle running gears.	12200 (40 Ft. „)
Tread diameter	900 (2.96 Ft. approx.)
Power equipment	Diesel engine with hydro mechanical transmission.
Number of engine and output	4 of 200 B.H.P. (800 H.P.)
Brake system	Compressed air disc brake originally to be supplemented at a later date by a magnetic rail brake



Frame Assembly of the front and other units.
(Photo by courtesy "Werkfoto; Linke-Hofmann-Busch")



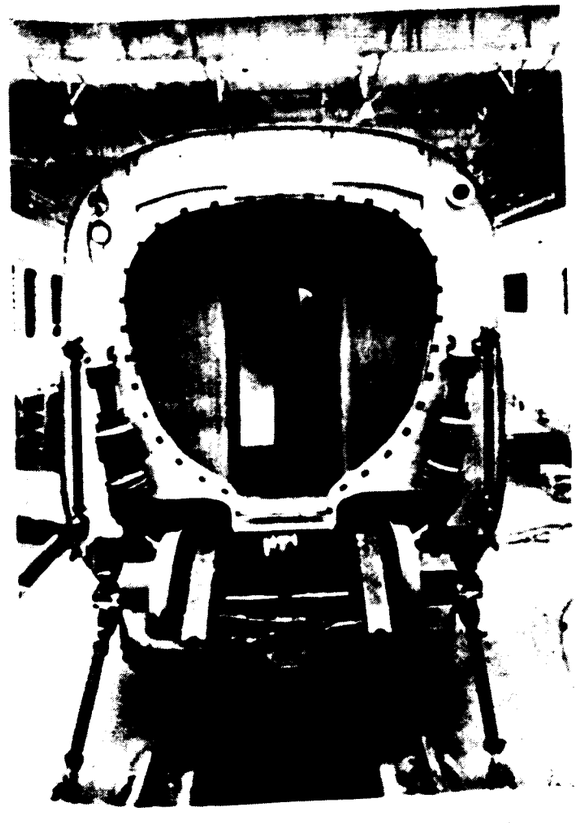
Inside view showing the details of door construction.
(Photo by courtesy "Werkfoto; Linke-Hofmann-Busch")

Inside structural detail of the coach.
(Photo by courtesy "Werkfoto; Linke-Hofmann-Busch")

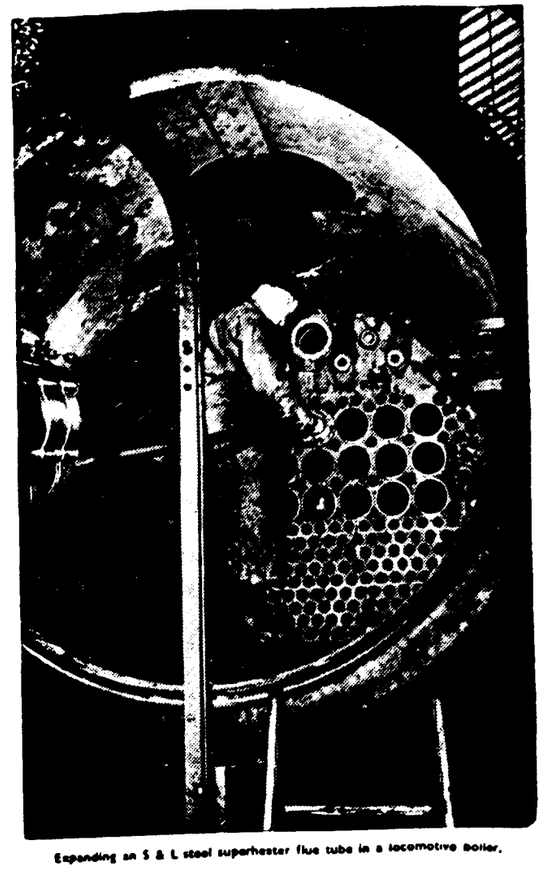
Maximum speed	160 Kilometers (99 miles/hour)
Weight of the train only	87 tons (approximately)

The mechanical system in each of the head units is identical design, each embodying two four cycle Diesel engines "V" type with eight cylinders and a rating of 160 B.H.P. at an equal to 2,000 minute, of the type built in large series for road vehicles. The diesel engines, which are to be replaced at a later date by pressure-charged diesel engine of 200 B.H.P. are mounted integral with their transmission on a bed plate with three point resilient support. The speed change system type A.E.G.—E.M.G consists of a hydraulic torque converter combined with a preselective mechanical gearbox comprising four forward and one reverse speeds. Power from the output and of the transmission is applied to both axles of the traction bogie by two carden shafts. Two radiators with louver type shutters and thermostatically controlled ventilating fan are mounted in the near of the driving position. The engine coolant system includes a cooling and prewarming system for the diesel engine lubricant and a cooling system for the transmission oil. The mechanical equipment of train set also comprises two diesel generators supplying the necessary current for electrical equipment on these sets. One each of these is situated in rear of the driving position in each head unit in close proximity to the air-conditioning plant. The diesel engines of these groups are of the same design as the traction engines and have direct connection to their respective A.C. generators of 380/220 volts 50 cycles; their operating speed in limited to 'n' equal to 1,500/min. only at which speed they have a rating of 125 B.H.P. each generator of 120 K.V.A. supplies the necessary current for its own circuit, current

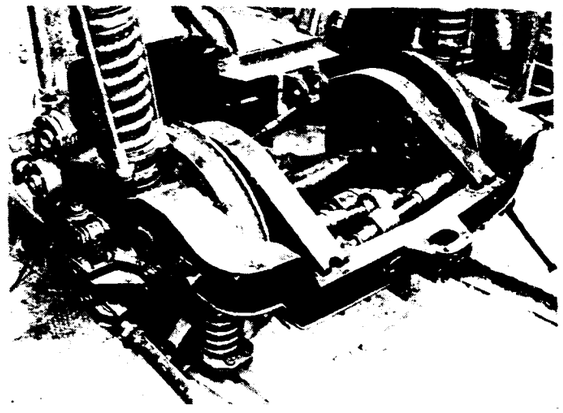
Body frame assembly showing the details of side walls and under frame.
(Photo by courtesy "Werkfoto; Linke-Hofmann-Busch")



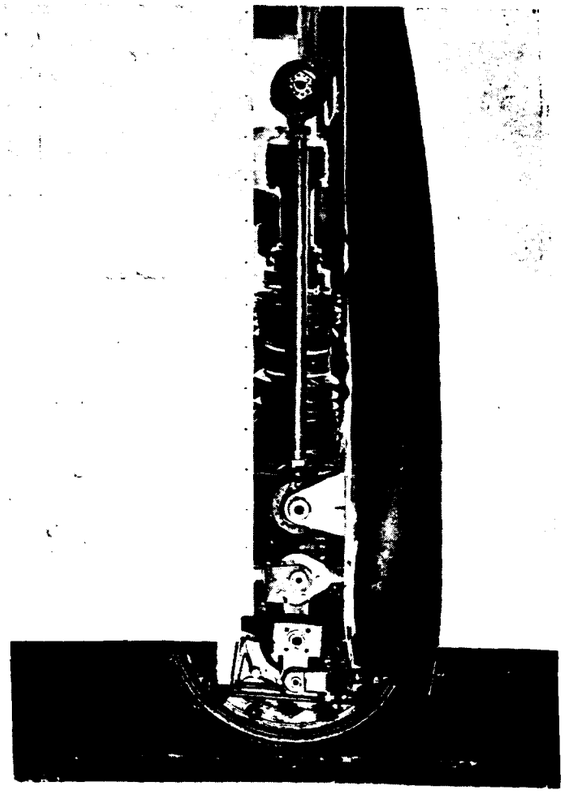
View of the end wall of the coach and bogie unit.
(Photo by courtesy "Werkfoto; Linke-Hofmann-Busch")



Expanding an S & L steel superheater flue tube in a locomotive boiler.



View of the Bogie unit.
(Photo by courtesy "Werkfoto; Linke-Hofmann-Busch")



Wheels between coaches.
(Photo by courtesy "Werkfoto; Linke-Hofmann-Busch")

consuming machines and appliances being equally divided between the two circuits. In case of a brake down of one of these generators, emergency switches automatically ensure the supply of all vital equipment with the necessary current (air intake compressions; brake air compressors; ventilating fan of the radiator system and part of the kitchen equipment)

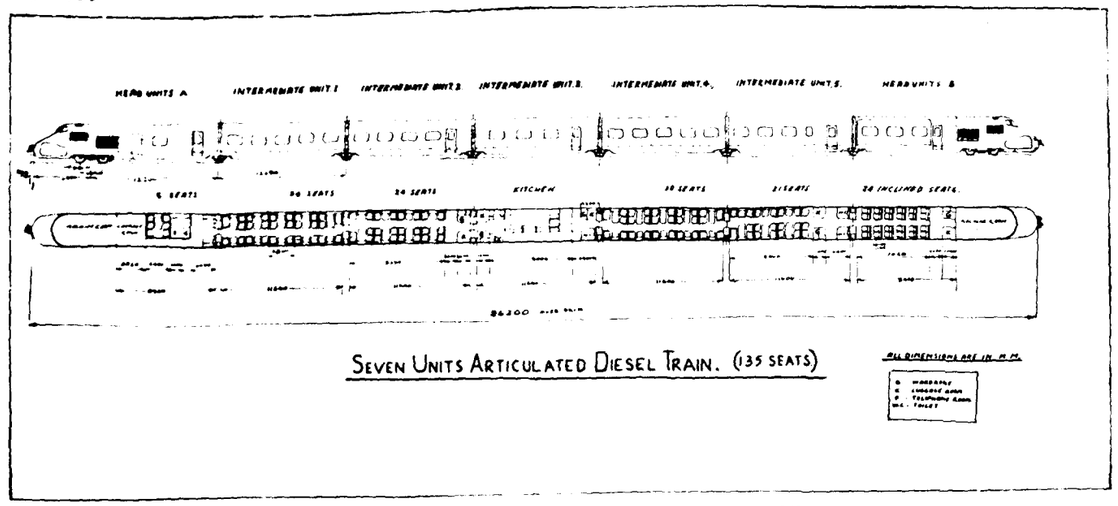
The plan of the train (drawing on page....) shows that seats are in open coach arrangement, with the exception of one small compartment intended to be used as a conference room. The wide passages between separate unit have been arranged in the manner shown to suggest a layout not usually associated with travel, but a rather with home life. That is, that of a flight of rooms leading into one another.

The tabular stressed construction method, utilising light alloys exclusively, is employed in building unit bodies: the supporting longitudinal members consists of sheets of the same length as the car body, amply strengthened by ribs, sticks and braces, trough sheets are also used in addition. The chief material used for the construction of middle and front coaches unit is Gattung Al Mg Si F 32 (Anti corodal and pansal) aluminium alloy consisting Mg 0.6 to 1.4; Si 0.6—1.6; Mn 0.6—1.0; Cr 0—0.3 and rest aluminium. Decorative parts like door and windows etc. are made of Gattung Al-Mg 3 F 18 (peraluman 3 and luxal) aluminium alloy consisting of Mg 2.0 to 4.0; Mn 0—0.4; Cr 0—0.3 and rest aluminium. All aluminium alloy material used is according to the German Engineering Standards (DIN. 1725).

Traction bogies represent an all welded steel plate construction. They are equipped with three cumulative springing system with three point resilient support and bolster, oscillations and vibrations being absorbed by hydraulic shock absorbers. Driving bevels and brake discs are mounted on the axles which are connected to the frame by guide rods.

The running gears of the intermediate unit consists of a single wheelset for each unit controlled by the coach body longitudinally and transversely by means of guide rods with springs. In negotiating a curve, the longitudinal guide rods place the corresponding axle at an angle equal to the bisector of the angle made by the axles of the two adjoining units. Coach bodies are equipped with lateral spring stabilisers to ensure satisfactory riding stability in a transverse direction.

The train is equipped with compressed air disc brakes, electrically controlled. The brakes cylinders are fitted



(Photo by courtesy "Werkfoto; Linke-Hofmann-Busch")

to the running gear. It has been envisaged eventually to incorporate a magnetic rail brake system in the traction bogies.

All the forward end; the head units are equipped with a centre buffer-coupling type 'Scharfenberg', in light weight construction, thus permitting several set of this type to be formed into multiset trains.

All windows are fixed and cannot be opened (double pane construction with safety glass on the inside and plate glass on the outside) in view of the fact that an air conditioning system is incorporated in these sets.

Four coaches are furnished with comfortable and adjustable upholstered seats with sponge-rubber filling, with tables arranged between the seats. Interior appointments of the small conference compartment are similar to those of a standard second class compartment. Interior panelling in passenger accommodations in one half of the set is in plywood faced with Macassar, while pear-tree faced plywood is used in the other half. The upholstery covering consists of person plush harmonised in shade to the colour of the interior panelling.

An entirely novel feature is the provision of luggage and wardrobe space in which passengers may register their portable luggage and top wear. This feature made it possible to omit luggage racks in passenger accommodations. Passenger space in one of the head units is resumed for inclined seats arranged in omnibus fashion.

Electric equipment is employed, exclusively in the kitchen; food and refreshments are kept in refrigerators. In all other respects kitchen operating; extensive use was made of previous experiences.

The air conditioning system has been designed to keep filtered air with an adequate proportion of fresh air from the outside in constant circulation through heat insulated conducts between the ceiling and the roof. With fully automatic control, this system warms the air in winter and cools and dehydrates it in summer.

A fluorescent train lighting system is embodies in employing the cold cathode system providing indirect lighting in passengers accommodations. Supplimentary lighting facilities include table-lamps in the open coaches, reading lamps fitted to the head rist of inclined seats also by fluorescent tubes, when the general lighting system is shut down (during the night) floor lamps, screened in on top, are lit to illuminate passages.

A loudspeaker system controlled from the writing compartment is available for announcements to passengers or for broadcasting transcribed music in the train from recorded discs or magnetic band recording.

Adjacent to the writing compartment, there is a telephone-both for long distance calls via ultra-short wave radio. The train is equipped with a pressure feed water supply in the lavatories.

Reference: Author is indebeted to the firm "LINKE-HOFMANN-BUSCH" BRAUNSCHWEG WEST GERMANY for supplying necessary details and permitting to publishing their work-photographs.

Reference Book: "Leichtmetall-Gliedertriebzuege"

MODERN MARSHALLING YARD EQUIPMENT

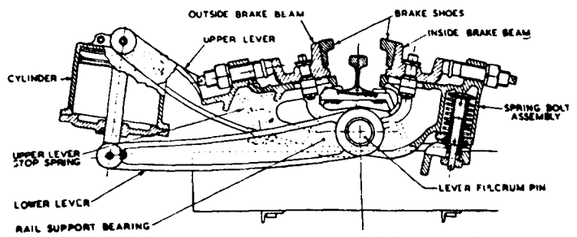
By a Technical Correspondent

(Exclusive to " The Indian Railway Engineer ")

ELECTRO-PNEUMATIC RETARDERS AND CENTRAL CONTROL

IN the report of the British Transport Commission on the modernisation and re-equipment of British Railways, attention is with reason paid to the subject of marshalling yards, the importance of which, in the cutting down of transit times and consequent economy in freight costs, is fully acknowledged. Adoption of plan involves resiting and modernisation on a very large scale, visualising as it does the construction or reconstruction of 50 yards and the closing of 150 existing yards.

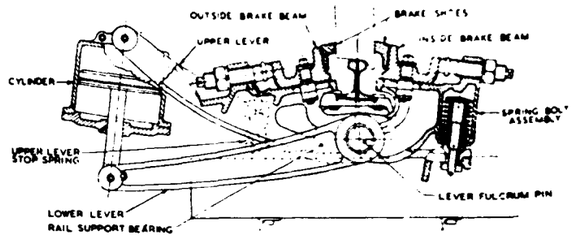
The new ones will be of the gravity siding type, with suitable gradients to give the appropriate speed to the wagons, defining appropriate speeds as the maximum speed at which full control over wagon movement together with requisite point clearance between 'cuts' can be obtained. This involves the provision of power-operated points and wagon retarders, all preferably operable from a central position.



Cross-section of the electro-pneumatic retarder in the open position

The initial cost of a yard mechanisation scheme and the running costs of the finished yard are so dependent upon the arrangement of track layout and gradients, that it is obviously important that the various equipments shall be correctly related in order to ensure maximum efficiency and economy. The usual method is for incoming trains to be propelled from the rear, to the summit of the hump, at the same time the wagons are uncoupled into "cuts" of single or several wagons, which then run down the farther side of the hump into the classification sidings, and thence to departure sidings from which the newly made up trains start.

It is, of course, desirable that the yard if possible be so arranged that vehicles arriving in the reception sidings may pass over the hump to the classification sidings, thence to the departure sidings, without shunting, and finally to the main line without crossing opposing traffic. It is also preferable that the classification track should be arranged on the "balloon" rather than the "ladder" principle. This ensures a symmetrical division from first pairs of points below the hump, often called the "King", "Queen" and "Jack" points to the siding selection points.

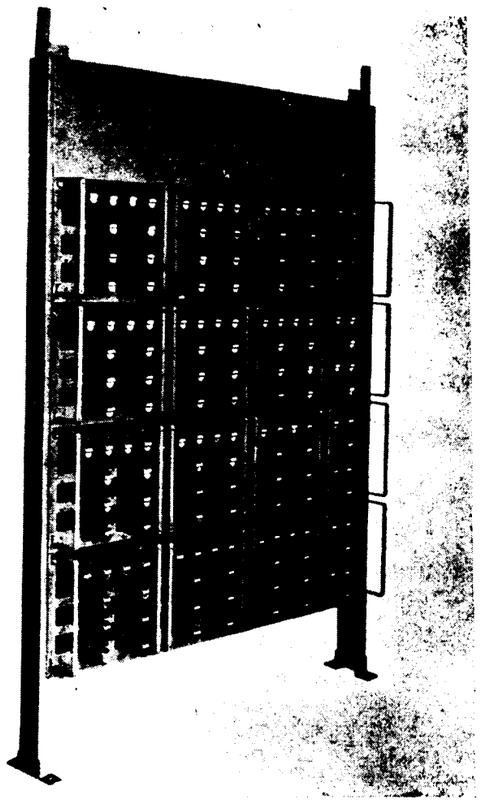


Cross-section of the retarder in the retarding position which may be compared with that of the open position shown above

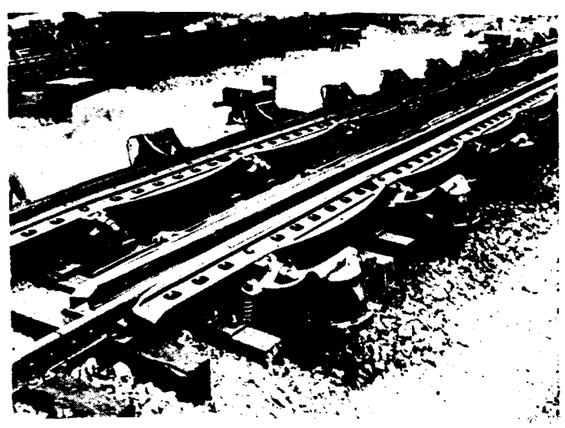
A point to be considered also is the vertical curve of the hump, and this, for the short type of English wagon should approximate to 10 chains, but the type of locomotive in use must also be considered, and a larger radius may be necessary, or a short length of level track may join two short vertical curves. The gradients selected would, of course, depend largely on the running characteristics of wagons and the length of yard.

IDEAL LAYOUT

The ideal arrangement of track layout, gradients, and retarders would be such that the time required for handling wagons from the hump summit to the clearance point is the same for each regardless of its weight or rolling condition. In practice the speeds must be controlled so that a very free running wagon does not close up on the preceding one in the switching area, and also that it will run as far as possible, and at a suitable speed, into one of the classification sidings, and to close up on the newly formed train. To ensure precise control of speeds, retarders are necessary, and to obtain a close headway between "cuts" route control of points is practically essential if manpower is to be kept at an economical level. There is a number of different types of control systems in use at present, but, after considerable experience, the modern tendency is towards the use of electro-pneumatic retarders, and route control of points.



A specially constructed relay rack.



One of the electro-pneumatic retarders which have been standardised by the S.N.C.F.

Electro-pneumatic retarders are very extensively used in the numerous marshalling yards in the United States, and they are standardised on the French National Railways (S.N.C.F.) where over 70 are now in service. The type selected by the French is the product of the Compagnie des Freins et Signaux Westinghouse, the English equivalent being the Westardair manufactured by Westinghouse Brake and Signal Co., Limited. This operates on the "nut cracker" principle and the accompanying drawings show a cross-section of one of the units from which retarders of any length can be built up. It will be seen that the unit consists of an air cylinder, the body and piston rod of each of which are connected to two levers, and so arranged that when air pushes out the piston rod two brake beams carrying brake shoes are moved towards each other in such a way as to grip the wheel of a wagon. This direct action between air cylinders and brake shoe will of necessity be smooth and flexible as well as powerful, while the unit construction enables retarders of any length to be installed and so offers a means of varying the maximum retarding force to suit local conditions of layout or type or weight of wagons.

The design is such that the grip of the shoes on the wheels in unaffected by wheel width, while the flexible method of beam connection enables the grip to be maintained even if the wagon is rocking on entry. The unit construction also enables these retarders to be installed on curves if required, and as the only metallic connection between the retarder units on the two rails is the air pipe connection, by adding an insulation to the latter, track or rail circuits can be taken through the retarder.

SPEED CONTROL

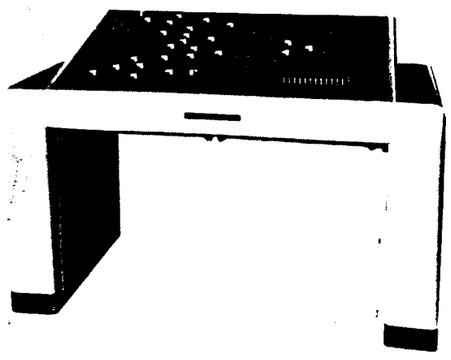
The retarder speed control system can also be used. In this each retarder can be set, by push buttons on the control desk, to predetermine the speed at which wagons leave the retarder and up to six different speeds can be arranged. This system reduces time and attention required in controlling retarders, and is particularly useful when automatic route setting is employed, as the retarder controls may be located in the point control desk. The combination increases the effective capacity of the operator. Point and route setting is also done by thumb switches for individual operation, or push buttons for route setting on a control desk, two systems of route setting being generally available. The first is the route-unit system by which one route at a time is set up, and the second the route storage system, in which, as the name implies, the operator can operate his push buttons in quick succession and set up and store routes for the desired number of "cuts". The advantage of this system, particularly if the retarder controls are mounted

on the same control desk, is that the operator after setting his routes can attend to the operations of the retarders.

Typical modern control desk, supplied for the Alameda marshalling yard of the Chilean State Railways by Westinghouse controls 25 routes. The points controlled from these panels can be either of the electric or electro-pneumatic types. It is generally found that the latter is more suitable as it is quicker in operation, simpler and more robust, and when electro-pneumatic retarders are already in use, the presence of air mains considerably cheapens first cost. Further, the e.p. valves controlling the point cylinders require only a very small operating current and can be worked over standard relay contacts.

SPECIAL RELAY RACKS

It will be appreciated that control and interlocking circuits necessitate the use of a considerable number of relays. These generally are of the plug-in type rendering replacement an easy matter. They are usually carried in specially constructed relay racks, which can conveniently be factory-wired, and so greatly facilitate and cheapen installation.



Control desk for the Alameda yard in Chile.

Although in the past mechanisation of marshalling yards has not been carried out in this country on as large a scale as it has been abroad, much development has been and is being made and the future will no doubt bring to light new methods, more than probably in the field of electronics, which will automatically effect much of the control normally carried out manually by an operator.—"Modern Transport", London.

Development of the individual axle drive for bogie-type Diesel hydraulic locomotives

By Dipl. Ing. Heinrich Herrmann, Essen

IN 1942, Fried. Krupp Lokomotivfabrik supplied one Diesel hydraulic locomotive with a total horse power of 2,000 H.P. to the Norwegian State Railways. It was the result of a 20 years study of the mechanical and electric transmission systems, and on the basis of this study it was dicided to design Diesel hydraulic locomotives.

In a similar manner to steam locomotives, all these locomotives were built with a rigid frame, the axles being driven by connecting and coupling rods and one or two jackshafts. Thus the a/m locomotive for Norway was built with axle arrangement 1-B-B-1 (2-4-4-2), each pair of driving axles being driven by one of the two Diesel engines, through its own KRUPP hydraulic transmission of the Lysholm-Smith type, and jack shaft. The locomotive was equipped with carrying axles, provided to facilitate the negotiation of curves. The distribution of the driving power on two engines each driving two axles represented an individual drive for each axle.

In keeping with the bogies with individual axle drive for electric locomotives, this design was also adopted for Diesel electric locomotives, particularly in the United States of America. As a result of the studies made by Fried. Krupp Lokomotivfabrik during the past years, Diesel hydraulic bogie-type locomotives were built with a genuine individual axle drive. The locomotives is driven by the Diesel engine, mounted on the main frame, via the hydraulic transmission, and cardan shafts which transmit the power to the bogie axles which are not connected together mechanically.

Compared to the electric power transmission where the nose-suspended traction motors cause a high axle load, the axle load is considerably lower with our axle drive and consequently a lower weight of unsprung masses was obtained. This resulted in substantially reduced stresses on the structure, improving the running properties of the locomotive.

The following is a description of a 1200 HP Bo'Bo'Bo' type Locomotive designed in accordance with this procedure and supplied early in 1953 to the Algerian Railways (Fig. 1).

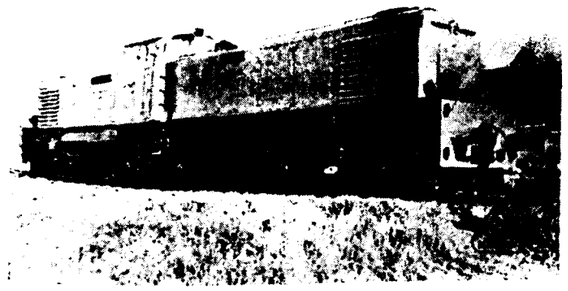


Fig. 1 1220 HP Diesel hydraulic locomotive axle arrangement Bo'Bo'Bo' for Algiers.

The chief characteristics of this locomotive are as follows :

gauge	4'-8½ to 3'-3 3/8"
diameter of driving wheels	3'-3 3/8"
bogie wheelbase	7'-10"
distance from pivot to pivot	2×19'-8"
total wheelbase	47'-3"
total length (buffers included)	60'-3"
maximum width	9'-1"
maximum height	13'-3"
continuous engine rating	2×550 = 1100 HP
one hour engine rating	2×610 = 1220 HP
maximum starting tractive effort abt.	48500 lbs
service weight	163142 lbs
axle load	27550 lbs
maximum speed	50 mph

The locomotive is of the articulated type carried on three 2-axle bogies. The frames of the two sections are supported on the centre bogie. Each of the two sections of the locomotive carries under a hood the Diesel engine, main transmission gear, cooling system and all auxiliary equipment required for the Diesel engine and for the operation of the locomotive. All this equipment is rigidly mounted on the locomotive frame. The driver's cab is arranged on one of the two sections of the loco above the centre bogie. The bonnets of the two power compartments being lower than the driver's cab, a good view is offered in both running directions. From the main transmission gears, all bogie axles are driven by means of cardan shafts.

The arrangement of the whole power plant can be seen from Fig. 2.

The two engines are four-stroke MAN Diesel engines of type W6V 22/30 supercharged by means of an exhaust-gas turbo blower. The Diesel engines develop a continuous rating of 550 HP each at 900 RPM and a one-hour rating of 610 HP each at 1000 RPM. They are water-cooled and are started by means of compressed air. The power of each Diesel engine is transmitted from the crank shaft via an elastic coupling on to a step-up gear, which drives three hydraulic torque converters running at higher speed. The hydraulic transmissions (Fig. 3) are KRUPP hydraulic torque converters, fitted with 1/pump blades. These blades can be moved in such a way that they form a closed ring. In this case, the circulation of the converter liquid, being a thin fluid oil, is stopped and no transmission of power takes place. If the engine speed is reduced to about 500 RPM., the transmission runs idle and it is not necessary to empty the hydraulic torque converters. Consequently the transmissions are at once ready for starting again and they work instantaneously when the blades are opened from the cab by means of the control instruments. It is left to the discretion of the driver, to start rapidly or slowly, with a high or low tractive effort, as may be required by the operating service. During service, the blade position of the pump wheels is automatically changed and adapted to the various circulating conditions, existing at different running speeds due to the various speeds of the turbine wheel. As a consequence, a wide speed range with a good efficiency is obtained so that for the maximum running speed of 50 mph (Fig. 4) the use of only two speed stages will be required.

The loads the locomotive is capable of hauling will be seen from Fig. 5.

Each hydraulic transmission has its own spur wheel speed change and reverse gear which are all accommodated in the same welded housing which is rigidly mounted on the main-frame between the bogies.

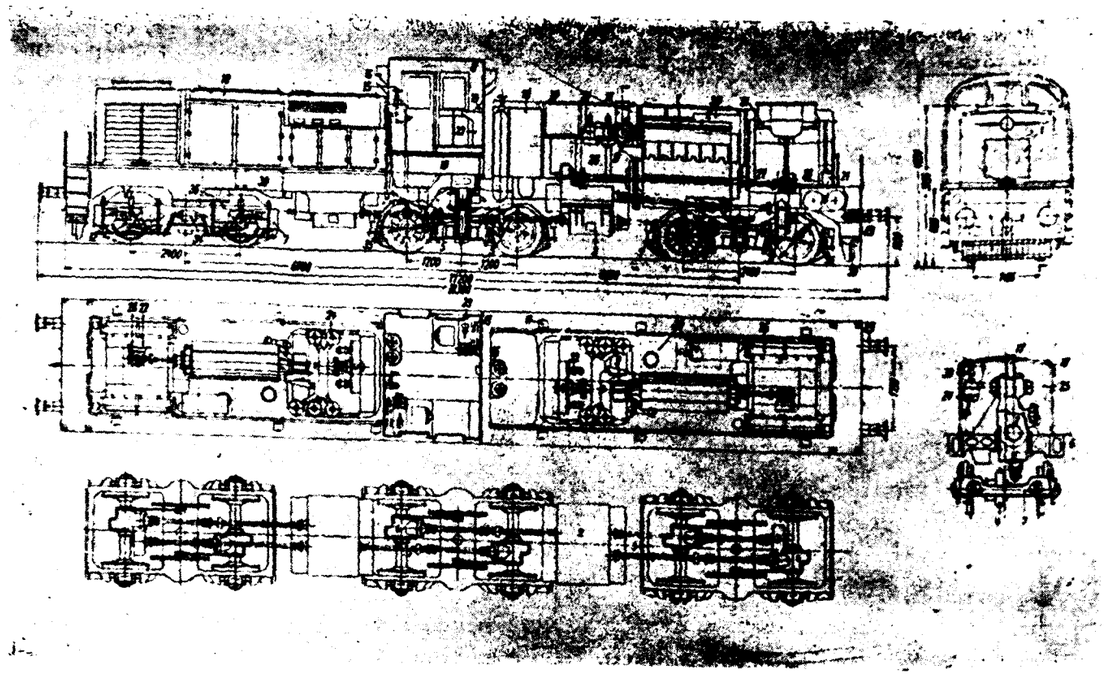


Fig. 2. Sections of the 1220 H. P. locomotive.

(1) Diesel engine (2) Main transmission (3) Intermediate gear (4) Axle gear (5) Driving and interemdiate shafts (6) Frame (7) Bogie (8) Driver's cab (9) Supercharging blower (10) Engine hood (11) Sand box (12) Sand pipes (13) Hand brake (14) Compressed air reservoir (15) Starting air bottle (16) Screen (17) Exhaust (18) Fuel tank (19) Control panel (20) Speed indicator (21) Battery (22) Lighting dynamo (23) Driver's stand ventilator (28) Fan drive (29) Draw and buffer gear (30) Water tank (31) Fan (32) Compressor (33) Rail guard (34) Brake cylinder (35) Brake shoe (36) Bearing spring.

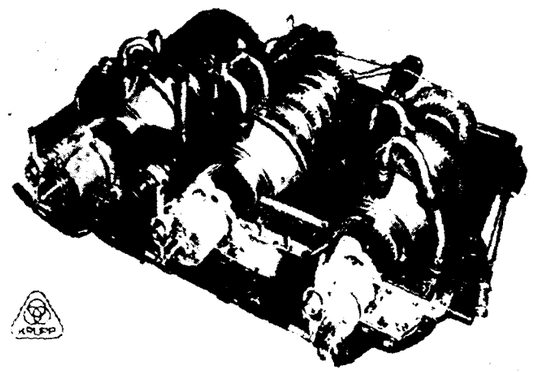


Fig. 3 KRUPP hydraulic transmission for the 1220 HP Diesel locomotive, without casing, on the test bed.

The change speed and reverse gear form the reduction gear which has three secondary shafts carried in supporting bearings fixed on the main-frame, two of which lead to the adjacent outer bogie and one to the centre bogie. The elevated shafts leading to the outer bogie are in connection with an intermediate gear also fixed on the main-frame and from which the inner axle of the bogie is driven by means of a cardan shaft and an axle gear. The outer axle is driven from the inferior shaft of the supporting bearing also by means of a cardan shaft and axle gear. The third shaft leading to the centre bogie passes above the axle of this bogie adjacent to the main transmission gear and drives the far axle. The result is that the cardan shafts, which have to take up the vertical movement of the axle as well as the rotatory movement of the bogies, are arranged symmetrically to the pivot, thus maintaining uniformity of rotation. All drives are obsolutely independent of each other, so

that differences in rotation of each shaft due to wear on driving wheels caused by negotiating curves etc., will be compensated by the individual hydraulic torque converters. This compensation is wide enough to permit the use of axles having tyres with substantially varying diameters.

This transmission of power, therefore, represents a genuine individual drive of each axle as is the case with electric transmission.

The change from one speed stage to another automatically occurs according to the running speed. The reverse gear is shifted by means of dog clutches, but this can only be done however during standstill of the locomotive. All change gear parts are contained in the main transmission gear thus dispensing with control rods to the bogies.

The power regulation of the locomotive from the cab as well as the regulation of the blades of the transmission is effected by a single lever. The pump blades inside the transmission are automatically regulated in the following manner:

According to the hydraulic law of the converter, the primary torque of which increases with the square of the pump wheel speed, a pre-determined amount of fuel is fed to the engine cylinders for any engine speed selected by the driver. Therefore the engine can transmit torques, which are in relation to the primary torque of the transmission at a corresponding engine speed. Should the actual amount of fuel adjusted by the engine regulator deviate from this pre-selected value, a control device is operated which automatically alters the pump blade position so that the actual amount of fuel delivered to the engine will be in accordance with the pre-selected value. The engine and hydraulic torque converter are then working with their optimum combined efficiency. At the same time, this automatic control device protects the engine from overload, as the amount of fuel can never exceed the pre-determined amount.

On the control desk are situated the power regulation lever, and next to it, the forward-and-reverse lever. These are interlocked so that the direction control lever can only be moved when the power lever is at idle running position. Conversely the power lever can only be moved when the direction control lever is in its

Tractive effort curves 1100 HP for 450 m altitude and for an ambient air temperature of 20° C

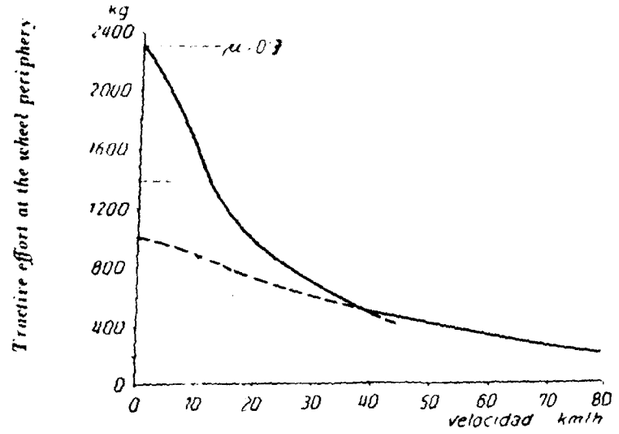


Fig. 4 —

Fig. 4 Tractive effort curves for the 1220 HP Diesel locomotive

forward or reverse position. In addition to these 2 levers there are controls for air pressure and vacuum brakes and the usual engine control dials. There are 2 control tables in the cab arranged diagonally opposite each other, for each travelling direction. The two engines have common pneumatic controls but can be driven individually or together as desired. The reverse gear control also operates pneumatically. The temperatures and oil pressures of Diesel engines and hydraulic transmissions are shown on gauges and tell-tale indicator

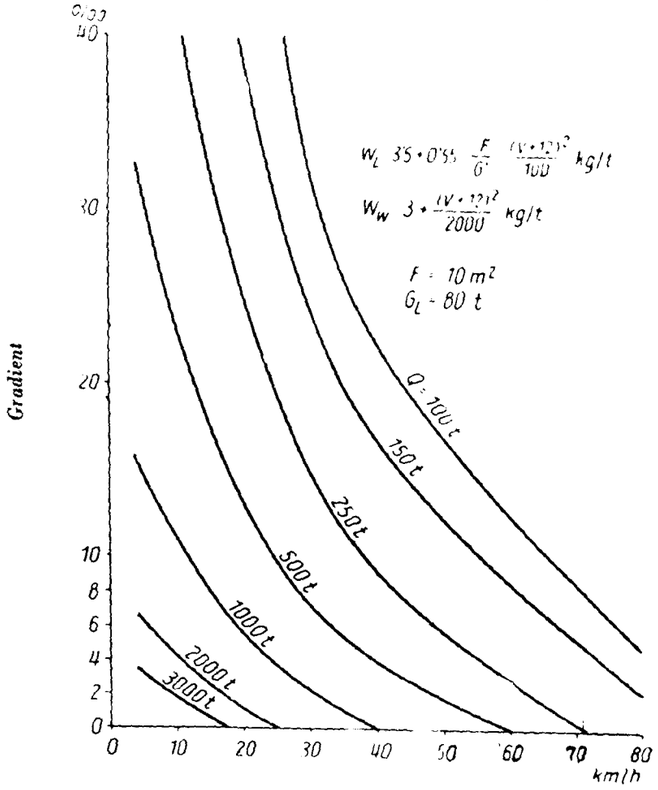


Fig. 5 Load curves for the 1220 HP locomotive.

lights are also fitted. The Diesel engine speeds are indicated electrically.

For the electric lighting each plant is provided with a dynamo and a 24 V battery. No other electrical equipment has been provided. Thus, the controls and electrical equipment are as simple as possible.

The ventilaters for the cooling systems provided at each end are mechanically driven from the free shaft end of either Diesel engine. The power is transmitted via an elastic coupling on to an auxiliary transmission gear driving the cooler fan by means of a turbo regulating coupling Due to the effect of a thermostat actuated by the engine cooling water, the terbo-coupling regulates the speed of the fan in such a way that the cooling water temperature is kept constant. The regulator has been arranged in such a way that in case of need, the maximun ventilator speed and hence the maximum cooling effect will be obtained with engine speeds of about 800 RPM and will be maintained up to the maximum engine speed of 1000 RPM.

The various auxiliary drives, such as the compressor for the compressed air brake, the vacuum pump for the train brake, and the lighting dynamo, are driven either from the step-up gear or partly from the ventilator gear by means of vee-belts.

The main frame, the bogie frames and the superstructure are electrically welded. The bogies are interchangeable.

The locomotive is designed to carry the following:

fuel	880	Gallons (imp. Gallon)
Lubricating oil	44	Gallons
cooling water	132	Gallons

thus enabling it to run long distances without refuelling or taking on water.

RAILWAY OFFICIALS' GAZETTE

COMMENCING with the year 1954, the Railway Board have instituted two annual awards for the best and second best articles respectively published during a calendar year in the Indian Railway Technical Bulletin. A committee of judges comprising the Director Research, Director Mechanical Engineering and Director Civil Engineering have announced the following awards for the year 1954 :

First Prize Rs. 200/- was awarded to Shri Gurdial Singh A. M. I. E., A. M. I. Struct. E.Executive Engineer (Survey), Northern Railway for his article entitled " *Culverts in High Fills* " which appeared in the Indian Railway Technical Bulletin No. 115, November 1954 issue.

Born in 1905, after passing the Matriculation examination in the 1st division he joined Civil Engineering School, Lucknow. He was elected to Associate Membership of the Institute of Structural Engineers, London, in 1932 and has been an associate member of Institute of Engineers (India) since 1949.

Appointed in the Design Office of the former North Western Railway he was during the course of his early service responsible for the design of many important buildings, bridges and steel structures; on the ex. E. P. Railway he was employed on the survey in connection with provision of rail facilities for the new capital of the Punjab and on the Mukerian-Pathankot Railway construction. He has contributed several articles to the Quarterly Technical Bulletin and the Proceedings of Punjab Engineering Congress.

Shri S. C. Vadera.

Shri Gurdial Singh.

Second Prize Rs. 100/- was awarded to Shri S. C. Vadera, Production Engineer, Central Railway, Locomotive Workshops, Parel for his article entitled 'An Appromixate Analysis of Static Stresses and Deflections in an I. R. S. Carriage Underframe, modified for Air-conditioned Coach' which appeared in the Indian Railway Technical Bulletin No. 114, August 1954 issue.

Born on 17th March 1927, he passed Senior Cambridge in 1942 and Inter Science in 1944 both in the 1st division. In 1945 he joined the railways as a special class Apprentice at Jamalpur and stood first in the final year in his batch. He was posted as Assistant Mechanical Engineer on the ex. G. I. P. Railway in 1950, and also worked as an Assistant Works Manager in the Matunga Workshops. He was awarded a Scholarship under the Industrial Co-operation Scheme and received 15 months training in Locomotive Engineering in West Germany recently. For sometime he was posted as Personal Assistant to Chief Mechanical Engineer, Central Railway. His hobbies are photography and carpentry.

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