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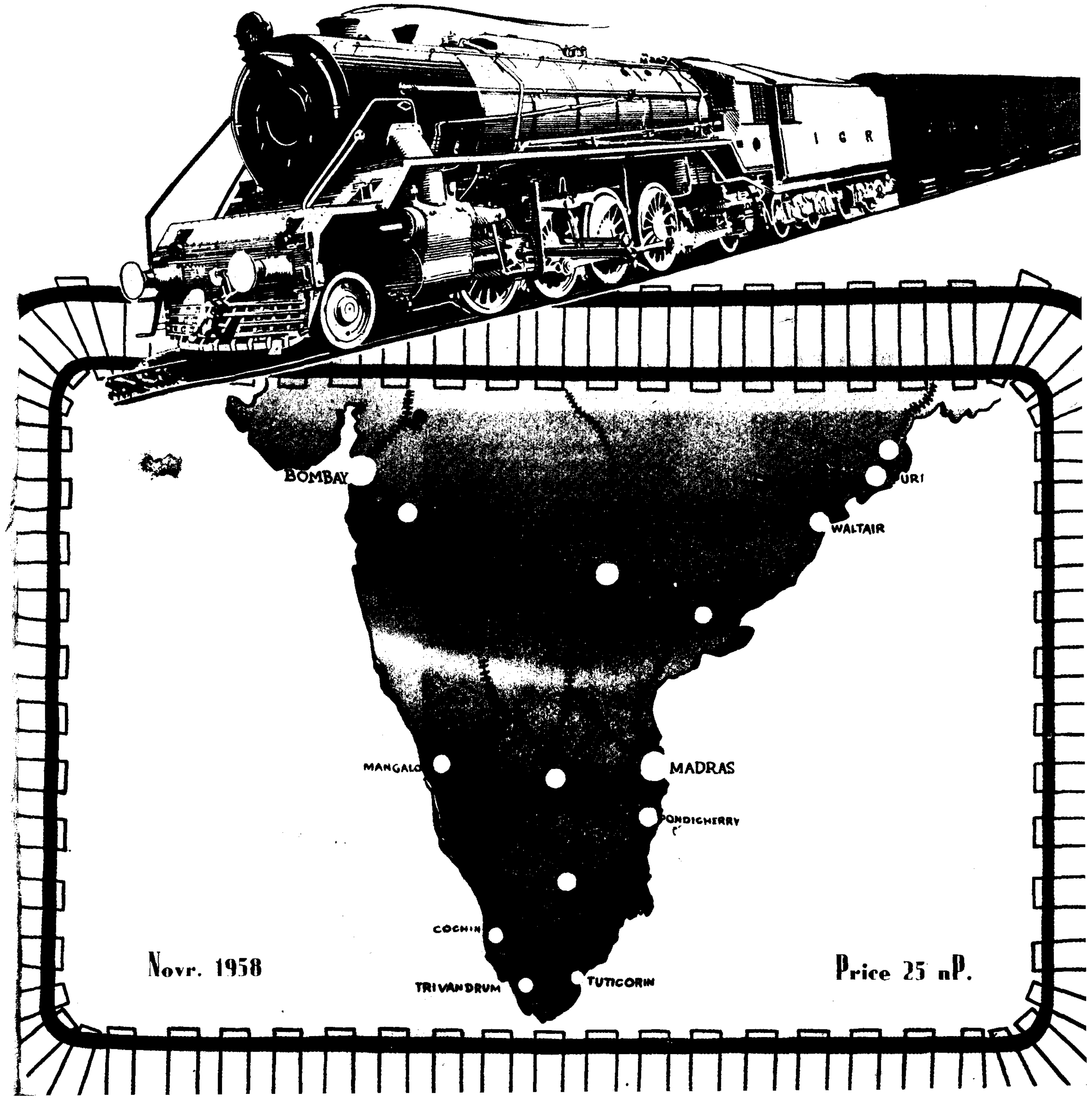

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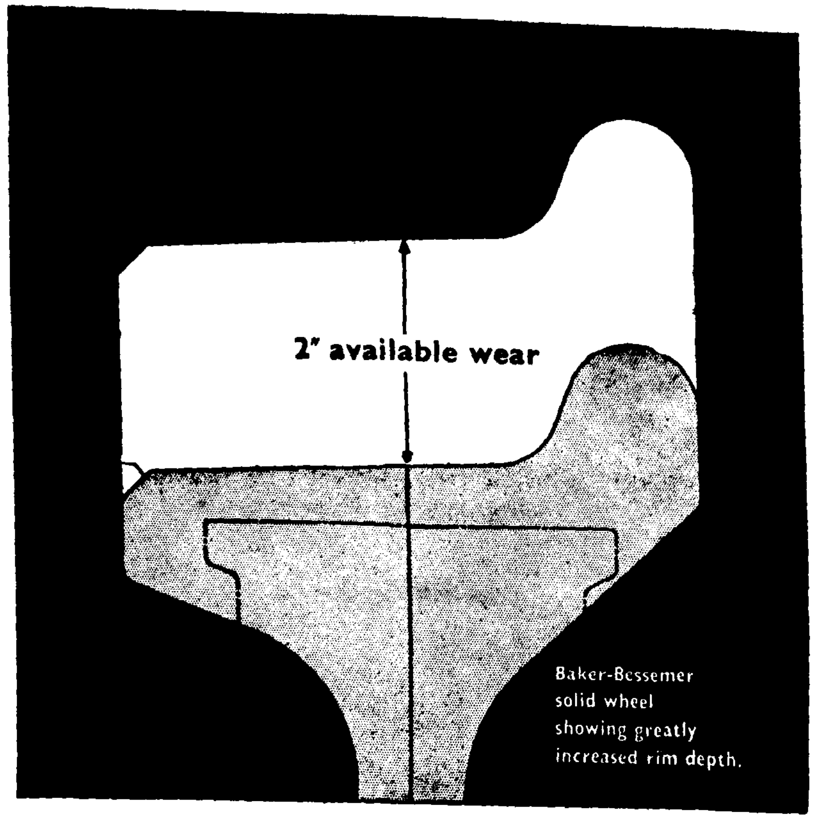

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New G-E Locomotive Design to haul Heavy Ore Loads Down Steep Grades

A new locomotive design has been developed by General Electric's (U. S. A.) Locomotive & Car Equipment Department for mines with steep downgrades leading away from the mine face.

The new design was incorporated in a specially-built locomotive for a G-E customer, but spokesmen for the company say that, where space is available, G-E's existing equipment can be adapted.

Chief feature of the new design is four sets of brakes—dynamic braking with the locomotive motors, standard air brakes, a special electro-magnetic brake, and manual parking brakes.

Normally, according to G-E, the maximum expected braking on tandem 27-ton locomotives with a combined weight of 54 tons would be roughly 27,000 pounds. The new design, however, can develop a braking effort in excess of 54,000 pounds.

With this extra braking, the locomotives are capable of safely hauling as much as 150 tons of ore down a grade averaging 6.5 per cent. This means a gross train weight of approximately 215 tons excluding the locomotive.

The extremely high braking effort available not only permits the locomotives to keep the train under control, but also enables them to stop it in a relatively short distance should an emergency arise.

Actual operating results in a mine have demonstrated the unusual capabilities of the locomotives. They have stopped a train of four loaded cars, weighing a total of 250 tons including the locomotive, moving down an 8 per cent grade at 8 miles per hour using only the locomotive brakes. Moreover, this was accomplished automatically without an operator at the controls, and the train was brought to a complete halt within 30 feet.

These locomotives permitted one mine to reach an ore body which for years had been considered unworkable because of the expense involved, not only in reaching the ore, but also in hauling it out and down 1800 feet of six per cent grade with a near—"U" turn at the bottom.

Ordinary locomotive brakes could not provide the margin of safety necessary for the loads that had to be hauled. To meet the need, a standard swivel-truck mine locomotive was modified by incorporating magnetic track brakes, two on each truck, giving a total of eight for the tandem locomotive.

The ore pocket at this particular mine was located 340 feet above the dumper, and the haulage way was approximately one mile long. This meant an average grade of 6.5 per cent, with some stretches over 8 per cent.

Because the run to the dumper was so short and all down grade, it was imperative that the train be under complete control. A runaway would certainly have been destructive to the rolling stock, the track, and possibly to the dumper itself. Moreover, the lives of people working along the right-of-way, on the locomotive, and on the dumper would have been jeopardized.

Not wanting to use cable hoists or dragging anchors, the customer and G-E worked out the magnetic brake system, which did not increase the locomotive's weight and did not run the risk of wheel slide. This system is roughly similar to one developed years ago for street cars.

Unlike street cars, however, these locomotives use track brakes in regular service rather than as an emergency or parking brake.

The magnetic brakes on street cars are usually operated from a 32-volt battery. For the locomotive application, the power had to be furnished from some other source during a service brake application in order to insure good battery charge at all times to take care of emergencies. Also, to keep brake shoe and track wear to a minimum, the current in the brake coil had to be varied according to the braking need.

To meet these requirements, a scheme was devised to supply the magnetic brakes from the energy being pumped into the resistors when the locomotive was running in dynamic braking. The required variation in the excitation current on the track brakes, was obtained by simply connecting them in parallel with the dynamic braking resistors.

As each notch of the braking controller increases the dynamic braking effort, the power pumped into the resistors increases and thus increases the excitation on the track brakes.

To further conserve the track and the wearing faces of the shoes, the track brakes are not applied on the first two steps of dynamic braking. On the third step the track brakes are connected and excitation is then increased with each step.

To prevent wheel slide, the air brakes are interlocked so that they cannot be applied during dynamic braking. Since loss of dynamic brakes due to wheel slide would also cut the power supplied to the track brakes, preventing wheel slide is mandatory.

As an emergency safety feature the locomotives are equipped with a foot switch and a tip-up controller handle. When released, these place the track brakes directly across the battery. In addition, battery power also operates a magnet valve to give a service air brake application.

While the addition of track brakes means more maintenance items on the locomotives, the benefits derived from the extra braking provided far outweigh the slightly greater first and maintenance expense, G-E believes.

The same scheme can be employed on any new mine locomotive that will have to work on extremely heavy grades. Older locomotives having a long enough wheel base to accommodate the brakes can be equipped in much the same manner, although some of the convenient control features may not be available.

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CO-OPERATIVE STORES ON RAILWAYS

There are 119 co-operative stores working on the Indian railways with a share capital of Rs. 8,98,420, said Shri Shah Nawaz Khan, Deputy Minister of Railways, in a written reply to a question by Dr. Shrimati Seeta Parmanand in the Rajya Sabha.

The Deputy Minister laid a statement on the table of the House showing the number of co-operative stores and their share capital according to various railway zones. There are 23 co-operative stores working on the Western Railway; 21 on the Central Railway; 19 on the Eastern Railway (including the Chittaranjan Locomotive Works): 17 on the Southern Railway (including the Integral Coach Factory stores); 15 on the Northern Railway; 14 on the South-Eastern Railway and five each on the North-Eastern and North-East Frontier Railways.

The Deputy Minister replied in the negative to a question whether the stores were a profit making concern. The Deputy Minister said, "The main object of these stores is not to make a profit, but to provide service to their members by way of supply of essential requirements at reasonable rates. The surplus income that they derive through the business is distributed to the members by way of dividend on shares and rebate on purchases, after setting apart a statutory minimum towards the Reserve Fund."

RAILWAY BOOK-STALLS

There is no proposal at present to open departmental book-stalls at railway stations, said Shri Shah Nawaz Khan, Deputy Minister of Railways, in a written reply to a question by Dr. Shrimati Seeta Parmanand in the Rajya Sabha.

The Deputy Minister said that there were 367 stations throughout the country which had book-stalls. Of these Messrs. Wheeler & Co. had book-stalls on 240 stations. There were 101 stations having book-stalls on the Southern Railway; 65 on the Central Railway; 56 on the Western Railway; 51 on the Northern Railway; 30 on the Eastern Railway; 29 on the North-Eastern Railway; 22 on the South-Eastern Railway and 13 on the North-East Frontier Railway.

Methods of Improving Utilization of Motive Power

By G. T. Bevan

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THE greatest single contribution to the economic operation of the world's railroads during the past half century has been the development of the diesel-electric locomotive.

In the diesel-electric locomotive, railroads have available a motive power unit with inherently different characteristics than those possessed by the reciprocating steam engine. However, these advantageous characteristics must be thoroughly understood and fully utilized in order to realize maximum benefits from dieselization.

To begin with, the combination of the diesel engine and the traction generator makes constant horsepower available over a wide range of locomotive speeds. This means hauling more profitable pay loads at higher speed. This can prove so beneficial in actual operation that it permits a new approach to the problem of locomotive dispatching. Many railroads switching to diesel-electrics have found that they can double the annual locomotive mileage formerly obtained with steam engines.

This increased mileage, plus the ability of diesel-electrics to produce more gross ton miles per train hour, can lead to a reduction in the number of motive power units in service. This will, of course, lower operating costs. The net result is that diesel-electric locomotives can do one-third more work per day at approximately one-half the cost of steam locomotives for the same operation.

FULL UTILIZATION IMPORTANT

Statistics show that 50 per cent of all railroad operating costs revolve around the utilization and maintenance of locomotives. Moreover, the characteristics of the motive-power in use have a large influence on the amount of rolling stock, and the number of tracks, yards and terminals required. In fact, to a large degree the entire economic life of the railroad industry depends upon the type and number of motive power units it uses in conducting its business.

In the early stages of dieselization little effort is generally required to obtain relatively high motive power utilization. Operating advantages and savings are so attractive that the diesel-electrics are worked to the fullest possible extent. Practically any assignment where these new locomotives are in use 24 hours per day shows their economic advantage over steam.

As dieselization progresses this picture changes. The new motive power can no longer be assigned exclusively to 24-hour duty; therefore, its economic advantage over the steam locomotive becomes less marked. Evidently means must be found to increase motive power utilization if the diesel-electric is to continue replacing the steam engine with the same economic results.

Motive power utilization has been greatly simplified with the recent introduction of the "universal" or road-switcher type locomotive. The construction and operating characteristics of this locomotive have been deliberately selected to make it capable of performing all three types of service: freight, passenger and switching. Operating experience in several countries has already demonstrated its success.

In addition to its flexibility, the "universal" design has other economic advantages. The initial cost of this type of locomotive is approximately 12 per cent lower than that of the road type, or commonly called "box cab" type diesel locomotive of comparable horsepower. Maintenance costs are also lower, often by 10 to 15 per cent.

NEW CONCEPT NEEDED

At the outset, this new form of motive power has been generally regarded simply as a substitute for the steam locomotive. This has necessarily limited the development of the diesel-electric's potential capabilities. In many instances division terminals and territories set up for steam locomotive operation are still in use. Consequently, there is some danger that the superior performance of the diesel-electric may be hampered by boundaries established earlier to meet the limitations of steam locomotives.

The entire scheme of railroad operations—including yard and terminal facilities, track capacities, and methods of train dispatching—should be analyzed to determine its suitability for diesel-electric operation. Only as this new type of locomotive is freed from the shackles of the steam locomotive's limitations can its potential capabilities be fully realized in terms of productivity and earning capacity.

With the advent of the "universal" or road-switcher type of locomotive, railroads have a motive power tool with which they can do a highly efficient job. Units of this type can be held in locomotive "pools", available for any service as required. For example, a single 1500-hp. road switcher locomotive unit can be used to replace a 1000-hp. yard switcher or a 1500-hp. road freight locomotive main line service, through the simple expedient of pooling the assignments and planning a cycle of operation with the purpose of using one locomotive for both jobs. Experience has indicated that, where operating conditions permit, greater motive power utilization can be obtained by operating a "pool" of road-switcher or "universal" type locomotives for all classes of service.

These economies can be further improved by arranging locomotive assignments so that all units operate on a cycle basis. Under this system, locomotives return to a common maintenance point for inspection and repairs after completing their tours of duty. The length of time and mileage they cover between inspections is determined by a routine schedule worked out by the operating department. In arranging such schedules an effort should be made to make sure that all units accumulate approximately the same mileage between inspections.

Under such a system, a locomotive might spend three days covering the thousand miles between points A and B and back. After the first thousand miles, it would be inspected. It would then spend three more days covering the thousand miles between point B and C and back. It would then be inspected and so on cycling back and forth through point B, the maintenance station. During its two three day runs on either side of point B, it would be regularly scheduled for various duties which can include passenger, freight and switching service.

This type of operation has several advantages. One of the most important has to do with terminal layovers. When locomotives are operated on a cycle system with maintenance being done at a central point, it is possible for them to be ready for reassignment to other duties in as little as ten minutes after arrival at a terminal. This means that fewer locomotives are required. Consequently, not only is the rate of return on total motive power investment higher, but operating expenses are reduced because there are fewer locomotives to maintain.

The cycle operation with its common maintenance point has resulted in a new concept of locomotive maintenance: centralized inspection and repair. This can result in further operation economies through the discontinuance of steam engine houses and associated facilities no longer required.

Utilization of locomotives is a phase of railroading that is now being recognized as a major component of economical operation. The high availability of the diesel-electric has permitted utilization that was not practical even with modern steam locomotives.

The difference between the terms availability and utilization as used of locomotives, can be seen from their definitions. Availability is the time a locomotive is available for service, expressed as a percentage of total time. For example, if a locomotive is in the shop for inspection and repairs two hours out of twenty-four, the availability is $\frac{24-2}{24}$ or 92 per cent. The availability of diesel-electric varies from 86 to 95 per cent. Utilization is the time a locomotive is actually in operation, expressed as a percentage of total time. For example, a locomotive is assigned to switching duty for 8 hours and then to road service for 12 hours. It is in use 20 hours out of 24, therefore, the utilization is $\frac{20}{24}$ or 83.2 per cent.

One thing affecting locomotive utilization is non-revenue service. Needless to say, this should be kept to a minimum. Wherever possible, the units should be scheduled to work in revenue service when travelling to and from maintenance points. The use of diesel-electric locomotives on work trains should be avoided except in cases of absolute necessity. Maximum use should be made of off-track equipment, thus reducing the need for work trains.

High locomotive utilization is not necessarily limited to the large transcontinental railroads of the United States, which enjoy exceptionally long-haul traffic. In fact, many smaller railroads with short hauls have done an outstanding job in this respect, sometimes operating diesel-electrics over five times the daily average mileage formerly run by steam.

CANADA'S MINERAL RESOURCES

CANADA's Mineral production set another all-time record for value in 1957, in spite of lower prices and lessening demand combining to shrink markets and cut production of many minerals, thus reducing earnings of many companies to well below 1956, the nation's mining industry on the whole enjoyed another big and profitable year. With inclusion of petroleum and natural gas, both of which showed moderate increases, total production value of $. 2,085 million in 1956 was topped by 2.5 per cent. at $. 2,134 million.

The year 1958 will be a difficult one in some respects, with further reductions expected in many items unless the overall business picture improves materially. Yet the promised threefold expansion next year in uranium output could turn the tide and result in another all-time record for the industry as a whole for 1958.

BASE METALS, GOLD, AND COAL OUTPUT OFF

Many minerals in 1957 showed a smaller volume of output and many had their production curtailed by reduced prices. Outstanding in this category were copper, lead, and zinc, usually the industry's star performers. Worldwide expansion of production of these metals had raised their production to high levels, while demand from the consuming industries, as well as government demands for stockpiling, had fallen off. Today with more supplies available than demands can absorb, production cutbacks are widespread.

Metals declined in value to $. 1,136 million from $ 1,146 million in 1956. Prices of copper, lead and zinc fell. Gold production for 1957 was about the same as 1956 but its value was reduced by about $. 2 million due to the premium on Canada's dollar cutting the price.

Other metals show a combined reduction of production amounting to some $ 5 million, while non-metallics production value showed a gain of some $ 7 million.

The value of coal production suffered another $ 5 million drop due to the further inroads of competition from other fuels and to the lessening demands from industry generally. Fuels other than coal showed a gain of $ 42 million, and structural materials gained $ 15 million.

URANIUM, ASBESTOS, AND NICKEL BETTER

Canada is established as one of the world's top uranium producers and has the advantage of fixed-price sales contracts with the government. Since few of the contract mines are yet in full production, Canadian output will increase sharply during the next two years. Output has jumped to some 12.9 million pounds, worth $ 131 million in 1957 from $ 46 million the previous year and by mid-1958 will be established at a rate exceeding $ 300 million yearly.

Iron ore continued to grow in importance and 1957 output was close to 1956 tonnage despite slackening steel activity in the United States where most of it is marketed. Prices were up 5 to 6 percent. Production in 1957 will reach a total of slightly in excess of 22 million tons with a value of $ 156 million. A few years ahead it will exceed 40 million tons annually valued at about $ 400 million.

The outlook for nickel is also encouraging. In spite of abatement of U. S. stockpile requirements, unlimited supplies will now be available for civilian industry for the first time since 1939. Nickel producers will be now able to make unrestricted sales efforts and increased usages and sales can be expected.

INDUSTRY AFFAIRS

A Delegation of Canadian Cabinet ministers conferred in Washington last fall with their counterparts in the American Administration on trade relations and voiced the alarm and dismay felt by the mining industry at the prospect of increased U. S. import duties on lead, zinc and copper. The industry will have an opportunity of voicing its views to the U. S. Tariff Commission when that body reviews the lead and zinc situations.

The Diefenbaker government announced its intention to revise the Industrial Relations and Dispute Investigations Act (Federal Labour Code), a matter of great importance to the mining industry. All uranium producers with one exception now operate under the code.

During the month-long tour across Canada last September the sixth Commonwealth Mining and Metallurgical Congress visited all the important Canadian mining camps and metallurgical centres from

Kitimat and Trail in the west through Edmonton, Beaverlodge, Steep Rock, Blind River, Sudbury, Timmins and Noranda to Schefferville in Ungava and toured the St. Lawerence Seaway. The party included some 350 visitors from 36 countries. The tour was sponsored by the Canadian Institute of Mining and Metallurgy.

METALLICS

Iron Ore

Steel producers who have been worried over an ore famine since World War II now find there is a plentiful supply, yet both prices and consumption are holding close to peak levels. Canada has climbed to fourth place behind the U. S., Russia and France: ahead of Sweden, the U. K. and West Germany. Final figures for 1957 showed its 10 producers had turned out 22 million long tons worth $ 156 million, with 1958 production pointing definitely higher.

As a result of the new trend to beneficiation and increased use of high-grade pellets of 64% iron as an ideal blast-furnace feed most big U. S. ore consumers are looking to Canada for lean Canadian ores that can give a richer pellet than U. S. taconites and jaspers.

The bulk of Canada's iron ore is exported: 13.7 million tons of the nation's 1956 production total (22.3 million tons) went across the border 2.5 million tons went to Britain, while shipments to West Germany, the Netherlands and Japan followed in that order. Canada imported 4.52 million tons in 1956, most of it going to Hamilton steel mills. In 1957 essentially the same export import pattern was followed, but with a quickening interest by West German and other European nations for high grade concentrates.

More than half Canada's production comes from the Ungava knob Lake fields. Marketing some 12.6 million tons in 1957 Iron Ore Co. of Canada should expand output to 20 million tons in the next few years. Two new producers are assured for 1958: Hilton Mines in the Ottawa Valley is readying a $ 16 million concentration plant, while Lowphos Ore Ltd., will ship concentrates from its plant near Capreol, Ont. Caland Ore Co. is continuing its huge dredging operation but will not be in production before 1959.

Canadian Charlson, near Steep Rock plans a concentration plant for a 250,000 ton production in 1959. Leading the search for low grade deposits that can be agglomerated and which promise tomorrow's big developments is U. S. Steel's Quebec Cartier Mining Co., 300 miles north of Shelter Bay on the St. Lawrence. With expenditures already reaching $ 10 million by the time production starts in 1961. It may turn out to be a 10-million ton yearly operation. Other big interests in the exploration stage include Canadian Javelin, Quebec Cobalt and Albanel Minerals.

URANIUM

Canada continues to rank third in uranium production after the United States and South Africa though it will probably assume leadership during late 1958 or early 1959. In 1957 Canada produced 12.9 million pounds of uranium oxide, valued at $ 131 million, almost a threefold increase over 1956. Canadian reserves are estimated at 225 million tons, containing some 237,000 tons of uranium oxide, compared with some 175,000 tons of oxide in the U. S., and 370,000 tons of oxide in South Africa.

There was little incentive for prospecting for new deposits during 1957. Deadlines for qualification for premium price contracts are passed and with no promise of five-year amoritization only exceptionally rich further deposits could be mined economically at present. Premium price contracts have been designed to repay capital within a five-year period which made it easier to raise the huge sums of money needed.

The need for cheap energy has forced Europe and to a lesser extent America to make use of oil gas and coal as primary fuels for producing electrical energy. Britain with less plentiful supplies has taken the lead in developing uranium-burning power plants. With demand increasing it is natural to consider possible successors to uranium but, so far, none exist.

Canadian contracts for uranium awarded to companies now producing or with plants under construction total over $ 1.5 billion. These contracts expire in 1963. Prices average around $ 10 per pound of contained uranium oxide. Eldorado has options on further production at prices equivalent to the U. S. Price of $ 8 per pound until 1966. The standard price in Canada for other than contracts calling for premium prices remains unchanged at $ 6.00. Eventual maximum rate of output from companies now in production alone is estimated at close to $ 400 million annually.

PRODUCERS

In the Beaverlodge camp, Eldorado Mines' new plant commenced production in 1957 at 500 tons daily, to be raised to 750 tons in 1958. It takes ore from Cinch Lake, National Explorations, and Cayzor Athabaska Mines. Eldorado moved treatment rate at its Uranium City plant up to 2000 tons daily and handles 150 tons daily from Rix Athabaska on a three year contract. Rayrock started a 150-ton mill at Marian River in June. The Eldorado Plant at Port Radium continued at normal production of 200 tons a day.

In the Bancroft area of Ontario, Bicroft smoothed out operations at its 1000-ton plant, while Faraday started its new plant up in April. This mill also handles shipments from Greyhawk. Canadian Dyno continued construction and will produce 1000 tons daily early in 1958.

At its Blind River plant in Western Ontario, Pronto Uranium stepped up tonnage to 1500 tons daily and is proceeding with deeper development. Algom brought its first 300-ton mill into operation in 1956 at Quirke and the second one of the same size at Nordic was operating at capacity early in 1957.

Precipitate shipments from Consolidated Denison started in June 1957 and the mill is gradually being brought up to 4000 tons daily with a target of 6000 tons daily early this year. Northspan's Nordic Lake Mill of 4000-ton capacity started production at 2000 tons in September. Its Panel Lake Mill will open late in 1958 and its 2000-ton operation at Spanish is close to production.

Can-Met Explorations' 3000-ton mill will be operating below capacity until underground work is opened up further. Stanleigh started feeding its 3000-ton mill late in 1957 while Stanrock expects to have its 3300-ton mill ready for production in February 1958. Miliken Lake Uranium will commence production at its 3000-ton mill in the spring.

NICKEL

With a slowdown in the industrial boom, slackening in defence orders, and large sale diversions of U. S. stockpile, quotas, the grey market for premium priced nickel is tapering off and producers face a struggle to regain markets lost to substitutes. Diversion of stockpile quotas, however, merely means producers may attempt to dispose of nickel contracted for by the U. S. Government to private industry. If unable to get the price they would receive from the Government the producers can require the Government to buy it at the contract price.

Canada, world's largest producer of nickel, produced close to 376 million pounds, worth $ 261.2 million in 1957, compared with 357 million pounds the previous year. This is 75.3 percent of estimated 1957 world production of some 490 million pounds. Anticipated world production is estimated at 650 million pounds by 1961. Available of this greatly increased supply may create serious marketing problems for producers, especially if defence consumption should be further curtailed, requiring a 75 per cent increase in peacetime industrial uses of nickel by 1960.

International Nickel, world's largest producer, sees the most promising field for expansion in stainless steel turbines, machine tools, corrosion resistant uses, and for chemical plants, electronics, nuclear power, missiles and space ships as well as in the hundreds of conventional peacetime uses. A vast increase in Inco's production will come from the new properties in Manitoba now under development. These are being readied for production by 1960.

Arcadia Nickel will commence production early in 1958. Another possible addition is the Gordon Lake division of Eastern Mining and Smelting near Kenora. E. M. & S. is also planning another smelter and refinery at Chicoutimi, Quebec. This smelter will treat ores from Nickel Rim, Gordon Lake, Arcadia, North Rankin and Canalask as well as ores from custom smelting from other parts of the world. During the year 1957 North Rankin Nickel mines brought its 250-ton per day mill into operation.

COPPER

Overproduction and sharply reduced prices spread gloom over the copper mining industry throughout 1957. The all-time high in tonnage production and value in 1956 of 353,293 tons valued at $ 297 million were cut sharply. Production of new primary copper in 1957 averaged some 28,000 tons monthly, off some 1,700 tons from the pace set in 1956. Production for 1957 was valued at $. 199.5 million, a drop of almost one-third.

What this means to Canadian copper mines is shown in Canada's export trade figures. Annually we export some 70 per cent of our output. In the first 8 months of 1957 we exported 37,500 tons more than in the previous year, yet we received $ 4.9 million less for it.

World production has not only caught up with demand, but has passed it by a substantial margin. Fabricators took only slightly less than the previous year's tonnage, but weakness in prices (down to 25¾ cents in October from the all-time high of 46 cents in July 1956) was the severest on record. To remedy the situation producers must develop increased consumption or cut back production neither of which is easy.

SOME NEW MINES........SOME FAILURES

While the search for new mines slowed down during 1957, Maritimes Mining opened an 1800 ton mill in Newfoundland in September while Buchans Mining Co. continued shaft-deepening operations. Heath Steele Mines began tune-up of their 1500 ton concentrator in New Brunswick. Merrill Island will start up its 650-ton plant in January, Copper Rand, Bouzan, Quebec Chibougamau and Bateman Bay are in various stages of exploration and development. Chibougamau and Bateman Bay are in various stages of exploration and development Chibougamau-Jaculet has suspended operations due to lack of ore. Beattie-Duqusene, Lyndhurst and Duvan have suspended operations.

The five month strike at Gaspe Copper Mines held off a large slice of production. Geco Mines and Wilroy Mines commenced production in Ontario, Coldstream was treating 600 tons daily. Hudson Bay Mining profits were down for 1957 though Sherritt Gordon has done better. In B. C. Woodgreen Copper is in bankruptcy, Midwest and Granby have ceased work, and Britannia is considering closing down.

LEAD

The available supply of lead has been running in excess of consumption. Decreased industrial activity, levelling off of U. S. stock-piling and barter programs and intended British stockpile sales, have upset the delicate pattern of supply and demand. Canadian production for 1957 valued at $ 52.4 million, was 10% below the same period of 1956. Refined output has been running close to 1956 figures when total output was 147,865 tons. Canadian exports have shown some increases over the previous year.

During 1957 due to softer markets and suspension of U. S. barter deals, four price-cuts reduced the price from 16¼ cents in May to 12¾ cents in October. The U. S. Tariff Commission may raise the lead import duty by 2.55 cents per pound from the current 1.0625 cents. Lead imports were slashed considerably in 1957 following the opening late in 1956 of the Ethyl Corporation of Canada plant at Sarnia. Lead consumption in Canada should show an untrend for the full year 1957 due to the opening of this plant.

Principal source of lead and zinc in Canada is the Sullivan Mine of Consolidated Smelters at Kimberley B. C. The Company operates the only lead refinery in Canada and treats domestic and foreign ores and concentrates. It also operates the H. B. and the Bluebell producing mines.

Production at Tulsequah and the open-pit mine at Sullivan, Jardun mines at the "Soo" and the Mayo mine in the Yukon all suspended operations during the year. Consolidated Sudbury Basin Mines has deferred plans to open. Heath Steele Mines in New Burnswick is producing lead from its 1500 ton mill.

ZINC

The year 1957 was discouraging for most zinc producers and the immediate outlook for the future is cloudy. Output in 1957 was valued at $ 99.7 million, 20 per cent below that of the previous year. Price declines due to oversupply forced production curtailment or suspension. The U. S. stockpile of zinc is bulging and is unlikely to be added to. The U. S. barger system initiated in 1956 to trade farm surpluses for foreign metal supplies has met with disfavour. Slab zinc consumption is down for 1957 in the U. S. world's largest consumer.

Zinc producers in the U. S. are urging tariff increases. Hearings were scheduled for year end, with strong probability for a hike in duties. This would be a severe blow to all zinc-producing countries. Four drops in prices between May and August totalling 3½ cents brought Canadian price for prime western zinc to 10 cents.

In spite of all these ills, it was predicted early last year that world production would create a new record. Today the estimate seems optimistic. Many U. S. and Canadian mines have shut down or curtailed production during 1957 U. S. Zinc output was running 3½% over the previous year, though Canadian output for the same period was some 2% lower than in 1956.

Besides the Consolidated Smelters' Kimberley Mine in B. C. where zinc is refined, Hudson Bay Mining

and Smelting at Flin Flon produces and refines slab zinc. In 1957 the Company began shaft sinking at a new property at Snow Lake Manitoba with an indicated deposit of nearly four million tons. Elsewhere, Heath Steele mines in New Brunswick commenced production in 1957 which Buchans in Newfoundland continued production and Brunswick Mining will soon be in production. Barvue and New Calumet mines in Quebec curtailed their production. Geco and Wilroy in Manitoba, began production in 1957 which capacities of 3300 and 1000 tons daily respectively. Surveys were under way for a rail route to the south shore of Great Slave Lake in the N. W. T. where large deposits are located.

GOLD

Gold mines of the world have been passing through another difficult year. Free world production will again show a small increase of some $ 10/20 million: this will reflect merely the remarkable expansion in output from South Africa, Canada, in second position, will produce about 60,000 ounces less than in 1956 for a decrease of some $ 2.0 million in value.

From the mine standpoint there were few developments of importance during the past year. One new gold mine had made its appearance. French Mines, in B. C. with a 30/50 ton milling plant having started production. Howe-sound in Manitoba, is on a salvage basis. Some old-established producers have raised their capacity slightly. Only one prospect, Taurcanis in the N. W. T. was doing underground development.

COBALT

Cobalt is passing through a transition period from the stimulus of government stockpiling to the growing pains of a civilian market. Canadian production will be close to the 1956 total of 1,843 tons, though domestic consumption will be sharply lower than the previous year's 218 tons or nearer 63 tons. Exports are expected to total as much as 1,250 tons. Relatively little cobalt is imported into Canada. Price for cobalt in concentrate form, now pegged at $ 2.00 is only about half the rate of a year ago.

Canadian nickel producers are the principal sources of cobalt. Some 35% to 40% of all production is in the alloy field for high temperature alloys, jet engines and atomic equipment, and offers best chances for the future. The permanent magnet industry uses 30% of all production, but is threatened by new materials.

PLATINUM

Revering the position in 1956 when demand for platinum greatly exceeded the supply, the platinum metals are now in oversupply. Falling prices have cut values to $ 84/87 an ounce. The oil industry largest consumer has cut back its buying. Its use was a catalyst for making high-octane gasoline.

The United States is the main consumer of platinoids, last year at 975,000 oz.; Canada exported 287,544 oz. to the U. S. in 1956. A new use for platinum has recently appeared in the U. S.—an automatic electrical system using platinum disc anodes has been developed to protect ships' hulls and propellers against corrosion.

Canada's production for 1957 is not likely to be in short supply. Most of it comes from nickel producers. International Nickel's Manitoba development, and Eastern Mining and Smelting Co. at Kenora are the largest untapped sources of the metal. Canada's domestic consumption in 1956 was valued at some $ 6 million and by 1958 it will rise with the increase in oil production. Canada's exports were down about $ 7 million below 1956 for the first seven months of 1957.

SILVER

Canadian silver production in 1957 was at a rate only slightly higher than that of 1956 at about 30,100 ounces. Exports of silver in all forms based on production for the first three quarters had fallen about 10% below that of 1956. The market has been stable and indications are that it will continue so.

The three North American countries, Mexico, United States and Canada, in that order, account for over half the world's production. Silver coinage takes much of the metal: Canada has been using greater amounts for the coinage the past few years. The U. S. treasury, Mexico, Saudi Arabia, West Germany and Canada are largest users for this purpose. Most of it comes from producers of zinc, lead and copper.

TITANIUM

Titanium, the 'wonder-metal' has failed to live to the publicity lavished upon it. Now the United States has indicated defence requirements for the metal will be substantially cut back. If it is to maintain its steady record of growth new markets must be developed for commercial use, and price reductions must be achieved in mill products. Today only half of the U. S. capacity production of 31,500 tons is in operation.

Ninety percent of the titanium produced has been for jet aircraft and missile components, where its high strength-to-weight ratio and resistance to corrosion and fatigue gave it advantages. But the metal is meeting sharp competition from nickel alloys which though heavier can withstand more heat.

Potential civilian markets are in civilian aircraft, automobiles, anodizing and plating, papermill and chemical process equipment, and marine fittings, while 95% of world output of titanium-bearing minerals is used in the titanium pigment industry a market of first importance to Canada, which is the world's leading producer of titanium slag and has the largest known deposits of ilmenite and rutile concentrates doubled in five years to 1,789,400 tons in 1956.

Price of titanium sponge has been cut from $ 5 per pound to $ 2.25 since 1951 and will go lower. Titanium mill products at $ 10/12 per pound must compete with stainless steel at about $ 1.00. Recent technological developments suggest its price will fall still further.

Canadian Titanium Pigments Ltd., opened Canada's first pigment plant at Varennes, Que., late in 1957. Slag will be fed to it from Quebec Iron and Titanium's five electric furnaces at Sorel, where three more furnaces were lately added to boost capacity to 375000 tons yearly by 1959. Baie St. Paul Titanic Iron Ore Co., Produces ilmenite and Continental Iron & Titanium Mining plans a 500-ton plant there. Several other companies have prospect in Quebec. Some 10,500 tons were produced in Canada in 1957 compared with 2300 tons last year.

MANGANESE

Canada is not a producer of manganese ore, but relies entirely on imports from India, South Africa and Morocco. Strategic Manganese Corporation is planning an electric smelter at Woodstock N. B. for processing low grade manganese iron ore from its Woodstock property. Capacity will be 5,000 tons daily with annual production of 70,000 tons of 7 6% ferro manganese and 74,000 tons of ingot iron. Manganese ore imports in 1956 totalled 208,000 tons. Ferromanganese exports totalled 59,445 tons valued at over $ 10 million.

MAGNESIUM

Canada ranks third after the United States and Russia in production with 19,000 tons output in 1956. As opposed to the general trend of non-ferrous metal production, output of primary magnesium in the U. S. continued at capacity during the first half of 1957, though July showed the first substantial decline. Figures for Canadian production, exports and imports of magnesium metal are not published but annual capacity amounts to some 8,000 tons 60% from Dominion Magnesium and 40% from Magnesium Co. of Canada an Alcan subsidiary.

LITHIUM

Lithium is a new-comer to Canadian mining. Some 5.4 million pounds of lithia were produced in 1957, vs. 4.8 million in 1956. To date there is only one producing company, Quebec Lithium, which with other partners has discovered the largest and richest deposits in the world. With a 1,500 ton per day mill capacity, it has a 5-year contract with Lithium Corporation of America to supply 165 tons daily of concentrates. The Company will proceed in 1958 with construction of its own lithium refinery and chemical facilities to process its lithia concentrates produced at Val d' Or. Quebec at a cost of some $ 3 million. A 450 acre area has been brought at Rouses Point, in New York State just south of the Quebec/New York border where work will be started next April.

MOLYBDENUM

World production of molybdenum reached a new high in 1955 at an estimated 33,600 short tons of ores and concentrates of which the U. S. produced 31,000 tons. U. S. Production in 1957 indicates it will compare favourably with 19.6.

All Canadian production comes from Molybdenite Corporation of Canada at Val d' Or which in 1956 produced 707 tons of molybdenite and 117,044 pounds of bismuth metal. In 1957 the company produced 874,600 pounds. The company expects to mine 188,000 tons and mill 168,000 tons during the full year of 1957.

INDIAN MICA

By D. B. Sahana, B.A., F.G.S.(Lond.), A.M.I.E.T.(Lond.), A.I.M.M.(Lond.), A.I.M.E.(U.S.A.), M.M.G.I., F.G.M.S., M.I.S.E.
Geologist & Mining Engineer, Kodarama — E. Rly., Bihar

MICA is a Complex Potash-alumina-Silicate containing proportions of Magnesia and Iron and also contains small amount of Soda, Calcium and Lithia and rearly fluorine. The Muscovite mica is a Potash mica having an approximate formula of H2KA13 (Si04)3. Phlogopite mica is a magnesian mica having a formula of $H_2KMg_3Al(SiO_4)_3$.

Mica is used largely in Electrical Industries and in Insulating material and is also a good dielectric. Mica is resistance to sudden change of temperature and are good heat insulators. Mica possesses perfect cleavage and can be easily split to .001 inch in thickness.

There are 3 distinct mica field in India—(i) The Bihar Mica Belt is approximately 100 miles in length and 20 miles in breadth. There are about 700 mica mines in Bihar out of which about 200 mica mines are either fully mechanised or partly mechanised. Bihar produces the best quality Ruby Mica in the world. (ii) The Madras Mica Field is about 60 miles in length and 8 to 10 miles in breadth. The mica mines in Madras produces mostly green and black-spotted mica and some ruby coloured mica. (iii) The extent of the Rajputana mica field is about 200 miles in length and 60 miles in width. There is a small deposit of Phlogopite mica in Travancore. There is also a deposit of Vermicullite in Mysore.

We have learnt on good authority that research work in the U. S. A. and in Europe has resulted in the successful invention of synthetic mica. This is certainly a disquieting piece of news for the Indian Mica Industry. No one can be stopped from carrying on scientific investigation and research. There are some people who think that the news of invention of synthetic mica is just an international hoax. But we must not be lulled into a sense of false security. Scientists in Europe and in America have been working to find out a substitute for mica since World War No. 1. I am quoting below some extracts on the subject which are self-explanatory.

1. Extract from the October 1946 issue of the Harper's Magazine.

"Mica was another thing. None is mined in Germany, so during the war our Signal Corps was mystified. Where was Germany getting it? One day a certain piece of mica was handed to one of our experts in U. S. Bureau of Mines for analysis and opinion. "Natural Mica", he reported, "and no impurities". But the mica was synthetic. The Kaiser Wilhelm Institute for Silicate Research had discovered how to make it and—something which had always eluded scientists—in large sheets.

We know now, thanks to Fiat teams, that ingredients of natural mica were melted in crucibles of carbon capable of taking 2,350 degree of heat, and then, this the real secret, cooled in a special way. Complete absence of vibration was the first essential. Then two forces directly perpendicular to each other were applied. One, vertically, was a controlled gradient of temperature in the cooling. At right angles to this horizontally, was introduced a magnetic field. This forced the formation of the crystals in large laminated sheets on that plane".

2. Taken from The New York Times of August 1st 1948 :—

"Work on strategic substance now is in pilot-plant stage.

A research program undertaken several years ago to develop the production of synthetic mica in commercial quantities and make the United States independent of foreign sources of this strategic mineral has reached the pilot-plant stage, the Army and Navy announced yesterday.

The Synthetic mica has all the characteristics of natural mica that is used widely in electronic equipment as an insulating material and resistors, the office of Naval research, The Army Signal Corps and the Navy Bureau of Ships reported.

The success of the research program also raises the possibility that mica parts may be fabricated directly from the synthetic product without the time-consuming and laborious tasks of sorting, grading, splitting and trimming necessary with natural mica.

The natural substance is a translucent silicate mineral with unique electrical properties that make it particularly suited for use in radio, radar, television and other circuits. It is split easily into thin sheets and can be shaped as desired. It is not affected easily by chemical corrosive agents.

Mica is mined extensively in India and Brazil. In spite of Government subsidy of $ 6 a pound, fields in this country were able to supply only 15% of the amount needed in the critical war years of 1943 and 1944, the announcement said. Commercial production of the synthetic product can fill this country's needs and make it unnecessary to stockpile for future emergencies.

U. S. Research Began in 1946

The synthetic is of a type known as fluorine phlogopite mica. Patents on mica substitute have been granted from time to time during the last thirty years, but none of them have resulted in the preparation of crystals large enough to be used in place of the natural mineral. Government sponsored research began with a Signal Corps contrast at the Colorado School of Mines of June 15, 1946. The Bureau of Mines Electrotechnical Laboratory began pilot-plant work on September 1, 1947, under a contract with office of Naval Research.

The Owners-Corning-Fiberglass Corporation has been retained under a consulting contract to make available all data and patents acquired by that company and the Corning Glass Works during investigation of mica synthesis in 1945 and 1946, the announcement said. Other groups also participated in the work.

The present Army-Navy research project is expected to solve the engineering problems involved in the synthesis of mica on an industrial scale and to define the conditions under which the manufacture of mica may be feasible economically.

Organisations interested in the possible application of fluorine-phlogopite mica were invited to communicate with the office of Naval Research for further details ".

Lately a substitute for natural mica has been successfully found out in some of the European countries known as SAMICA. This is natural mica in every respect. It is a type of mica paper produced from Ground Mica and may endanger the Mica Splittings Industry in India. Micanite Boards are prepared by using loose splittings with a binder or bonding material known as Glyptal a Phthalic anhydride and glycerine compound dissolved in alcohol. A varnish made with shellac and spirit is also used as a binder.

Most of the mica produced in India is exported to foreign countries and I am giving below the figures of export through Calcutta Port during 1957 :—

	Quantity in Cwt.	Value in Rupees
Block Mica	31,976	Rs. 2,74,51,396/-
Mica Splittings	1,05,483	Rs. 3,26,74,164/-
Scrap Mica & Washers	1,39,990	Rs. 8,24,701/-
Mica of Mixed description	2,180	Rs. 49,51,994/-
Total—	2,79,629	Rs. 6,59,02,255/-

If the consumption of Indian mica is analysed countrywise we find the position of the different countries as follows :

U. S. A.	Approximately	34.5%
U. K.	,,	20%
Germany	,,	19%
Japan	,,	12%
All other European countries viz : Holland, France etc.	,,	14.5%
	Total :	100%

It is still a long way before we can use Mica in the manufacture of electrical appliances in India. But we may look forward to progressive use of mica in India as envisaged in the FIVE YEAR PLAN.

HOW TO RESERVE ACCOMMODATION

Unless you reserve your berth (I Class) or Seats (II and 3rd Class long distance) in advance, you may not be sure of getting accommodation on the train you wish to travel by.

Application should be made to the Station Master of your starting station at least 3 days in advance specifying the date and train by which you intend travelling and the tickets must be bought in advance. The reservation fee leviable is 8 Annas per seat or berth.

Reservation by I and II Class from intermediate stations by Express trains can also be made similarly, but reservation ticket can be issued only after getting an advice from the Reservation Centre that the reservation has been made.

Tickets will be issued only if accommodation is available.

If the reserved seats or berths are not occupied at least 5 minutes before the booked departure of the train the reservation will be cancelled and the seat or berth given away to another.

Reservation fee is not refundable.

III Class seats are also reservable on Express and certain other important trains for long distance passengers from the train-starting stations on payment of a reservation fee of 4 Annas per seat.

Do not occupy a berth or seat reserved for another, as you are liable to be displaced at the last moment.

If you find another person occupying the berth or seat reserved for you and if he will not vacate it on demand, report it to the Guard or Station Master. They will help you.

(Inserted in the interests of Travelling Public)

Pioneers in Electric Traction

By J. C. Way, A.M.I.E.E., M.I.LOCO.E.

Supplying electric locomotives and coaches to railways in various parts of the world, including India, Metropolitan-Vickers Electrical Co. Ltd., are now applying their vast resources to A.C. industrial frequency traction.

METROPOLITAN-VICKERS Electrical Co. Ltd., and its predecessor, The British Westing house Electric and Manufacturing Co. Ltd. have specialised in electric traction since the workshops were erected at Trafford Park, Manchester, in 1902.

The first traction order, which was for the complete electrification of the Mersey Railway (an underground line below the River Mersey between Liverpool and Birkenhead) was received in 1901, and the equipment was commissioned as early as 1903. This order, together with another placed shortly afterwards in 1902 for the electrification of London's Metropolitan Railway, established the new Company in the traction field, and thereafter, right up to the present day, Metrovick and its predecessor have kept abreast of the demands and requirements of the times, and not infrequently pioneered new developments. During the first World War and in the years following, Metrovick supplied much of the existing equipment for multiple unit trains on the Southern Region of British Railways and 1500V D. C. traction equipment was manufactured and supplied in such widely separated parts of the world as New South Wales, Argentine, Holland, Spain, and Russia.

MAJOR ADVANCES

There were major advances after the first World War. The success of the 41 freight and 23 passenger locomotive made for the Great Indian Peninsula Railways and their capacity to haul and brake (regeneratively) heavy goods and express trains on gradients of 1 in 37 under most difficult conditions was an achievement that caused considerable interest in railway circles. The introduction of 3000V D. C. operation with locomotives in South Africa and motor coaches in suburban service in Rio de Janeiro and Warsaw demonstrated the ability of the Company to produce reliable designs for a system that had, up to that time, not a very wide application. Those early 3000V equipments were so successful that the Company has now made and designed more motor coach equipments operating at this voltage than all other manufacturers in the world put together, and more complete locomotive equipments than any other manufacturer.

After the second World War, large quantities of motor coach equipments were ordered from India, Brazil and South Africa to operate at 3000V D. C. Australia at 1500V D. C. and British Railways at 600V D. C. 3000V D. C. electric locomotives were supplied to South Africa and Brazil, and 1500V locomotives to New South Wales. The 3680 H. P. locomotives for New South Wales, which are still in course of delivery, are the most powerful locomotive of their type to have been built in Great Britain. In addition, British Railways were supplied with complete regenerative electrical equipments for 58—1868 H. P. 87 ton, 1500 volt mixed traffic Bo+Bo locomotives, and complete regenerative electrical equipments for 7-2760 H. P. 102 ton, 1500 volt Co-Co type locomotives. These locomotives operate over the Pennine Range between Manchester and Sheffield.

Metrovick also built one of the first gas turbine locomotive to be put into operation. Trials on the British railways showed that it could be used successfully when hauling specialised loads, and demonstrated the success of many other new features including a novel from of suspension which permitted good riding at high speed with low weight transfer characteristics.

The field of diesel traction has been covered by orders received from the Western Australian Government Railways, C. I. E. (Irish Transport Authority) and British Railways. The Irish order was one of the largest single orders for diesel electric locomotives to be placed in this country and covered the supply of 94 locomotives — 60 of 1200 H. P. and 34 of 550 H. P.

Experience has not been confined to D. C. traction only. Equipment for operating at 6.6 kV., 25 c/s. A. C. was supplied for use on the Thamshavn-Lokken Railway in Norway and the Lancaster-Heysham Line in the United Kingdom. In addition 26 traction motors and other equipment were supplied to the Hungarian State Railways for use in their Kando Locomotives in 1932.

The resources of the Company are now being applied to A. C. industrial frequency traction. A vast amount of research, design, development, and testing, is being undertaken for the purpose of providing the British Railways with sound, reliable equipment for the A. C., 25 KV., 50 c/s electrification proposals to be carried out under their Modernisation Plan. Installations in France and the Belgian Congo have given an admirable background for this work, but the demands of an intense suburban service and the peculiarities of the British main line traffic require very special consideration.

LIKE INDIAN CONDITIONS

In some ways, these traffic conditions are not dissimilar from those anticipated on the Indian Railways, particularly in suburban areas. Robustness and long life with simple maintenance are features that are needed by both British and Indian systems.

The use of industrial frequency requires the incorporation of all available modern developments, such as new insulating materials in the motors to permit them to run at higher temperatures and to enable special features to be embodied in the transformer, which must be of an unusual shape, in the rectifying equipment which has to withstand the mechanical shocks and peculiar loading characteristics of railway operation, and in traction type switchgear which must be adapted for use with alternating current.

Should it be decided to use industrial frequency traction in India, these modern developments could be adapted for use in hot, humid, and dust-laden atmosphere of the country, but the choice between this and the old established D. C. system, either for a part or the whole of the railway electrification programme, depends on many factors.

INDO-BRITISH INDUSTRIAL ENTERPRISE EXPANDS

Manufacture of Electric Tools

Further expansion in the range of Wolf electric tools manufactured in India is promised by the joint Wolf Electric Tools Ltd. - Rallis India Ltd. enterprise at Mulund, near Bombay.

The present range of Indian-produced tools, states the London office of the new firm—Ralliwolf Private Ltd.—will be extended to cover more specialized types. These will include portable grinders, sanders, flexible shaft grinders, lathe grinders, blowers, and valve seat grinders.

The new industry was started in India two years ago, when Wolf Electric Tools Ltd. joined forces with Rallis Ltd. to assemble a limited range of electric tools, partly from components sent from England but using, wherever possible, local sources for other materials.

Now, Ralliwolf announces, the stage is set for progressive expansion. With building operations for the Mulund factory under way and scheduled to be completed by the middle of 1959, manufacturing processes will be extended progressively, and the existing range of tools extended.

* * *

4TH INTERNATIONAL CONFERENCE ON PUBLIC HEALTH EDUCATION WITH EXHIBITION

The 4th International Conference on Public Health Education will take place at Duesseldorf (German Federal Republic) from May 3 to 9, 1959. Delegates from about 60 countries representing public health education bodies will discuss and exchange their experiences. An exhibition will be held to coincide with the conference, and NOWEA Nordwestdeutsche Ausstellungs—Gesellschaft m. b. H. of Duesseldorf has been entrusted with the organisation.

Conference and exhibition will endeavour to promote the solution of health problems by the use of preventative media and methods to safeguard the health of children of school age between the ages of six to eighteen. The Congress will discuss in particular general problems of health education, the raising of health standards, leisure time activity and sport, as well as hygienic conditions, environment improvements and mental health. It will be of interest to all engaged in education, training and welfare of youth, and also to playsicians, social workers and public health officials, local government, ministerial bodies, associations and insurance companies, etc., whose work is concerned with these problems.

IN YOUR OWN INTERESTS

HOW TO PURCHASE TICKETS

Buy your tickets only at the proper place. The authorised offices are (i) the Booking Offices at the railway stations, (ii) the Town or City Booking Offices, (iii) the Out-agencies, (iv) Travel Agent. Never buy tickets from any other source as that may lead you to trouble. Please note that tickets are not transferable.

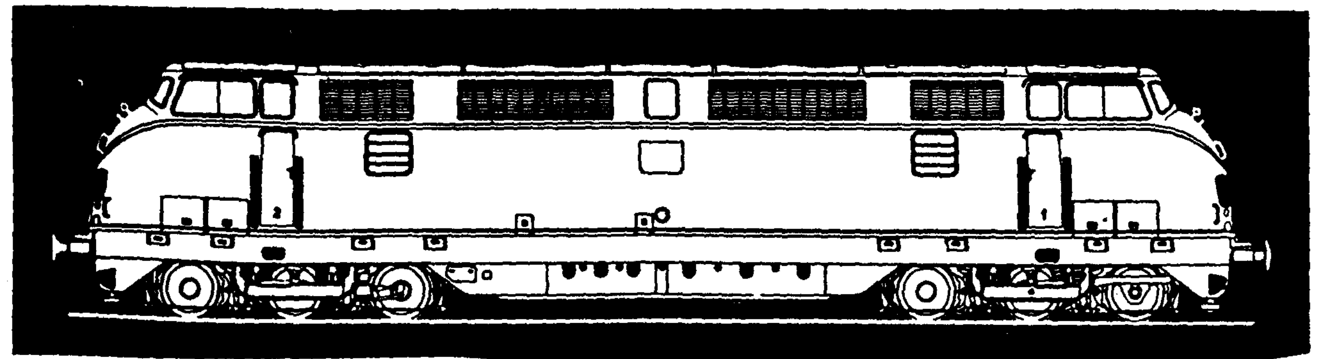
Buy your tickets in the proper time. You can avoid unnecessary excitement and trouble if you come to the station in good time, that is at least half an hour before the scheduled departure of your train. The Time Tables of the Railway are on sale at Booking Offices and Bookstalls.

Buy your tickets in the proper manner. Queue up at the Booking Window and you can get your ticket easier and quicker than by crowding at the counter.

By handing in the *exact fare in good coins or currency* you get the ticket easier and quicker, and save for yourself and the Booking Clerk time and trouble.

Check up your ticket and money before leaving the counter and draw the attention of the Booking Clerk to any discrepancy you may notice.

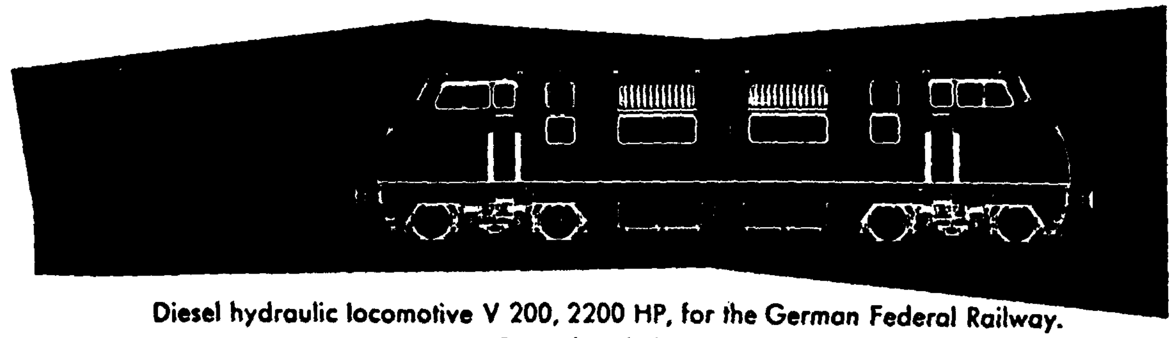
(Inserted in the interests of Travelling Public)



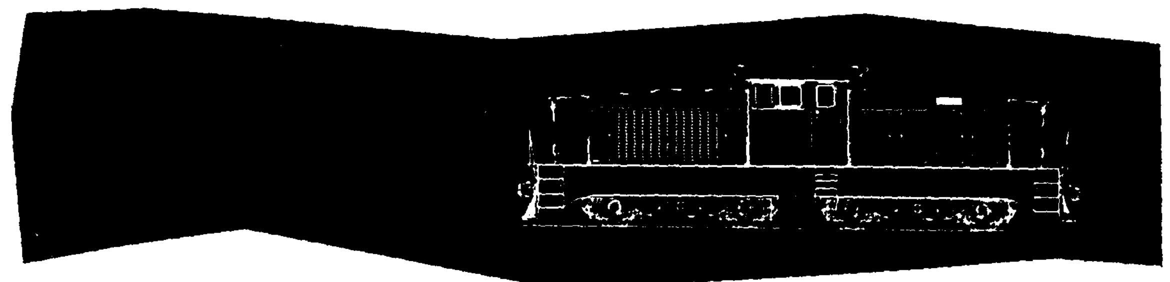
Diesel hydraulic multiple purpose locomotive ML 3000 C'C', the modern and most efficient locomotive of its type.

KRAUSS-MAFFEI

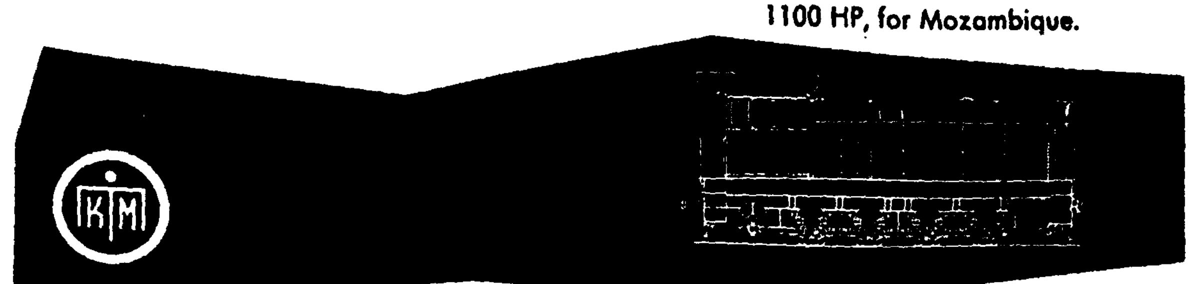
MUNCHEN/GERMANY



Diesel hydraulic locomotive V 200, 2200 HP, for the German Federal Railway.
Proved in daily mileages of 600 miles and more.



Diesel hydraulic multiple purpose locomotive ML 1100 B'B',
1100 HP, for Mozambique.



Diesel hydraulic locomotive 700 HP
for South African Steelworks (Iscor, Pretoria) 3' – 6" gauge.

DIESEL HYDRAULIC LOCOMOTIVES OF EVERY CAPACITY

SOUTHERN RAILWAYS MAGAZINE Regd. No. M. 5551 Vol. X No. 5 November 1958

CLEANLINESS LEADS TO HEALTH AND HAPPINESS

Clean orderly habits contribute to general health and welfare and as such to happiness and prosperity; they are more important than medicines.

Cleanliness prevents disease; medicine only attempts to cure.

Cleanliness of the person, of the houses and colonies, reflects discipline in the individual and the community. Discipline is the foundation stone for progress of oneself and the country. Cleanliness is a good habit. It is also cheap.

All Railwaymen should set an example of cleanliness. This will help others and themselves.

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Managing Editor: T. S. Krishna Rao

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SIGNALLING, INTERLOCKIN[G]
&
TELECOMMUNICATIONS
SUPPLEMENT

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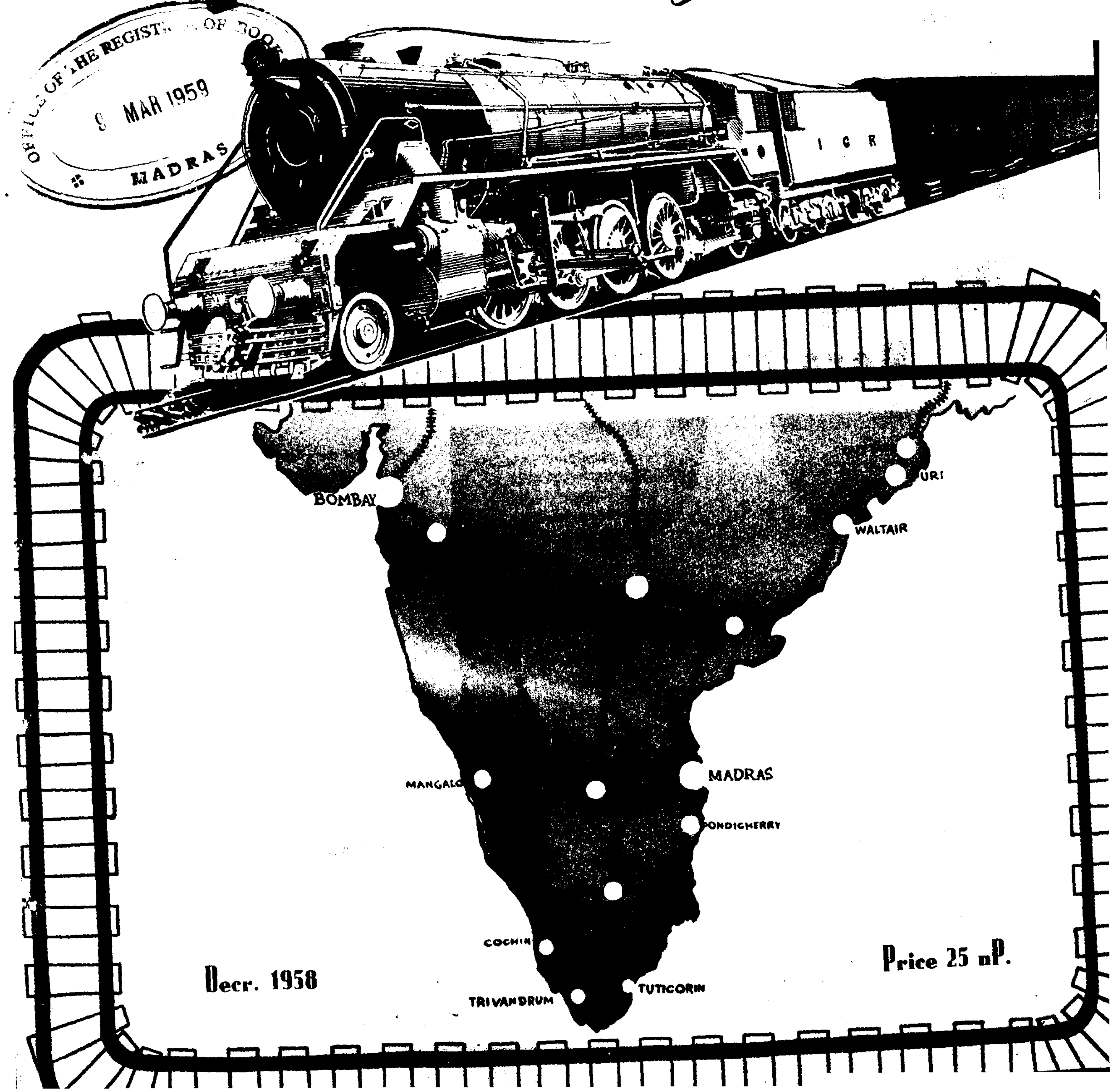
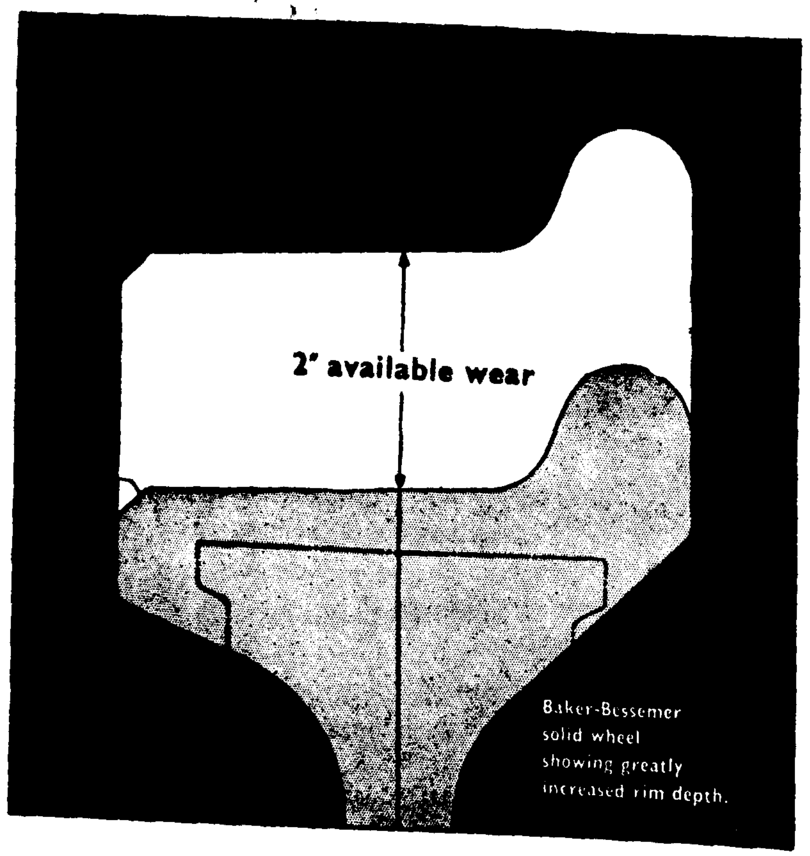
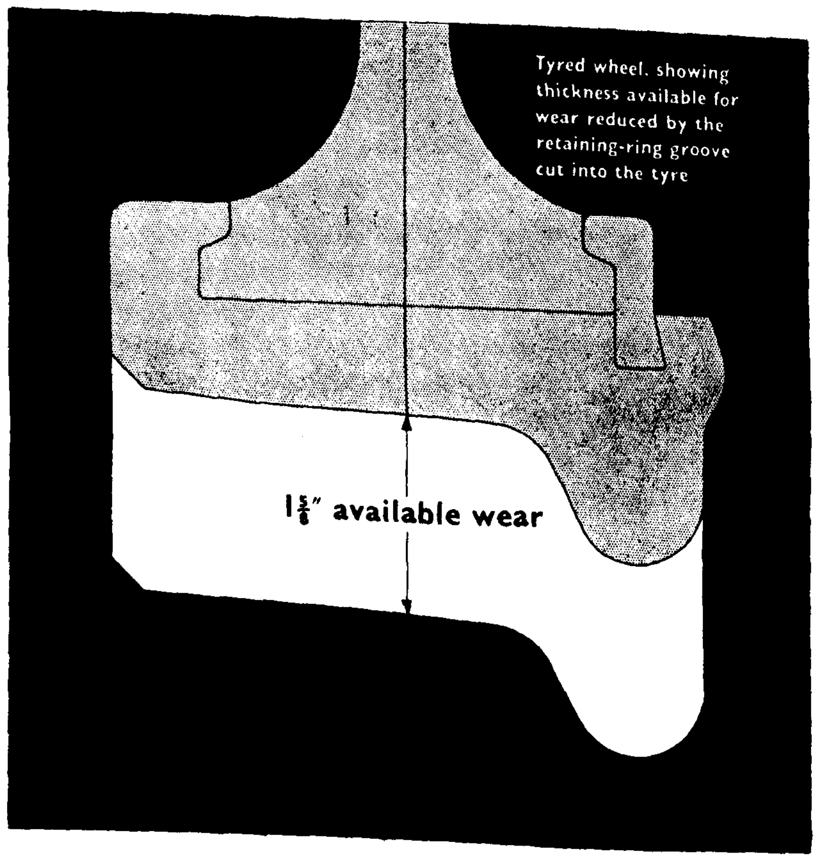
SOUTHERN RAILWAYS *Magazine*





The solid wheel has an initial life 20% greater than the corresponding type of tyred wheel. This is fully illustrated by a comparison of the solid wheel, I.R.S. Drawing No. WA. 22, and the built-up wheel to I.R.S. Drawing No. WA. 23.

More than 20% increase in life



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SOUTHERN RAILWAYS MAGAZINE

SIGNALLING, INTERLOCKING & TELECOMMUNICATIONS SUPPLEMENT

Vol. X No. 6 DECEMBER 1958 Price 25 nP.

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EDITORIAL NOTICE

The Editor invites contributions to the Magazine on a variety of topics—short stories, technical features written in simple English understandable to the laymen, Aspects of Railway Working, places of tourist interest, News from home line, activities on Railway Institutes etc. All copy should be brief and typed as far as possible.

Photographs illustrating social functions, sports events, scenic sports etc. are also invited. All contributions should reach the Editor not latter than 5th of each month. Rejected Mss. will be returned provided sufficient stamps for postage are enclosed. No responsibility will be borne for copy lost in transit.

Views expressed in this Magazine should not be taken as having official authority.

All correspondence should be addressed to the Editor, "Southern Railways Magazine", Post Box No. 17, Tanjore, (S. India).

The Manufacture of Signalling, Interlocking and Telecommunications Equipment used on Indian Railways

INDIAN Railways were from their start, just over one-hundred years ago, built by British engineers and it is not surprising therefore that standards and practices used and followed in England should be found in India. These standards, many of which were later on incorporated in a code known as BSS apply not only to permanent way, structures and rolling stock, but also to signalling and telecommunication material.

Signalling in Britain was and still largely is, mechanical, that is the signals are moved by wires and levers and the points by rods and levers, the levers being grouped together in a frame which contains the necessary interlocking between the levers. Many refinements and additional safety devices such as the track circuit have since been added and to-day many mechanical installations have been replaced by all-electric or electro-pneumatic installations.

The same pattern has obtained in India, although there is still a greater predominance of mechanical signalling here than there is in Britain and many of the mechanical installations are worked by "double wire" in which the points as well as the signals are wire operated. Amongst the more important power signalled installations may be mentioned the following all-electric, Howrah and Dum Dum (E. R.), Madras — Tambaram, Erode, Salem and Madura (S. R.), Lumding (N. E. F. R.) and Bombay Churchgate (W. R.) whilst electro-pneumatic installations are to be found at Bombay Central (W. R.), Bombay Victoria Terminus and Kurla (C. R.).

Signalling material therefore falls into two main groups, mechanical and power and whilst their function, the setting up and proving of the route over which the train is to travel and the conveyance of the vital message to the driver is the same, the means by

With the best compliments of:

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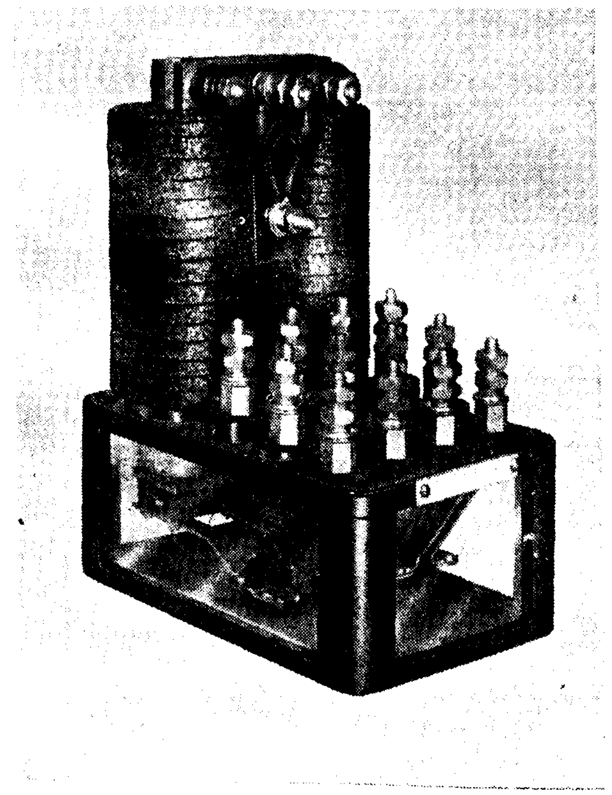
Representing

THE GENERAL ELECTRIC CO. LTD. OF ENGLAND

which they attain them is different. Mechanical signalling providing it has no electric locks or track circuits and discounting the block instruments, calls for no electrical knowledge at all and the materials which it uses are mainly cast iron and steel, some of the latter, that used for the wires being high tensile. Power signalling calls for a much greater variety of materials and a wider engineering knowledge for its manufacture.

Early mechanical signalling installations employed material manufactured in Britain but for many years now this apparatus has been produced here, largely from indigenous material. Some has been manufactured in the Railways' own workshops and some by private manufacturers such as Saxby & Farmer in Calcutta.

Whilst the day of mechanical signalling is by no means over and there are still many such installations giving sterling service it is towards power signalling that railways are turning more and more to-day and in the circumscribed space of this short article consideration will therefore be given to the manufacture of electrical signalling material. The introduction of power signalling in India followed the same lines as did that of its predecessor mechanical signalling: the practices and standards are British and to this day the bulk of the material used is imported from Britain. The reasons for this are not far to seek. The considerably more skilful technique needed for the manu-



S.G.E. Type BA Relay Shelf Pattern.

Installation of Type HB Combined Point Machine, 110 Volts D.C. showing contact box with double pole cut-off contacts.

facture of the material and the still relatively small demand for it have not warranted the setting up of manufacturing facilities to produce all the complicated apparatus which a modern power signalling installation requires. However, there are definite signs that the necessity for relying on foreign supplies is being overcome. Some small items of equipment, such as mercury treadles and circuit controllers have been made in India for some time and now the range is about to be extended and the assembly of relays and colour light signals is likely to start soon. If the modernisation of signalling keeps pace with the modernisation of the rest of the Railways' equipment, and one of the most important facets of that programme is the electrification of long stretches of main line, then there is good ground for believing that the quantities of power signalling equipment needed will justify their manufacture here.

It need not be stressed that the paramount function of signalling is to ensure safety of operation so that human lives, be they of passengers or of railway servants are not endangered and the secondary function is to enable the maximum use to be made of permanent way and rolling stock, in other words to ensure the most efficient operation possible of the trains. The attainment of such important targets as these calls for equipment made to an extremely high standard in whose manufacture only the best of materials may be used and in which rigorous inspection at every stage and thorough testing at completion is as essential as is inherent soundness of design.

In a previous paragraph the variety of the materials used in power signalling equipment was stressed and it will be interesting now to consider just one item, a direct current neutral relay of shelf pattern and see what materials are used in its manufacture. Starting at the bottom is a well made of bakelite. Both the material and the process of moulding have to be of good quality as the weight of the relay rests on the well. Glass windows are provided in the sides of the well. On the top of the well is the plateform consisting of a bakelite moulding. As all the working parts, both fixed and moving are mounted on this it must be strong, extremely accurate and of high insulation. The cores on which the coils are mounted and the pole pieces which transmit the magnetic flux to the armature are of high quality silicon steel. The armature which carries the moveable contacts is of radio metal, a special alloy of low reluctance and low permanence. The moveable contacts have nickle plated base mountings, phosphor bronze fingers and silver tipped contacts. The fixed contacts are of two types, front and back. The former are of silver-electrographite material which is non-fusible and the latter are of silver. The coils are wound to the required resistance with enamelled copper wire and after very through drying are sealed against moisture. The terminals are nickle plated brass.

This brief description gives an idea of the materials which a relay calls for. The materials have to be made into components, the components assembled and finally the complete relay has to be tested to ensure that it complies with the relevant standard British Specification. A very great deal of technical know-how is called for in the manufacture of the components, the assembly and the testing and such skill is not acquired without considerable experience.

The same pattern of high quality of materials, inspection and testing, good design and the experience of many years goes into the manufacture of all the other components, such as point machines, colour light signals, locks, controllers, detectors, transformers, cables and all the many accessories which are built into a complete power signalling installation.

It is not difficult to realise therefore that the manufacture of signalling equipment on which human lives depend calls for a high quality of material and a high degree of skill and experience, as the apparatus must never fail. By its very nature therefore, it cannot be cheap and the only way to keep its cost at all reasonable is to make sufficient quantities of it and that, in turn, means that there must be a steady market which can absorb the manufacturers' output.

The remarks made about signalling apparatus apply equally to block instruments and telecommunications equipment. For many years there has been a demand for the former as they are used with mechanical signalling, and sometimes with power signalling and single line token instruments have been made here for a long time. The maunfacture of telecommunications apparatus has been undertaken at Bangalore during the last few years and the Railways requirements in this sphere are thus met from indigenous resources.

Enough has been said to show that the manufacture of signalling and its associated equipment calls for the highest qualities of material, design and skill which can only be acquired by long experience and it is, therefore, incumbent on manufacturers who wish to be in a position to supply the growing demand for power signalling equipment, to provide for these so that the Railways' needs and the high standards which they call for can be met.

EXPANSION ON JAGADHRI WORKSHOPS

Shri Shah Nawaz Khan, Deputy Minister for Railways, said at Jagadhri on November 3, 1958 that the Railway Board had approved a plan to expand the Northern Railway Workshop at Jagadhri at a cost of Rs. 4 crores. When the Plan is implemented the outturn of carriage and wagon repair will be increased from 12 units to 40 units a day.

Shri Shah Nawaz Khan said the expansion scheme would provide 4,000 additional jobs and the Jagadhri Workshop would be one of the biggest railway workshops in India then.

IN YOUR OWN INTERESTS

HOW TO PURCHASE TICKETS

Buy your tickets only at the proper place. The authorised offices are (i) the Booking offices at the railway stations, (ii) the Town or City Booking Offices, (iii) the out-Agencies, (iv) Travel Agent. Never buy tickets from any other source as that may lead you to trouble. Please note that tickets are not transferable.

Buy your tickets in the proper time. You can avoid unnecessary excitement and trouble if you come to the station in good time, that is at least half an hour before the scheduled departure of your train. The Time Tables of the Railway are on sale at Booking Offices and Bookstalls.

Buy your tickets in the proper manner. Queue up at the Booking Window and you can get your ticket easier and quicker than by crowding at the counter.

By handing in the *exact fare in good coins or currency* you get the ticket easier and quicker, and save for yourself and the Booking Clerk time and trouble.

Check up your ticket and money before leaving the counter and draw the attention of the Booking Clerk to any discrepancy you may notice.

(Inserted in the interests of Travelling Public)

POWER FOR RAILWAY SIGNALLING

By H. C. Towers, M.I.E.E., M.I.R.S.E., M.Inst.T.

NEARLY 120 years ago the first electrical device was introduced to railway signalling and communications. This was the Cooke & Wheatstone telegraph accepted by the Great Western Railway for use between West Drayton and Paddington after having been rejected by other railway companies. Its success led to the development of various electro-magnetic devices for train signalling instruments and indicators. This apparatus had no power problems for the various coils only needed a few milliamperes for their operation and the current was supplied by some form of primary battery.

The actual operation of points and signals by electrical power started in about the early twenties. Before this they were worked by compressed air, electrically controlled though there were a few instances of hydraulic operation. The use of compressed air for railway brakes and signals was introduced by George Westinghouse. By 1890 he had been successful in the installation of air brakes on railway trains and he decided to use a similar method for working railway points and signals. The first electro-pneumatic power signal installation in Great Britain is at Granary Junction, Great Eastern Railway, opened in 1899. This was followed by extensive installations on the newer tube lines and the District Railway from 1905 to 1907.

Power installations are understood to be those where all points and signals are operated by either the all electric method (points driven by electric point machines) or electro-pneumatically. In the early electro-pneumatic installations the magnets on the point valves were d. c. working on 12 Volts. This power was supplied from secondary batteries in the signal cabin on trickle charge through resistance from d. c. mains. In course of time a. c. supply displaced d. c. on account of the ease with which the voltage could be stepped up and down by means of transformers. The conversion of electro-pneumatic point operation from d. c. to a. c. meant that the point valves had to be fitted with coils suitable for operation on 110V a. c. which was the standard operating voltage for a. c. signalling. The alternating current coil and iron system had never been entirely satisfactory and in the case of the point magnets there was chattering of the operating parts which meant frequent changing for shop overhaul. The increasing use of metal rectifiers in all industries led to the inclusion of one of these in each point valve permitting d. c. operation of the valve magnet from a line operating voltage of 110V a. c. The power and distribution arrangements for present day signalling systems embodies the best features of the various methods that have been used in the past.

TYPES OF INSTALLATIONS

Power supply arrangements for signalling installations vary with the quantity of electrical apparatus that has to be operated. Although there are many types of installations they can generally be gathered into four classes (a) a mechanical signal box with a few track circuits and signal arm and light indicators etc. (b) an installation of the same type but with complete track circuiting and more electrical instruments and apparatus (c) an electro-mechanical scheme where some of the points are manually worked from the mechanical frame while others are worked electrically. Signals are colour light or electrically operated semaphores and (d) a complete power scheme where all points and signals are electrically operated and

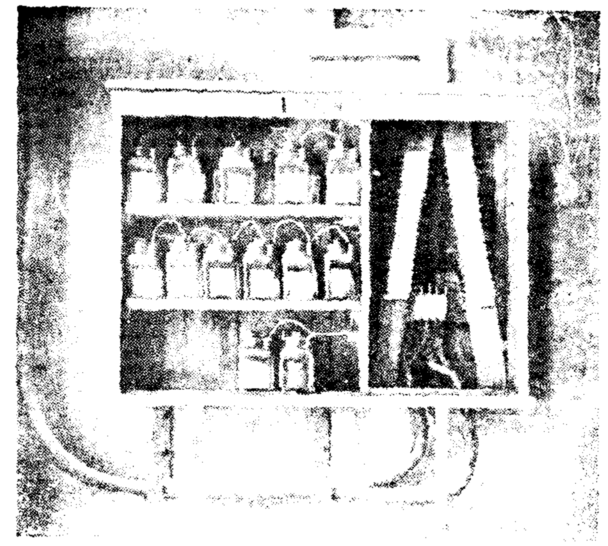
ANNOUNCEMENT

We have pleasure in announcing to all our Advertisers and Readers that we propose to bring out a special **Steam, Electric, Diesel & Diesel-Electric Traction Supplement** along with our February issue.

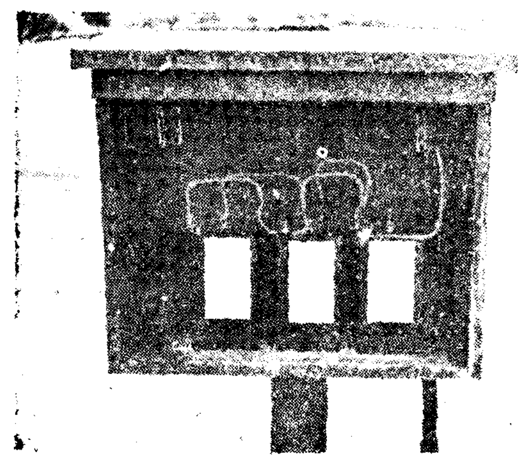
EDITOR

controlled from a power signal frame or relay interlocking panel.

With (a) the power requirements are usually satisfied with primary cells each track circuit having its own feed from a primary battery or batteries with other functions worked from similar sources. (b) in this type of installation the signal cabin battery might be of the secondary type trickle charged through a metal rectifier transformer unit. In this case the various functions in the signal cabin would be fed from a common bus bar. The track circuits could be fed from primary batteries and types are available which can feed a track circuit for a year or more before exhaustion. Alternatively a lead acid cell can be used on trickle charge but this method entails capital expenditure on a supply cable through the track circuited area and also the cost of transformer/rectifier charging units.



Armoured signal cable termination and group of No. 1 Leclanche cells fitted with AD conversion units outside station building. Western Railway, India.



Track Circuit "B" Feed
(Close up view of Battery)
Three cells A. D. 618A connected in parallel.

(c) implies complete track circuiting with all main running signals of the multi-aspect or searchlight type. Where points are worked by all electric point machines they may be d. c. or a. c. though generally the former method of operation is used. The normal operating voltage for multi-aspect colour light signals in 110V a. c. and this is transformed down to the signal lamp voltage of about 12 Volts by lamp transformers in the signal head. If the track circuits are powered by primary cells it may not be necessary to run a signal supply cable throughout the area but only to certain locations for point detection circuits etc. The transformer arrangements at the signal cabin will depend on the kind of power available.

(d) comprises a complete power signalling scheme with all apparatus, track circuits, points and signals energised from a main source of electrical supply. The transformer, switching and other arrangements varies with the size of the installation.

POWER FOR ISOLATED PLACES

The majority of railway stations in the United Kingdom have an electrical supply or are close to one. The problem of providing electrical power for signalling is greater in up country districts overseas and principally in Commonwealth countries. Generally, in remote parts, single line railway is used with crossing stations spaced according to traffic density or local conditions.

Electrical signalling is often used at these crossing stations and its adoption in overseas countries is increasing. These installations vary from electrical operation of signals to complete track circuiting in station limits with power working of signals and points. Several well known methods of generating power are available for working these installations but the use of primary batteries is still very popular. Several types have been developed to meet the needs of railway signalling and are very suitable for feeding track circuits, signal machines, relay circuits, etc.

The electric signal machine is designed to operate a signal arm from 0 to 45 degrees in the lower quadrant or as a three position signal in the upper quadrant with aspects at 0, 45 and 90 degrees. The arm spindle is worked by an electric motor and gear train and contacts working in conjuction with the motor are arranged to cut it out when the arm has attained the position. A hold off slot retains the arm as long as required the lever or switch controlling the signal is "at clear" or a train passes the signal and replaces it to danger through track circuit occupancy. The average current required by the motor to wind off the arm is about 2 Amperes for about 10 seconds and the holding current 18 to 20 milliamperes. The voltage required varies but for battery operation it is between 10 and 12 Volts. Primary batteries are available with capacities of 1000 Watt Hours and upwards which are very suitable for this type of work.

If searchlight signals are preferred to semaphores there is no difficulty in working them from primary batteries. A special design of lens and lamp produces a highly concentrated beam of light and this indication can be clearly observed up to 3,500 feet. The signal operates in conjunction with what is known as approach lighting so that it is only illuminated when a train has approached within sighting distance of it. This is arranged by having a track circuit about half a mile long outside the outermost signal at stations. The signals are illuminated through this track circuit becoming occupied by the approaching train.

The motors of electric point machines require more current than signal machines and on this account they cannot be operated from a battery unless it is on trickle charge. This difficulty has been overcome by the introduction of the hand generator which provides an economical means of operating points and signals electrically and without the expense of installing and maintaining batteries. The system is only suitable where there are a few points to be operated and traffic is light such as at stations on a single line railway. The circuits for working the point machines may be controlled through contacts actuated by a standard lever in a mechanical lever frame or from a relay energised through a switch on a small control panel.

The hand generator is actuated through a gear train driven by a handle which is turned by the operator. Information is given as to when the points are correctly set and locked by visuals illuminated by the point detection circuits. The operator also experiences a sudden diminution of effort required to turn the handle when the work of the point motor is completed. With the hand generator system it is only possible to drive one point machine at a time and where several machines have to be worked for a train movement the interlocking arrangements prevent the operator from connecting more than one machine at a time. The system can also be used advantageously in a signal cabin where most of the points are close to the lever frame and can be worked manually but where one or two are situated at some considerable distance away. These can be worked by hand generator system thereby saving the maintenance charges and wages of staff required for an additional cabin.

FEEDING SIGNAL LOCATIONS BETWEEN STATIONS

On many railways automatic signals are used and these operate without the aid of a signalman and purely by the action of trains passing over the track circuits that control them. There may be several automatic signal sections between two signal boxes or stations and these signals, and their associated track circuits, need an electrical supply to operate them. If the stations are electrically lit, the lighting mains can be used. On long, single line sections in desolate country, where intermediate automatic signals are necessary between stations, no power supply may be available. In these cases signals and track circuits have to be powered from primary batteries.

In British practice the generally accepted voltage for signalling purposes in 110V and voltages lower than this such as 12, 24 and 30 Volts. The voltage of the signal main supplying a given area or section depends on the load and the length of the section and may be stepped up to the required voltage according to circumstance.

At signal locations, step down transformers are provided for distribution of different voltages for the various circuits to be fed. The main location case houses the signalling relays, fuses, bus bars, terminals etc. and it can also accommodate the main transformer. Where the voltage of the signal main is higher than 110V, the mains power transformer, fuses, etc. is often accommodated in a separate case fixed at the side of the main location case. This separates all high voltage equipment from the rest of the apparatus thereby safeguarding maintenance personnel. Switching arrangements are provided at each station so that a section of main can be isolated in case of a defect.

On some railways, particularly in the U. S. A. power factor improvement is used to increase the efficiency of signal mains. The method used is to connect capacities across the signal mains at places where an inductive load is connected.

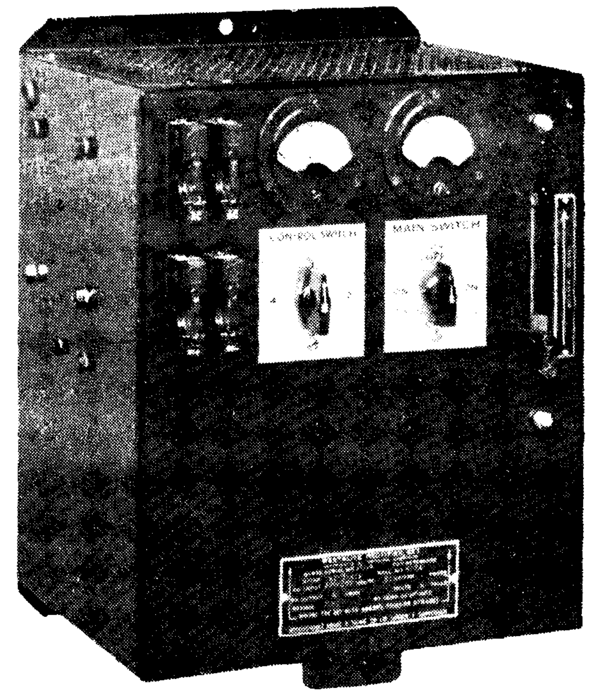
POWER FOR LARGER INSTALLATIONS

The amount of power plant required for a large interlocking like York, waterloo, Euston, Paddington, Stratford, etc. is such that a separate power room or building is essential. On British Railways an electrical supply is usually obtained from the British Electricity Authority. If a railway power supply is available this may be taken as a standby or vice versa. Suitable automatic switching arrangements are arranged to bring the alternative supply in should the main supply be interrupted. Power is usually received at 415-V from the electricity authority or, if the same source is used for electric traction, is reduced from the voltage received and supplied at 415-V for signalling purposes.

A signal main is run from the power room around the area controlled from the signal box and it loops into every signal location where a power supply is required. The distribution voltage depends on the distance of the furthermost places to be fed from the power room and the load in between. For short distances a voltage of 110 is used while for larger areas it may be as high as 660-V. The cabin transformers may therefore step down from 415-V to 110-V or step up to 660V. These are arranged to duplicate, one being in service at a time the other acting as a standby. They are changed over by manual switching arrangements and are usually on load for one week at a time.

The voltage of the circuits inside the signal box depends on the type of control apparatus. In the case of a power frame, with miniature levers, operating circuit controllers, voltages of 110 can be used for controlling the signal relays and point control circuits. In relay interlocking installations the controls on signals and points are small rotary switches mounted on a panel bearing a geographical representation of the area controlled, with miniature lights repeating the position of trains on the various track circuits. The voltages handled by these switches is generally not in excess of 12-V and they operate relays governing control circuits of the normal value of 110-V.

The panel control circuits are usually fed from a lead acid battery of 6 cells on trickle charge through a transformer-rectifier charging unit. The power for the point control circuits depends on the type of point operation in use. This may be electro-pneumatic, or all electric a. c. or d. c. In electro-pneumatic installations, the point switches are operated by air motors at

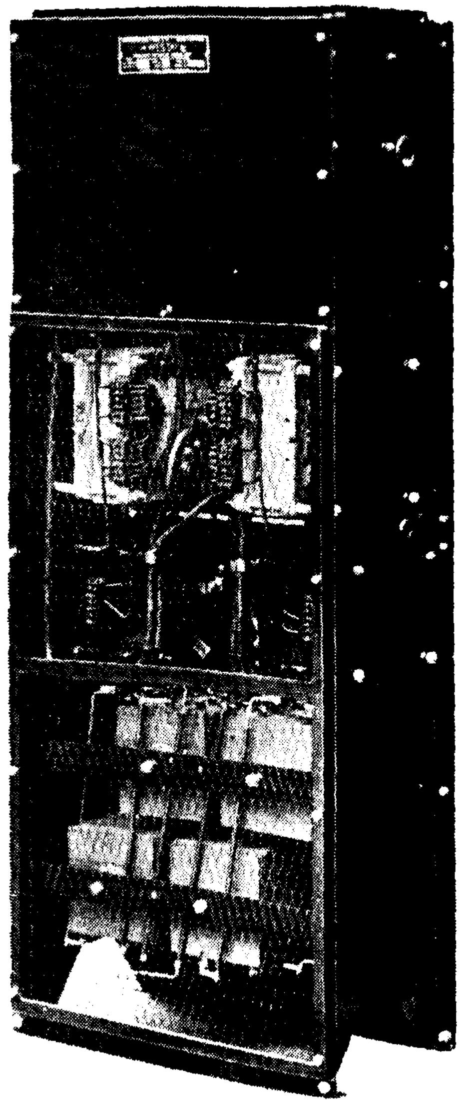


Type SBC. 3 battery charger.

an average pressures of 60! lbs. The passage of air is governed by electrically operated valves energised by normal and reverse contacts on the controlling function in the signal cabin. The control circuit may be a. c. or d. c. but the general practice is to use a. c. with a small rectifier on the point air valve with a d. c. coil for operation. In all electric points the switches are worked by all electric point machines. These comprise an electric motor which actuates the driving bar through a gear train. A clutch is incorporated and cut out contacts for switching out the motor when the work of driving the switches is completed. Both a. c. and d. c. motors are in use though the latter type is probably more popular. These operate from a battery of lead acid cells on trickle charges through a suitable transformer rectifier unit.

The largest relay interlocking installation in the world was opened in the early part of 1951 at York (British Railways). This signal box controls 33¼ track miles and has 317 track circuits. There are 277 power worked points and most of these are electro-pneumatic. The relay room attached to the signal box houses over 3,000 relays. A brief description of the power arrangements for such a large installation will be of interest. Power is received at the signal box by two 660-V single phase feeders feeding a 660-V bus bar through oil filled circuit breakers which are tripped by an over-current time delay relay or reverse current relays in each feeder. From this busbar feeds are taken to the main 660–110-V 35kVA transformers, the 660–110/55 shunt signal lighting transformer and two ring mains feeding north and south of the yard through appropriate switch gear. The two supply feeders to this switch-gear may be paralleled and are brought from a main supply contactor and busbars on the control panel in the power house close to the station. An isolating knife switch is provided to direct to incoming B. E. A. feeder direct to the busbars so isolating the control panel and contacting gear for maintenance purposes. The main contactor is energised over a voltage relay connected across the incoming feeder and set to trip the contactor if the voltage falls more than 6% and to initiate the starting of the standby set. There is a time delay of three seconds in this operation to prevent false starting due to switching surges. The standby diesel engine is started up by two starter motors; when the alternator voltage reaches 660-V, the standby contactor is energised and the set takes the load. Eight seconds are required to run up to working voltage. The standby set comprises a six cylinder 1,000 r. p. m. McLaren diesel engine directly coupled to an 85kVA 660-V single phase Lancashire Dynamo-Crypto pedestal bearing type alternator. The main exciter is also directly coupled to the alternator and is provided with a belt driven pilot exciter and an Isonthal voltage regulator. The set starts and runs without attention and will stop should the lubricating oil pressure not build up within a given time from starting, or fail at any time. Once the set has started a return is not made to the main supply until it has been restored and the set is stopped manually.

The air for operating the point machines is supplied by duplicate, electrically driven two stage air compressors, each with a rated output of 200 cu. feet of free air per minute and driven by 40 b. h. p. 3-phase. 375 r. p. m. directly coupled slip ring motors. The operation is automatic and controlled by the pressure in the air storage tank. The main set starts up when the pressure falls to 55 lb. per sq. in. and stops when the pressure rises to 65 lb. If the pressure drops as low as 54 lb—the standby set is then automatically started. A changeover switch permits either set to be on duty as required. There is also an emergency set of similar design to act when there is a power failure. This set can deliver 100 cu. feet per minute and is driven by a 22 b. h. p. two stroke 450 r. p. m. diesel engine.



1.2 kW constant voltage charger supplied to Southern Railway. This consists of two 600 watt Westat equipments in series, operating from 220/250 volt 75 c.p.s. single-phase. Output 20 amperes to charge a 480 A.H. battery.

Another installation in which all electric point machines are used, is at Potters Bar (Eastern Region). Opened in March 1955 it is one of the largest pattern relay interlockings in the country. All signals are of the multi-aspect type and the points are operated by all electric point machines on a 110-V d. c. supply with a. c. superimposed point detection. The signal box, which is of modern and unusual design, has a separate power room. Power is obtained from the electricity authority at 415-V. 3-phase and is received on the switchboard in the power room. Here it is fed to duplicate transformers and stepped up to 660-V, single phase. The power room also

contains a 30kVA diesel driven generator which automatically takes up the load if the main supply fails. The 660-V supply is fed to cubicle type switchboard in the relay room which contains all the apparatus for distributing the various signal box supplies (except batteries which are housed in a separate room). One half of the cubicle. (screened off from the remainder), receives the 660-V supply, and by means of duplicate transformers and associated control gear delivers 110-V to the other cubicle and feeds 660-V to the outdoor apparatus power cases. The cubicle also accommodates transformer/rectifier sets and contactors with the relevant switches, volt meters and ammeters for the following supplies :—

(a) 110-V a. c. for signal lamp feeds, track circuits, relay local coils etc.

(b) 12-V a. c. for illuminated diagram and console lights.

(c) 110-V d. c. for point machine operation: This supply is taken from an 88 cell 35 Ah battery which is on constant trickle charge through a metal rectifier charging unit. The battery acts as a standby in case of power failure.

(d) 12-V d. c. for interlocking and control relays, point contactors, magnetic point indicators on the illuminated diagram etc. The supply is obtained through a constant voltage rectifier with a floating 9 cell 35 Ah battery which maintains the supply in the event of power failure for the period required by the diesel alternator standby to run up to speed.

These supplied are taken from the cubicle to the fuse and busbar racks.

FUTURE DEVELOPMENTS

The previous section has described the power arrangements which are standard for present day practice in modern power signalling installations. The York installation is at present the largest in use but it is not likely that the size of this interlocking will be exceeded.

The modernisation of British Railways and the growing consciousness for the need of modern signalling on railways overseas will no doubt promote the fruition of many interesting signalling schemes. The decision of the British Transport Commission to use the 25kV 50c/s single phase system of electric traction will introduce new problems for the railway signal engineer. These will principally concern freedom of interference with track circuits and other apparatus. Experiments have been made in France with audio-frequencies generated by valve oscillators but there are complications.

Railway signalling has a long and ancient history of achievement and problems surmounted and with its present wealth of experience in mechanical, electrical and telecommunication engineering and electronics it can face the future with confidence.

BHILAI STEEL PLANT

Prime Minister Nehru said that the Bhilai steel plant was expected to be completed on scheduled (by the end of the year) but if the schedule was passed, it might be by a month or so—not much.

Mr. Nehru who was replying to a question at his Press conference about a recent communication from the Soviet Premier, Mr. Khrushchev, on the progress of the plant, said certain delays had occurred but Government would keep to the schedule. "We hope we will keep to the schedule. But if it is passed, it may be by a month or so and not much."

The Prime Minister said that the Soviet Ambassador to India, on his return here some weeks ago from the Soviet Union, brought a letter from Mr. Khrushchev to him regarding the Bhilai steel plant.

Mr. Khrushchev had expressed the hope that there would be no delay in the plant's completion on time. "We, of course, are very anxious that there should be no delay."

Mr. Nehru said that some delay had occurred because of two or three reasons. One contractor did not come up to expectations and delayed matters. There was some delay at the ports. Then there was the big question of trained personnel for the steel plants. These trained men were needed in thousands for the three new steel plants and one old one whose capacity had been doubled. All this work had absorbed all the welders and other trained people in this work. India was sending a number of people to the Soviet Union for training and technicians were coming here from the Soviet Union.

Signalling System on the Netherlands Railways

SAFETY ON THE LINE

The task of the signalling system is—inter alia—to render train movements safe by mechanical and electrical means.

The Netherlands Railways adhere to the principle that between two trains running on open track in the same direction there must always be at least one fixed signal indicating "stop". On the same principle, on a single-track line there must be a fixed signal indicating "stop" to prevent the despatch of a train, if the particular section of line is occupied or about to be occupied by a train coming in the opposite direction. If such signals and the points concerned in train movements are manually operated, we speak of a "block system". A part of the free track to which only one train is admitted is then called a "block".

The Netherlands block systems are absolute, which means that restrictive admission of a second train to an occupied block is forbidden. At the entrance to each block there is a block signal, which must be locked behind the train by the block signalman by electrical means. This lock can only be opened when the next signalman has locked his signal behind the train.

Although very few mistakes are made in the manipulation of the equipment described above, every precaution has been taken by the Netherlands Railways to preclude premature or incorrect operation.

To increase safety, the operations have been made dependent on the co-operation of the train, which is brought about when it passes over an insulated section of rail which is connected to a track circuit, this circuit being shorted via the wheels and axles of the train.

These and as many other safety devices as possible are constructed in such a manner that any fault in the system indicates a position corresponding to "danger" or "permission withheld" (closed circuit principle). Nearly all the important lines in the Netherlands are equipped with these block systems.

Although it is impossible for a second train to enter a block with the signal at danger, there is still a chance of an error being made. Vehicles may by mistake be left behind, or enter a block without the signalman noticing it. The only protection against this danger is to extend insulation to the whole of the block and to make the regular admission of a train dependent on the track being unoccupied. This is an expensive solution, but it is the only effective one if the possibility of errors is to be precluded. By the additional step of making the operation automatic, an automatic block system is obtained.

On 31st December, 1952, 240 kilometres of track were fitted with an automatic block system and 1,600 kilometres with other block systems.

Since World War II the Netherlands Railways are gradually replacing the semaphore signals by coloured light signals, which are clearly visible at a great distance, even when viewed against the sun.

Unlike semaphores, light signals no longer indicate a direction, but exclusively show speeds, based on the generally accepted principle that it is not the direction in which he may travel, but the speed at which he can run that is of importance for the driver. Each signal not registering "stop", gives the requisite indication as to the position of the next signal on the line. The light signals are placed at intervals of about 1,500 metres. The introduction of this new system has rendered it possible for trains to follow each other at very frequent intervals.

SAFETY AT THE STATIONS

A second important factor in safety is the assurance that the points and bridges are in the correct position and are secured as long as the train passes over them.

The mechanical interlocking of signals and points is very old, older than the block system. Originally the system was confined to making the operation of the signals concerned dependent on the locking of the points.

At a very early stage the system was introduced in the Netherlands of having the signal boxes at the stations co-operate by operating electrical locks, to control the proper direction of running, and transferring the releasing of the points crossed by a

train when entering a station to another centre, the so-called control post or train direction officer's post. In this case, too, the co-operation of the train is invoked at a very early stage, in such a manner that the lock retaining the closure of the points is not released till the last axle has left the insulated rail. Proper control of the number of trains on the track is greatly promoted by co-operation of signal boxes. Here, too, however, just as in the case of the automatic block, the last word is—insulate the rails. Complete insulation of the arrival tracks at stations is being adopted more and more.

The electrical operation of points and signals, less subject to distance than manual operation, has led to a concentration of signal boxes. The problems consequent upon the extension of apparatus in length were solved by the construction of very remarkable multi-row devices, a Netherlands invention, which was in fact the only system which offered a fundamental solution of the difficulties. This system has in turn been outmoded by apparatuses which effect the connection between points, track occupation and signals entirely by electrical means (all relay interlocking). Even if there is a choice of directions of travel, it can be dealt with automatically. Manipulation is effected by pressing buttons on a panel showing the lay-out of the station. Since the manipulations are extremely simple and require no exertion, while erroneous operations have no effect, it is possible to handle traffic at a rapid rate. The possibilities, even for large stations, have been recognized in this country and the largest installation of this type was successfully taken into service, without any hesitation or previous testing at small stations. Practically all the components of the NX (eNtrance-eXit) system are now also being manufactured in the Netherlands. For the present the Netherlands is not adopting the control of several stations from a central point (centralized traffic control) because investigations have shown that in view of the number of staff required, no economy can be effected by the system and the capacity of the lines cannot be increased to any considerable extent. The signalling systems of the Netherlands Railways are all such that a fault can never give an indication of an "all-clear" situation. Nor have they signals indicating "all-clear" by not giving any indication at all.

SAFETY AT CROSSINGS

On 31st December, 1952, the Netherlands Railway system had 3,358 crossings of public roads and the railways. Of these there were 2,090 crossings on main lines and 1,139 on local lines. Of the former, 827 crossings were guarded or closed in some way; of the latter category, 146. The Netherlands Railways regard as the ideal solution of the problem of crossings the free crossings, i. e. bridges and viaducts over or under the railway. There were 448 of these in the network on the above date.

Of the 3,229 public level crossings between road and rail on the main and local railway lines 600 were protected by barriers operated on the spot and 373 crossings with remote-controlled barriers. Furthermore, on 31st December, 1952, 99 crossings were served by automatic equipment consisting of a flashing light. These are installations operated by the trains and situated on the right hand side of the crossings which are not closed. If there is not train approaching they show a green light which flashes 45 times a minute. This proves once more that the Netherlands Railways do not identify themselves with the principle accepted in other countries that an "all-clear" condition can be indicated by giving no sign at all. On the approach of a train a red light on these signals flashes with a frequency of 90 per minute, while at the same time a bell starts ringing. If the equipment is out of order, this is shown by a constant orange light in which is printed the warning "signal not in operation". Finally, there are 80 crossings equipped with swing gates. A new form of level crossing safety device in the Netherlands is the half crossing barrier of American type with alternate red lights and a bell signal. These barriers only close off the right hand side of the road and are fitted with flashing lights which show red during the descent of the bar and while it is closed. On the pole placed on the right hand side of the road to which the barrier is attached there are also red flashing lights, as well as a bell signal. With this type of crossing barrier, which is mainly employed at remote-controlled crossings, it is impossible for a road user to become shut in between the barriers. If he is on the crossing while the barriers are descending, he can always escape. Both the unguarded and the automatically controlled crossings in the Netherlands are provided with St. Andrew's crosses, which are placed at 12 metres distance on either side of the crossing and which consist of one or two crosses, dependent on whether they indicate a single track or double track line. At some unguarded crossings there are, moreover, warning signs which consist of triangular signs

(Continued on page 14)

SPE "WALTER" Type Split Bushes for use on Railway Signalling Equipment

SIGNALLING equipment, where cranks, compensators and so on, constitute potential wearing points which, by virtue of their multiplicity, present an appreciable problem for railway maintenance staff, if the inevitable wear is to be kept within limits which will not affect the efficiency of operation.

To provide for such a situation most railways today have adopted the policy of bushing components so that wear is at least confined to a renewable steel bush rather than allowing it to develop on a component part relatively expensive to repair. Such a policy necessitates the accurate machining of bushes to provide the requisite interference fit, and the provision of oversize bushes and pins to suit holes which for various reasons subsequently need enlarging, and, ultimately, the scrapping of components when the maximum hole diameter is exceeded. It also implies the existence of hydraulic or pneumatic presses for fitting and removal, which in turn involves labour in transportation of components to and from such presses.

A simplified and economical method of bushing various components using normal hand tools only can be carried out by using Walter Patent Bushes as manufactured by the SPE Co. Ltd., Edinburgh Avenue, Trading Estate, Slough, Bucks.

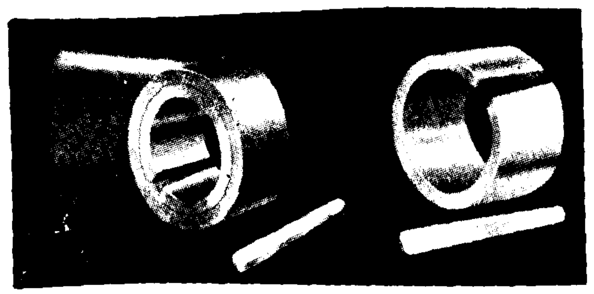
The split bush is tapped into place and positively locked into position by the application of a tapered key firmly driven home, the protruding ends of the key being finally cut off and the edges left smooth. To remove such a bush when worn is equally simple, and as the Walter bush is case-hardened it ensures utmost resistance to wear even when positive lubrication is absent (also supplied in stainless steel and bronzes).

As such a bush does not have to withstand the pressing-in stresses normal to a plain bush, it is not necessary for it to have a wall thickness of more than 1/8 in. and therefore for the same size pin a smaller hole in the component is required. Thus if the Walter bush is embodied in new designs opportunity may be taken to reduce the cross-section of the component without reducing strength and so obtain a reduction in material resulting in a lighter component.

The Walter Bush can be worked to close tolerances. The tolerance is actually only the variation in the wall thickness of the bush. During manufacture of these bushes they are placed into a definite outside diameter hole and the bore is sized thus controlling the wall thickness to within $-.000''$ to $+.002''$ for normal applications. For example 1" outside diameter bush, when fitted to a normal 1" hole can be supplied to give the following bore tolerances.

"A"	+.006"
	+.010"
"B"	+.002"
	+.004"
"C"	+.002"
	-.000"

The difference between the Walter Bushes and a solid bush is that the variation in outside and inside diameters is dictated *ONLY* by the exactness of the holes in which these bushes are fixed.

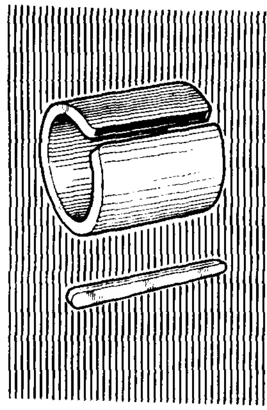


(Continued from page 13)

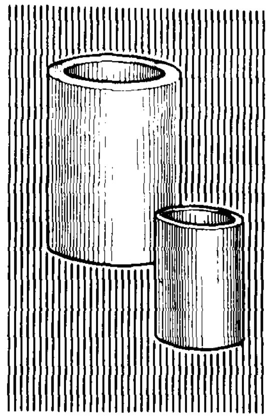
with a red border with a locomotive against a white background.

The visibility of the guarded crossings is increased by improving the lighting. At the unguarded crossings numerous obstacles which impede a free view are being removed. Furthermore, on barriers and warning gates a light reflecting material, Scotchlite, is being introduced, making these objects more noticeable in the dark.

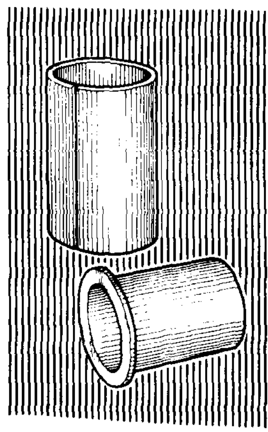
BUSHES



WALTER PATENT SPLIT BUSHES
in
CASE-HARDENED STEEL
NON-CORRODIBLE HARDENED STAINLESS STEEL
NON-CORRODIBLE BRONZES
Manufactured in other materials to customer's specification
Supplied with taper keys in size range ¼" to 12" internal diameter



PLAIN BUSHES
in
HARDENED & GROUND STEELS
HARDENED STEELS (Burnished finish)
NON-CORRODIBLE HARDENED STAINLESS STEELS (Ground or Burnished Finish)
BRONZES - Thin or thick walled



WRAPPED BUSHES
in
STEEL
BRONZES - Thin or thick walled

FLANGED BUSHES
in
STEEL
BRONZE

- Manufacture of Bushes in other materials to customer's specification
- Large or small quantities

SPE COMPANY LTD.
SLOUGH BUCKS ENGLAND
TELEPHONE SLOUGH 24271 TELEGRAMS PRIMING, SLOUGH

Where, however, they are required to replace plain bushes in stock already in service the wall thickness or outside diameter can be increased to meet existing conditions.

In specifying such bushes for new stock the question of standardisation is most adequately dealt with, since future renewals call simply for the replacement of bushes of the original size, and no question of stocks of oversize bushes arises, nor consequent renewal of main components.

£ 2,500,000 INDIAN RAILWAY CONTRACT FOR BICC GROUP

The BICC Group has been awarded a contract by the Indian Railway Board for the design, supply and installation of 25 kV 50-cycle, single-phase A. C. overhead equipment. The approximate value of the contract, obtained against keen international competition, is £ 2,500,000 of which about 60% will be spent in Indian currency on locally manufactured materials and the local staff and labour costs, while about 40% will be in materials to be supplied from the United Kingdom.

The lines to be equipped are near Calcutta on the main line to Bombay on the South Eastern Railway; they lie between Tatanagar and Rourkela, together with the branch from Rajkharswan to Dongaposi. The length of track to be electrified is about 420 miles and the route links the iron ore fields in Bihar with the existing steel plant at Tatanagar and the new plant under construction at Rourkela.

The copper catenary and contact wire will, in most cases, be supported from steel masts by means of hinged cantilevers which allow along-track movement. The tension in the conductors will be kept constant by means of balance-weights, thus giving a level contact wire suitable for good current collection at high speeds.

The Indian Railways have decided to standardize their future electrifications on the 25 kV 50-cycle single phase A. C. system. Previously, lines in the Bombay district were equipped for 1,500-volt D. C. operation and in the Calcutta area lines were equipped for 3,000 volt D. C. operation. The overhead equipment for over 500 track miles of the lines in the Bombay area was designed, supplied and erected by the BICC Group who also supplied and installed the power and communications cables on the 3,000-volt D. C. system in the Calcutta area.

Work on the new contract is to begin immediately and is due to be completed in June 1960.

Diesel Rail Bus for British Railways

THE British Transport Commission has entrusted to Messrs. Waggon- und Maschinenbau GmbH. Donauwoerth, the design and construction of five Diesel Rail Buses. The cars which are equipped with only two pairs of wheels are, it is understood, to be put into service in rural and suburban services. The bodies of the cars have been designed in accordance with British Railway requirements and the underframe and power equipment, transmission and brake gear are generally of similar design to cars at present running on the German Federal Railways. The cars will all pass the BR Standard C 1 loading gauge.

In the design of the cars attention has been given to light weight construction principles. Wherever possible standard production components have been used in order to facilitate the supply of replacement parts as necessary.

THE MAIN CHARACTERISTICS AND DIMENSIONS ARE AS FOLLOWS :

		appr.	
A) CAR BODY	Length over buffers	45'—9¼"	13950 mm
	length of car body	41'—10"	12750 mm
	width over body panels	8'—8⅜"	2650 mm
	inside width of body	8'—4"	2539 mm
	height from rail to top of roof	11'—9⅛"	3587 mm
	height of floor above rail	4'—0"	1220 mm
	interior height, floor to ceiling	7'—6"	2286 mm
B) BOGIE	Gauge	4'—8½"	1435 mm
	wheelbase	19'—8¼"	6000 mm
	wheel diameter	3'—3⅜"	1000 mm
C) POWER UNIT	Diesel underfloor engine (" BUESSING ") 150 HP (150 PS) at 1900 r. p. m.		
	Power transmission : a) ZF electro-magnetic 6-speed gear box		
	b) Final drive and reversing gear (" GMEINDER ")		
D) GENERAL	Max. speed	55 mph	88 km/h
	Tare weight of car (ready for service)	15 tons	15 to
	Power weight ratio	10 HP/ton	10 PS/to
	Seating	56 persons	
	Standing accommodation	40 passengers	
	Compressed air disc brakes (" KNORR "—BSI)		
	Hand brake — lever operated from driver's cab		

ODY

The body contour has been designed to comply with ie British Railways C 1 loading gauge. To meet the quirements of the body designed and for absorbing uffer shocks, a through length underframe is proded constructed of longitudinal girders made up from elded flanged plates. The cross beams are of andard Channels NP 14, the other cross beams ing of channels of the NP 10 type. To increase the gidity, a corrugated plate floor is connected to the nderframe. This corrugated plate is welded to the longitudinal and cross beams by means of plug and stitch welding, and design produces a car body of light and modern welded construction. The exterior and roof sheeting are of light metal. The ends are of light gauge steel plate.

A side apron 425 mm. deep is welded to the solebars and provides an extension to the body side panels.

The underframe consists of channel-shaped crossbeams (NP 14 and NP 10) which are welded to the longitudinal girders. Traction stresses produced by the Power Equipment are transferred into the longitudinal girders by means of parallel and transverse braces consisting of flanged plates. To absorb compression stresses and maintain rigidity, the floor has been constructed of corrugated steel sections attached by welding to the underframe longitudinal and transverse members.

The body framing is formed as a light steel structure fabricated by welding together flanged plate channels. The body side pillars are " Zed " section pressings. The side and roof panals of non-corrosive light metal sheets have been riveted to the body framing. The roof plates have been crimped longitudinally in order to provide maximum rigidity. To achieve a balanced light weight structure the steel has been used for the underframe and body framing members whilst aluminium sheets form the body side panels.

UNDERFRAME

The underframe is a rectangular constructure comprising two longitudinal side girders (or sole-bars) and two headstocks of rolled sections and welded together. In addition longitudinal and transverse members are fitted as necessary to carry the Diesel-mechanical power unit and give ample rigidity to the frame. The axle boxes for roller bearings of the " SKF " type are carried in adjustable guides of the " FERROZELL " type, having a longitudinal clearance of 0,5 mm. and a transverse clearance of 0,5 mm. " FERROZELL " is a wear-resisting synthetic material which does not require lubrication and has been used successfully on the German Federal Railways for a number of years. The axle clearance of 2×0,5 mm. enables—in contrast with a rigid axle — smoother running when negotiating curves.

During trial runs with the cars riding has proved to be very good with an absence of any appreciable oscillation or undue vibration, irrespective of the fact that the wave length of the sine curve is so much shortened by the clearance of the axles. The longitudinal clearance of the axles is kept constant by wedge adjustment, but this adjustment is necessary only after long periods in service due to the use of " FERROZELL " which has high wear-resistant qualities. The light wheel sets with double waved wheel discs and solid axles are carried by 6-plate laminated springs via adjustable spring screws on the underframe. The wheel diameter of 1000 mm. permits 24 mm. of tyre wear. Each axle has two brake discs of the " BSI " type by which the brake is applied through brake shoes having a lining of synthetic material.

POWER UNIT

The supply of fuel to the diesel engine is pneumatically regulated by a foot-operated valve installed in the driver's cab and by a governor fitted to the engine. In case of failure of the pneumatic throttle motor, the engine can be controlled by a hand lever. A governor of the injection pump (" BOSCH ") limits the speed when running idle. A push button fitted on the driver's panel enables the driver to cut out the engine electro-pneumatically. The cooling water of the engine is passed through a cooling unit with hydraulic fan drive of " BEHR " type mounted in the underframe and is automatically kept within a limit of 72/80°C.

The air intake to the engine is via an exchangeable filter element of the " DELBAG " type fitted in an accessible position in the vestibule. The exhaust gases are carried away by an exhaust pipe rising through the roof of the car, the pipe being insulated against heat and sound.

The engine-driven fluid flywheel operates automatically depending upon the speed of the engine and is locked when either shaft exceeds appr. 800 r. p. m.

Drive to the 6-speed gear box is by conventional cardan shaft. This gear box is of an electro-mechanical type, the 6-speeds being electrically selected by the driver, drive being by means of electro-magnetic multiple disc clutches. The 6-gear ratio allows full utilization of the engine power curve.

Final drive torque is transmitted to the frame by means of flexibly mounted torque arm. Drive from the gear box to final drive is again by conventional cardan shaft. Forward and reverse gears are mounted in the final drive unit and selection is operated pneumatically by driver controlled valve. In the event of loss of air pressure the design allows for selection by hand, access to this being by means of trap in floor.

INTERIOR FINISH

The floor, body sides and roof are fitted with special insulation materials to provide thermal and sound efficiency. The interior of the car is lined with plywood panels having a clear LIMBA polish whilst the ceilings are painted ivory finish. The front and body side windows of safety glass are secured by rubber glazing material. The upper parts of the body side windows are hinged to provide a limited ventilating opening. Curtains are provided at the body side windows and sun visors are fitted at the driver's front window as protection against direct sun rays. The saloons are equipped with luggage racks running lengthwise above the windows and are of light metal construction with hemp mesh netting. The seating arrangement is 2×3 giving a seating capacity of 56 seats (i. e. 18 in each saloon). The seats are constructed with spiral springs covered by rubberised hair and trimmed in artificial leather of green colour. The seats are padded with rubberised hair and trimmed with an artifical leather. The doors which are situated almost centrally on each side of the body are power operated and under the control of the driver, but a push button is fitted above the doors to enable passengers to operate the opening of the doors. In case of emergency the doors can also be opened and closed by hand. A luggage room is provided of each side of the car in the entrance vestibule.

The header tank for the cooling water, engine air inlet and filter, fire extinguisher and tool/medical cupboard are located in the luggage room through which the exhaust pipe also passes. A letter rack and emergency ladder are fitted in the second luggage room. All operating and driving controls are located in the driver's cab which is separated from the passenger accommodation, and is fitted with a door.

The driver's window is fitted with an electrically operated windscreen wiper and a suitable type of sun visor. The driver's window has a defroster, which is heated from a nozzle. For the driver an upholstered folding seat is provided. The rear windows are fitted with curtains to prevent ingress of light from the passenger compartments; a small extinguisher is provided in each driver's cab.

ADDITIONAL EQUIPMENT

Apart from the windows of the hinged opening type, special electric turbo fans (to be operated by the passengers) and automatic fans have been provided.

In the cooling water circuit four radiators are interconnected with the engine cooling system, as well as a " WEBASTO " oil heater for preheating and keeping warm the cooling water.

The electric equipment consists of 4 batteries (12 volts, 180 Ah Din 72311) and of 2 generators ("BOSCH") of 1000 watts, driven by the diesel engine. The engine's starter and the magnetic valves for the door operating device are of 24 volts, all other equipments, encl., 16 ceiling lamps, of 12 volts.

At both ends of the car, on the roof, a three-tone typhoon (alternate tone) horn is fitted. The signal buzzers are operated electrically from the driver's stand.

The rail buses are equipped with automatic compressed air disc brakes, of the " KNORR " type; in the event of failure causing reduced pressure of the brake pipe, the brakes are automatically operated.

In addition to the compressed air brake equipment, an electro-pneumatic " dead man's handle " is fitted.

The sanding gear is air-operated controlled from each driver's stand. The sand boxes are fitted on the driving axle in accessible positions.

Railway Minister says limited resources in way of railway expansion

Shri Jagjivan Ram, Union Minister for Railways, said at Dhar, Madhya Pradesh, on November 6, 1958, that the demands for new railway lines in various States was great, but the resources were limited. He said that the railways would require at least Rs. 1,400 crores in the third Five Year Plan if they wanted to provide additional railway lines in every State of the Indian Union.

He said there were demands for expansion of railway lines in every State and in certain States they wanted priority over others. The Jammu & Kashmir and Tripura & Manipur States had demanded that they should get priority over other States in respect of construction of new lines because they did not possess even an inch of railway line at present.

Shri Jagjivan Ram said the cost of construction of railway lines per mile in the plain region of the country was about Rs. 7 lakhs and Rs. 16 to 25 lakhs in hilly and mountain areas. He said the demands for railway lines were great but resources were limited. New railway lines, especially in backward areas would be of no use unless road development programmes were taken in hand simultaneously.

Automatic Operation of Points in Railway Marshalling Yards

THE goods traffic carried by a railway provides a very considerable portion of its revenue. The amount received from this source is there for almost directly proportional to the speed and efficiency with which goods trains can be handled. These trains are composed of a number of wagons picked up from junction and wayside stations, each meant for different destinations. They have to be broken up and resorted in goods yards so that new trains can be formed with wagons so marshalled that they can by shunted off at stations with the minimum amount of delay.

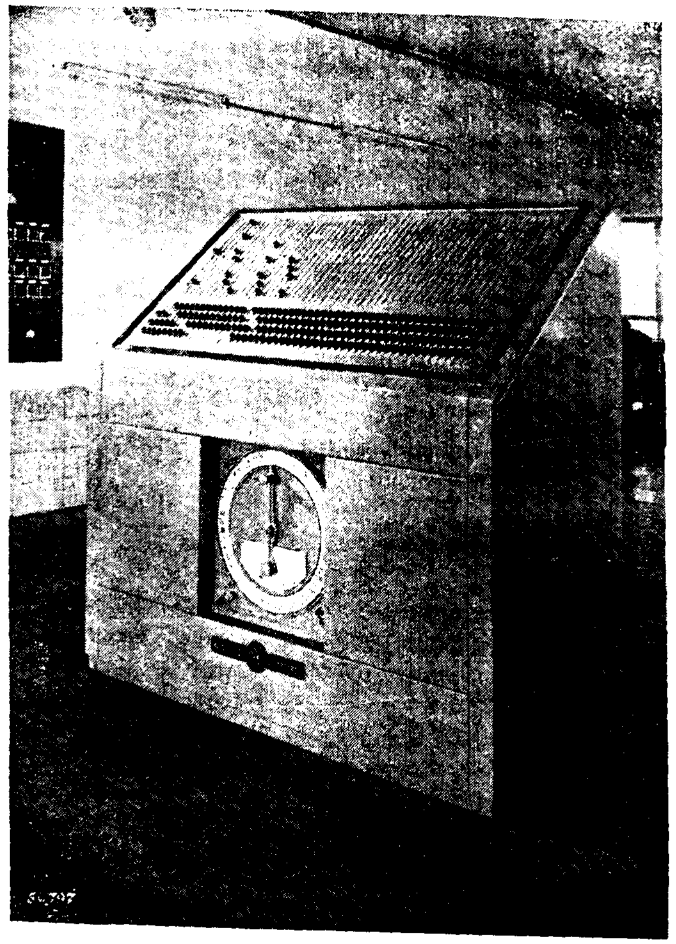
In modern practice large goods yards are now divided into several parts consisting of (a) the reception yard (b) the shunting yard or sorting sidings and (c) the formation yard. The reception yard receives the trains. There they are uncoupled and taken over by the shunting engines. The shunting yard is where the trains are broken up and the wagons distributed to a number of tracks according to their destinations. The number of tracks provided depends on the density of traffic in the yard and space available. The formation or marshalling yard is where new trains are made up and trucks arranged in correct order for shunting off at their destination.

The approach to the sorting sidings from the reception lines is by means of a hump and the wagons are slowly pushed to the top of this hump by the shunting engine. The trucks then descend the hump by gravity and enter the head of the sorting sidings. It is necessary to control the speed of the wagons at this point. In some instances they must be allowed to attain sufficient momentum to allow them to reach the furthermost end of a siding: in others they must be checked to prevent them coming into violent collision with other wagons if the siding is half or three quarters full. There are several factors which influence the speed of a wagon running down the hump to the sorting sidings; wind velocity, loading of wagon, axle lubrication, etc. Each wagon may therefore attain its own individual speed and it is necessary to check those that travel fast to prevent overtaking. In early installations this was done by brakemen who slipped skids on the rail between the wheels of a running wagon. This was pushed along the rail by the wheel the increased resistance slowing up the wagon. The skids were ejected from the rail at fixed points by blocks fixed to the rail. In modern schemes rail brakes are used. These consist of bars mounted parallel with the rails and these squeeze the wheels under pressure which may be hydraulic, pneumatic or electric. The brakes are controlled by a brakesman in a control tower. The introduction of track brakes was an important step in the modernisation of marshalling yards affording flexibility in braking and eliminating the dangerous task of men placing skids under the moving wagons.

There may be as many as 40 to 50, perhaps more, point switches between the head of the yard and the sorting sidings and several of these have to be operated for each wagon. Six to eight wagons per minute may be coming over the hump so that even if the points are power operated it would be impossible for an operator to cope with so many manipulations per minute.

This problem has been appreciated by the Belgian Railways who have placed orders with Ateliers de Constructions Electriques de Charleroi for the partial or total equipment of various marshalling yards in accordance with the individual circumstances pertaining to each case: Hal (1929), Grand-Maritime (1930), Antwerp North (1932), Schaerbeek (1935), Veroux-Goreux (1949), Courtrai (1953), and Saint-Ghislain (1955). The installations employed in the last four yards are automatic, three being of the " all

Panel in control tower.
(*Courtesy*: A.C.E.C. Charleroi)



Route recorder in control tower.
(*Courtesy:* A.C.E.C. Charleroi)

relay" type. In the case of Courtrai and Saint-Ghislain all the points are automatically controlled.

In the reception yard the goods train is divided into a number of "cuts". A cut is the technical term for several wagons coupled together, meant for the same destination and which will go to the same sorting siding. Before the sorting of each train starts, the operator records in order the sidings to which each cut is to be sent. Shunting then commences and as each successive cut is pushed over the hump it travels through the head of the yard to its appropriate siding the points automatically setting behind it ready for the following cut.

The equipment installed in the control cabin enables the whole installation to be operated by a single brakeman when automatic sorting is in use. Provision is made for the individual operation of points if necessary. This facility is not often used but it is advantageous for maintenance testing and also for changing the route of a cut during sorting should it be necessary. The control apparatus comprises three units, the recorder, the control desk and the brakesman's illuminated indicator panel.

The recorder serves to fix the routes of the cuts in the order of their arrival. The routes are set up by the insertion of plugs corresponding to the number of the sorting siding. When the plan of distribution has been set up it can easily be checked by direct reading of the siding numbers from the plug panel. The unit is usually set up before sorting commences but it is possible to change the routing of cuts from one siding to another by transferring plugs providing the track circuits concerned have not become occupied.

The recorder contains a cut selector the dial of which appears in the front of the cabinet. This selector serves to choose, in order, the various routes which have been set up. The device has 50 positions and advances step by step as the cuts pass over the first set of points. It is operated either by track circuit or photo electric cell associated with the points. The selector forms the link between the recorder and the automatic point control relays.

The control desk is arranged to rotate through an angle of approximately 120 degrees, about a verticle axis, so that the operator can place it to suit circumstances. The main panel of the unit shows a schematic plan of the shunting yard represented by luminous lines. Push buttons for individual point control and for operation of the signals at the entry of the hump are also mounted on the panel. Main push buttons are provided which can partially or completely switch off the installation with the exception of the point control and supervisory circuits. The buttons allow the choice of automatic control of one or both halves of the yard or of individual control of the whole.

Arrangements are such that one half of the yard may be working automatically while the other is being manually operated. During automatic operation, additional supervision of the passage of the cuts over the first set of points is normally effected by a photo detector. The method used for detection of the position of cuts in the yard head must be such that the passage of vehicles is detected on a sufficiently short section of track as, when two cuts arrive simultaneously on the same section, overtaking is considered to have taken place. This could not be accomplished by the use of a track

circuit since this operates only once and cannot detect the arrival of a second cut.

The Courtrai and Saint-Ghislain yards are equipped with photo electric detectors at the right of the first set of points. The installation consists of two photo electric cells illuminated by corresponding light sources. The light beams are crossed and during normal operation only one cell is in use the second acting as a standby. The beams are inclined with respect to the track in order to prevent repeated operation of the detector when cuts composed of several coupled wagons are passing.

An epitome of the sorting operations as carried out by the ACEC system is as follows. The goods train arrives on a siding in the reception yard, the goods engine is detached and a shunting engine takes over. The train is divided into cuts and their destination is communicated to the operator in the control tower. He sets up the itenaries of the various cuts by inserting plugs in the recorder. The shunting commences and after the first cut has descended the hump, cleared all the points and entered its sorting siding, the various points concerned automatically reset for the next following cut. The whole process continues automatically until the last cut has come to rest in the appropriate sorting siding.

The operator only has to hold a watching brief while automatic sorting is in operation the progress of each cut being indicated on the illuminated panel. Emergency arrangements are provided in case a cut may be routed into the wrong siding and the operator is provided with an indication of the track on which the cut is standing. The indication is given by the illumination of red lamps on the control panel and is provided irrespective of the cause of the deviation which may have been due to one cut overtaking another, non-operation of points or individual operation of points during automatic sorting.

To summarize the installation, the ACEC system of automatic control has the following functions:—

(1) To set the points in the path of each cut in accordance with the desired distribution.

(2) To cancel the route of any cut which overtakes another so that this incident will not affect the sorting of following cuts.

(3) To supervise the correctness of the distribution by indicating the position of any incorrectly routed cut.

(4) To permit priority operation of any individual set of points without affecting the automatic operation of the remainder.

INDIAN TEAK PURCHASE MISSION

The Minister of Works, Housing and Supply, Shri K. C. Reddy, said in the Lok Sabha during question hour on September 22 that an Indian Teak Purchase Mission had visited Burma to negotiate the purchase of teak.

The members of the Mission were: (i) Shri V. N. Rajan, I. C. S., Director General of Supplies and Disposals; (ii) Shri H. D. Singh, Director, Ministry of Railways (Railway Board); (iii) Shri S. N. Ghosh, Deputy Secretary, Ministry of Finance (Supply Branch); (iv) Shri B. N. Swarup, I. A. S., Deputy Secretary, Ministry of Commerce & Industry; and (v) Shri V. Subramaniam, Deputy Director (Supplies), Directorate-General of Supplies and Disposals. The Mission also visited Thailand (Bangkok).

The Minister added that discussions were held by the team with the Burma State Timber Board for the supply of 15,000/20,000 tons of Burma Teak during 1958–59 to meet the requirements of the Railway Board and a provisional agreement reached, which awaited the final approval of the Burmese Government. The visit to Thailand was exploratory in character with a view to investigating additional sources of supply.

* * *

RAIL BUSES TO BE INTRODUCED

Shri S. V. Ramaswamy, Deputy Minister for Railways said in Coimbatore on November 7, 1958 that the Indian railways would introduce in large numbers "rail buses" to cover short distances and to meet the rather enormous road transport competition.

At least a dozen such "buses" would be made available in the Southern section and orders for them had already been placed with the Chittaranjan Workshops.

Shri Ramaswamy said that in the interest of economy, the Railways would use diesel engines as far as possible.

Telecommunication Cables for British Railways Manchester-Crewe Electrification

THE British Transport Commission have announced the award of a £ 290,000 contract to British Insulated Callender's Cables Limited for the supply and installation of telecommunication cables on the Crewe-Manchester line as part of the Railway Modernisation Programme This follows the recent award to the BICC Group of the supply and erection contract for electrification of this line and is a striking tribute to the technical resources of the BICC Group. Both audio and carrier types of cable are included in the installation, together with distribution cabinets and trackside telephone cabinets.

Severe problems are set for the telephone cable designer by the presence of a 25kV alternating current traction system running in close proximity to telephone cables throughout their length. In conventional cables the voltages induced by high load or fault currents in the overhead traction system might be sufficiently high to cause damage to the insulation of the cable and connected apparatus, or to endanger the lives of people using the railway telephone system.

It is therefore necessary to provide heavy screening to keep the induced voltage on the cables within safe limits. BICC have developed for this purpose special cables having aluminium sheaths of sufficient thickness to give a low longitudinal resistance, and provided with a multiple steel tape armour of selected material to raise the external sheath impedance The earthing of the cable sheaths is of the utmost importance in ensuring the effectiveness of the screening, and the BICC system of deep driven earthing rods is eminently suited to provide earthing points of low resistance at regular intervals.

It is of paramount importance that both the steel tapes and the aluminium sheath should be securely protected against corrosion, both from earth currents and local soil conditions because of their vital importance for screening purposes. Very careful attention has therefore been paid to the protective serving which is applied over the steel tapes, this being the patent P. V. C. and rubber sandwich type which the Company introduced some time ago for use on power cables. In this connection the Company's wide experience of resolving corrosion problems has been of great value and it may be said that these cables are as well protected as any yet supplied to British Railways. A point of interest is that the security of the protective serving is tested by applying a voltage of 10 kV between the steel tapes and the coating of graphite with which the cable is finished: this means that a final test can be made after the cables have actually been laid so that the state of the serving need not be in doubt.

VOLUNTARY BLOOD DONATION FOR BLOOD TRANSFUSION SERVICE

The Financial Adviser and Chief Accounts Officer of the Western Railway arranged with the St. George's Hospital voluntary blood transfusion service for a Lecture and Film Show held in his office in the new Churchgate Station Building recently. The Lecture was well attended by both the officers and staff. What is more gratifying is that in response to the appeal, 5 officers and 40 members of the staff volunteered to donate their blood. The Accounts Department of the Railway must be congratulated on their voluntary endeavour in supporting the worthy cause.

* * *

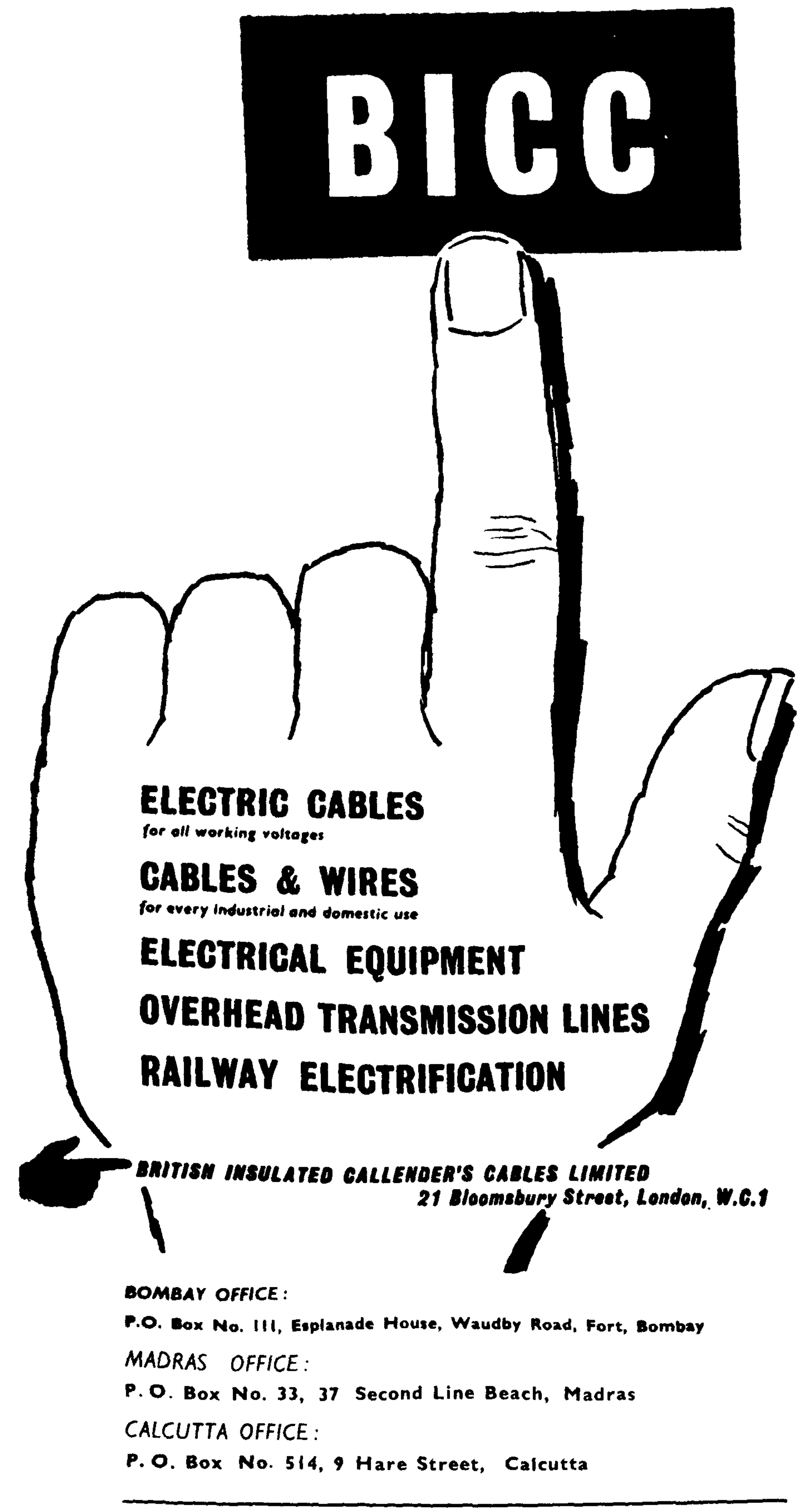
MARKED DECLINE OF CRIME ON RAILWAYS

Shri Shah Nawaz Khan, Deputy Minister for Railways, enumerated the various steps the Railway Ministry had taken in co-operation with State Governments to put down crime on railways.

He was speaking during a two-hour discussion on a non-official motion moved by Shri Dwarka Nath Tiwari in the Lok Sabha on "the state of insecurity and danger to life and property in railway travel and protection of railway staff against police and officials who violate rules".

Shri Shah Nawaz Khan said that exaggerated pictures of these crimes had been given, although one would not deny that these crimes took place frequently. The Government had always tried to minimise them and ensure safe travel on the railways.

The Deputy Minister quoted figures to show that there had been a marked decline in cases of theft, loot, dacoity and murders as a result of the various measures taken by Government.



The Application of Radio Links to Railway Signalling and Communications

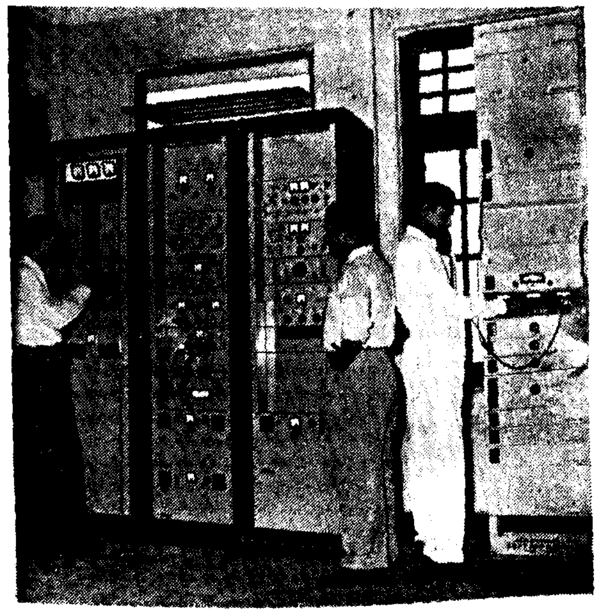
By D. N. Weston and J. B. Paterson

GENERAL INTRODUCTION

IN the last 15 years or so the advances made in the design of radio valves, components, and circuit techniques have enabled new types of radio equipment to be manufactured which can be used as a direct alternative to, or replacement of, open-wire telephone or telegraph lines, and lines or cables on which carrier telephone or telegraph circuits are operated. These radio links operate in the V. H. F. and microwave frequency bands, and provide circuits of extremely high quality. With proper choice of radio stations the fading characteristics of radio propagation in these bands are such that the use of automatic gain control circuits, and of frequency-modulation techniques operated with limiter circuits, permit this very high quality to be rigidly maintained for months of continuous 24-hour-per day operation, without adjustments being required to the radio equipment. Routine monthly maintenance using the simplest of test equipment permits early 'diagnosis' of degraded circuit or valve characteristics before the overall performance quality is appreciably affected.

In general, communication between two places by radio link is only possible when there are not too many or too large physical obstacles such as hills or buildings lying in the path between the aerials at the two places. Since the aerials are small, they can easily be mounted at the tops of masts to increase the communication range, but of course on longer routes it is necessary to provide intermediate radio relay or repeater stations to receive, amplify and retransmit the signals in each direction. Nevertheless, despite the small transmitted powers used, which may be between about 0.1 and 50 watts, distances of up to 40 miles or more are quite normal between successive radio stations in a system.

Radio links can be classed into two basic types, one type carrying a single telephone circuit only, and the other type carrying a multichannel signal fed to it by conventional carrier telephony terminal equipment. Many Telephone Administrations are now using these systems extensively, especially the multichannel systems, and many of the trunk circuits for telephone, telegraph and teleprinter services are, unbeknown to many of the users of the services, carried by such radio links. Radio links are also extensively adapted for such purposes as telesignalling and telemetering on oil pipeline and public utility systems, and are also applicable for use by railways. It is estimated that radio links totalling nearly 100,000 route miles are now in service throughout the world.



Typical multichannel radio link terminal equipment with special high power amplifier for long distance operation (left hand cabinet) and carrier telephone terminal (right hand rack).

RELATIVE ADVANTAGES OF LINE AND RADIO SYSTEMS

The advantages in performance, reliability, and in capital and maintenance costs of radio link systems, as compared with line networks, are generally well known and accepted as applied to trunk telephone networks, but are rather less well known in respect of the needs of railway communications. Clearly the introduction of radio communications to railway procedure is a major step, considering the traditional use of wire-line communication in railway systems. This is partly because the early development of railways was concurrent with the development of telegraphy, and partly because each new railway route was itself an ideal wire-line route, there being access to the wire-line both for communication and maintenance purposes at all points along the railway.

The respective merits of radio and line for these all-station communication links, will vary according to the type of railway under consideration. In urban areas where railway traffic in dense, and where stations are separated by not more than 2 to 4 miles, line communication would probably be the most suitable. The linking of stations and block control points by radio would be more advantageous in rural areas, where stations are separated by 8 to 15 miles. For example a railway route consisting of several hundred miles of single track, with block control loops at such intervals, and including a minimum of junction points, would be highly appropriate for the application of radio links. It is primarily with this type of system that this article is concerned.

TYPES OF COMMUNICATIONS SYSTEMS REQUIRED

The systems which will be discussed are those giving:

(a) Traffic control telephone circuits

(b) Station to station telegraphy

(c) Electro-Telegraph Signalling and block permissive systems.

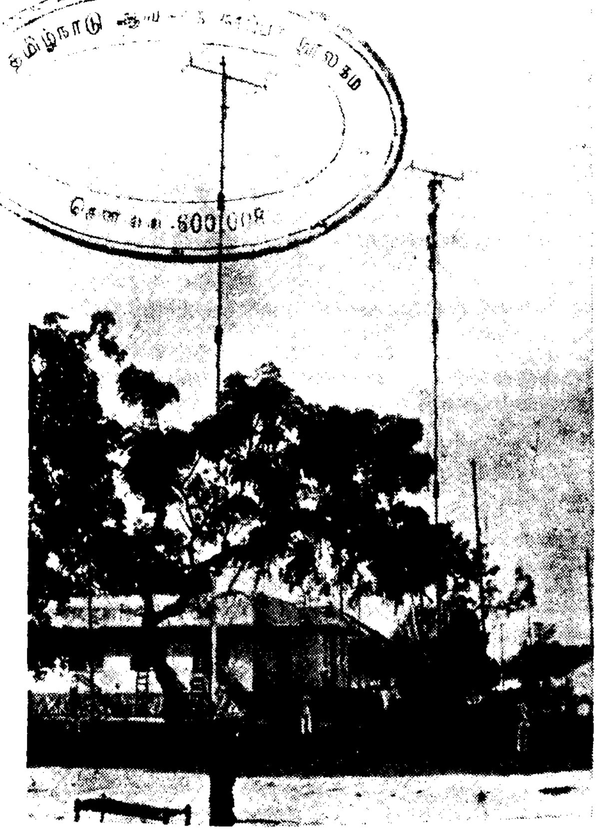
Busy circuits between main centres can employ multichannel radio links of appropriate channel capacity, and some such systems have already been installed for the railways in India. For other services single channel VHF link equipment is most suitable and economical, and can be wall or rack mounted within the way-stations.

TRAFFIC CONTROL CIRCUITS

Line routes operating with carrier telephone equipment can be replaced by multichannel radio links, a radio station being required at each point where access to channels is required, together with possible additional radio repeater stations, if the access stations are too far apart. Often traffic control telephone circuits to most stations employ only one telephone pair, enabling a central control point to contact any station over a distance of 50 to 150 miles, on a party line basis. The control point can call selectively any individual station in its zone, for example by two digit dialling, normal ring-down calling being used from the way station to the control station.

The extended length of the line gives rise to a large degree of faulting especially that due to heavy rains, static interference and crosstalk, and also the way stations can communicate with each other, preventing use of the line by the controller. If, as would normally be necessary over a circuit of this distance, up to 200 lbs. per mile copper conductor is used, the cost of both installation and maintenance is high.

In order to provide these facilities by radio the traffic control center can be linked either by the intermediate stations of a multichannel link connecting



Typical VHF aerial installation at a way station.

zone centres, or by a single channel radio link, to main or other chosen stations at about 30 to 40 miles separation along the route, so that each of these key stations will relay the channel to the next key station in the control zone. Main and standby radio equipment would be accommodated at each of the stations, to ensure complete reliability of service. A supply of power would be required, either from mains or a small duplicated diesel alternator plant.

At each of these key stations a single transmitter/receiver fed from the primary system would link up with a set of four to five local or satellite way stations, so that a direct circuit with the control station would be accomplished. The duplication of these secondary links to the way stations would not be essential. Radio equipment at these way-stations can be battery operated, switching itself on automatically for only a few seconds each half-minute to listen for calls, thus reducing the power drain to a very low figure. The selective call impulses from the dial at the control stations would be converted to tone pulses for transmission over the radio system. A number of push-button tone-code devices is available as an alternative to a dialling system. With this system of key and satellite stations the way-stations will not be able to communicate with each other, since within each secondary network they will be using a common transmitting and a common receiving radio frequency. VHF radio systems of course are not affected by weather or static.

ALL-STATION TELEGRAPHY

In order to link all stations to arbitrary control stations for local telegraphy the radio link described above can again be used since it is possible to superimpose on the voice channel a telegraph signal which is completely undetectable to the users of that voice channel. At each of the stations telegraph tone equipment injects a signal into a band between 1600-2000 c/s in the voice channel, and this band is filtered from the voice channel received at each station, so that one speech channel and one quite separate telegraph channel are extracted.

It is not necessary that the telegraph circuits thus superimposed should be inter-connected in exactly the same way as the traffic control system, and it is likely that only a part of the zone would be connected into one common telegraph network.

BLOCK SIGNALLING (E. T. S.)

Telegraph and Telephone signalling between block points is normally effected by a pair of conductors exclusively linking one block point to the next, with instruments at each station serving the adjacent stations in each direction, the normal transmission of telegraph signals over these lines being provided by means of DC pulses. If each block section is provided with its own independent single channel radio link, which would not normally be connected into any other system, the transmission of such telegraph signals can be achieved by converting the DC pulses into tones. Two sets of radio equipment would therefore be required at each block point, each connected to its respective telegraph instrument, and also to the telephone instrument which is normally connected into the circuit, calling being indicated in the usual way by the telegraph bell codes. The tone provided for the telegraph facility would as before be filtered out of the band of speech frequencies, to prevent false operation of the telegraph signalling by voice frequencies. In case of a failure of the radio link the system would become inactive, just as if a line fault has occurred, and where permissive systems are used would not permit false release of staffs or tokens.

CONCLUSION

It is possible to use radio links to replace wire-lines for all forms of railway communications, and such a step would in many cases improve the quality of service, and also ease the arrangements for maintenance by concentrating it at the stations themselves. The cases where an increase in communications capacity is required, or where a completely new route is to be installed, very considerable savings in capital cost may also be realized by the use of radio in preference to line techniques.

CHILDREN'S RAILWAY PRESENTED TO PRIME MINISTER

Shri Jagjivan Ram, Union Railway Minister, presented a Children's Railway to Prime Minister Nehru, on the occasion of his birthday on 14th November 1958.

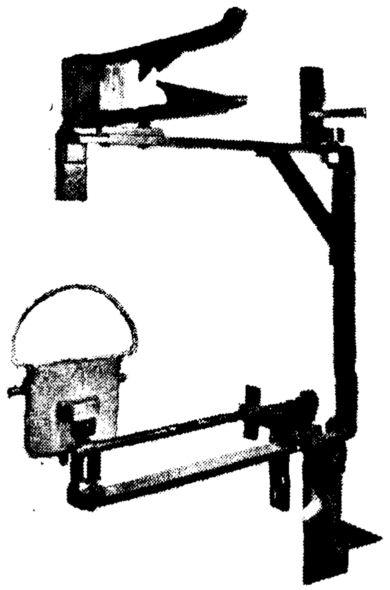
Requesting the Prime Minister to accept "this humble contribution of the Indian railways towards the entertainment and education of the children", Shri Jagjivan Ram said, "It is happy coincidence that each year the children's day is celebrated on 14th November, which is also the birthday of our Prime Minister." He said children were the "wealth of the nation and the citizens of tomorrow, and that is why the Prime Minister takes such keen interest in their welfare. Children form a fair proportion of the 38 lakh passengers who travel by rail in India every day.

TYERS KEY TOKEN APPARATUS

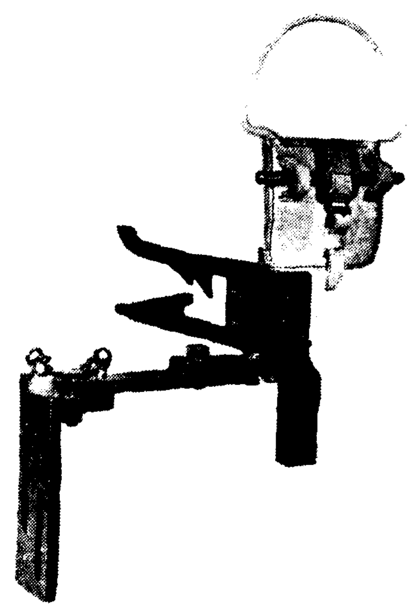
IT has long been accepted that a Token System provides the most simple and safe method of operating trains over a single line. The acceptance and retention of a token provides the driver with authority to occupy the line and only simple forms of signalling are required to ensure compliance with operating regulations. The token is also frequently used for supplementary functions, one example being the release of points for the occupation of an intermediate siding.

Token apparatus was pioneered by Tyer & Co. Ltd., the early tokens being in the form of tablets. Key Token apparatus was first introduced in 1912, the token being in the form of a key rather than a staff, ball or tablet and has since been installed extensively in many parts of the world.

The modern Token Instrument has been adopted as a standard for new work and replacements on single lines by most Regions of British Railways. Development has been continuous since the introduction of the Key Token instrument and many novel requirements have been found for its use. In the construction of the modern instrument completely up-to-date production techniques and materials are employed and full use is made of die cast light alloys, thermo setting and thermo plastic mouldings and rust resisting alloy steels. Complete interchangeability of component parts is also ensured by extensive tooling and quality control. Paint and plating finishes are of the highest quality with the object of ensuring long life and low maintenance.



Automatic Token Exchanger. Ground fitting.
(Note Token carrier pouch. Suitable for ETS/Stave or Key Token.)



Automatic Token Exchanger. Loco. attachment.

The essential requirements for a Token System are that the extraction of a token from an instrument at one end of a block section, shall require the co-operation of both signalmen and that it shall be impossible for a second token to be extracted excepting where permissive working is in operation, until the token already obtained has been inserted in one or other of the section instruments. This is achieved by the use of direct current drawn usually from primary batteries which is fed over a single metallic line wire with earth return, via pole changing contacts in the sending instrument, similar contacts in the receiving instrument, to a polarised relay which must receive current of the correct polarity to effect the operation of an electric lock controlling the extraction of a token. The polarity of relays for the release of a token may be different at each end of a section. Instruments are provided with standard ward plates which can be fitted in any one of four positions known as positions A. B. C. and D. A pair of instruments controlling a block sections are each fitted with ward plates to give the same configuration whilst those controlling adjacent sections are each

TYER'S

SIGNALLING EQUIPMENT

to British and Overseas Railway's Standards

Single line Absolute/Permissive Block Control equipment and all types of KEY TOKEN INSTRUMENTS

—

All types section token pouch/carriers

—

Automatic token exchange apparatus

—

Lever locks with circuit controllers

—

Gravity Locks for all types of levers

—

Arm and Light signal repeaters

—

Signal lamps and thermostatic expanders

—

2-, 4- or 6-way circuit controllers

—

Double line Block apparatus, all types

—

Relays: flashing, interlocking track, line, thermal and polarised

—

Terminals and Fuse Blocks and links with plastic or porcelain bases

COLOUR LIGHT SIGNALS

—

ROUTE INDICATORS

—

2 OR 3 ASPECT INDICATORS

—

DIAGRAM PANEL LAMP UNITS

—

AUTOMATIC TRAIN CONTROL EQUIPMENT

—

LEVEL CROSSING PROTECTION EQUIPMENT including lifting barriers

—

POINT DETECTORS

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—

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—

Closed Circuit Industrial Television and Electronic Apparatus

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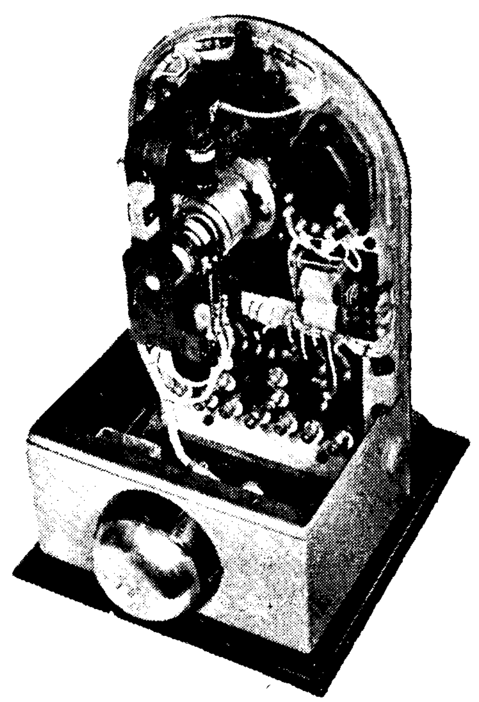
Special packings and piston leathers for Locomotives

given a different configuration, thus making it impossible to put a token into the wrong instrument in a signal box. The key tokens are provided with configuration slots corresponding to the chosen position of the ward plate and are usually engraved with the names of the stations controlled by the block. Tokens are provided with leather pouches either for carrying through the section and to simplify hand exchanging, or for automatic exchanging.



The main functional components in a Key Token instrument which will be readily identified in the illustration are as follows :—

i. A switch plunger to send current over the line for communication purposes and to permit the extraction of a token at the far end of a section.

ii. A current indicator to show when current is being sent or received.

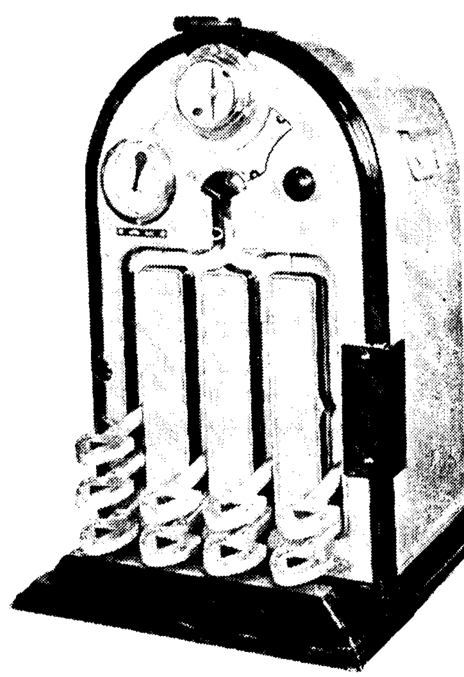
iii. A bell or bell relay to receive incoming communications.

iv. A commutator embodying phase changing and other contacts, which is operated by the insertion or extraction of a token.

v. A polarised relay to receive signals to release a token.

vi. An electrical indicator which can have two or three indications to show block occupation.

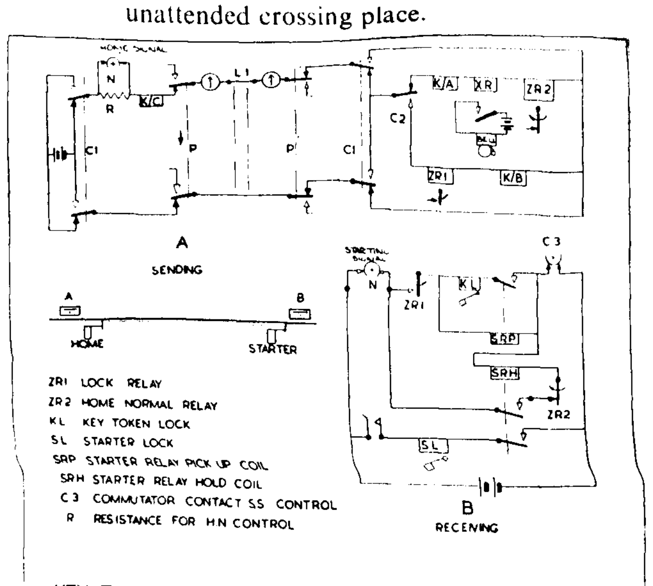
vii. A storage magazine sufficient to retain up to 50 tokens.



The primary purpose of the Key Token instrument as has been stated is to provide co-operative control for the occupation of a single line by one train only, i. e. absolute working. In addition to this function however, there are a number of secondary functions some of which will now be briefly described :—

viii. To provide by the addition of a supplementary unit for the occupation of the block by more than one train travelling in the same direction.

ix. To provide by the addition of a supplementary unit for the crossing of trains at an unattended crossing place.



KEY TOKEN CIRCUIT WITH HOME NORMAL & S S CONTROLS

x. To control the setting in or out of trains at an intermediate siding in the block section.

xi. To control the starting of a train from a signal remote from the signal box.

xii. To make the release of a starting or first stop signal depend upon the prior extraction of a token.

xiii. To prevent the release of a second token for a following train until the last stop signal has been replaced to normal in addition to the token for the first train being restored to one of the instruments.

xiv. To provide either full no signalman operation of a block section or, alternatively, automatic operation at one end with signalman control at the other end, e. g. at a Works siding.

xv. To control train working over a triangular section by a combination of absolute and auxiliary instruments.

The operation of an absolute instrument provided with HOME NORMAL AND STARTING SIGNAL controls, as shown in Fig: will now be described. Only the sending circuits for instruments A. and receiving circuits for instrument B. are shown but it will be understood that these are duplicated in each instrument :—

By pressing switch P. the signalman at A. will isolate his receive circuits and make up a circuit from the battery of his instrument via line, receive circuits at B. and earth return. The polarity of current sent by A. depends upon the position of commutator contacts C1 at A. and that received by local circuits at B. by commutator contacts C1 at B. With commutator contacts C2 at B. as shown, coils KA, XR and ZR2 will be energised. The energisation of coil Xr will ring the single stroke bell at B. to provide communication. The function of coils KA and ZR2 will be described later. To extract a token B. will then insert a key into the commutator aperture and rotate it. In so doing commutator contact C2 will switch to complete circuit ZR1, and providing that the correct polarity of current is being received by the relay, this will be operated to complete a local circuit via the key token lock to permit the completion of a half turn of the commutator and the extraction of the token. Coil KB is also energised to operate the latch of the 3-position indicator, where fitted. The final movement of the commutator remakes contact C2 and also switches contact C1 to put current of reverse polarity on coils KA, XR and ZR2. Coil KA with the prior operation of coil KB will cause the indicator to change from LINE BLOCKED to TRAIN GOING TO. As contacts C1 have now been reversed current received from A. and switched to relay ZR1 via contact C2, will operate the relay away from the lock release position and no further energisation of the lock circuit is possible.

In the arrangement shown a token release can only be obtained if the N. or Normal contact on the starting signal lever is closed. Contact C3 will be closed during the early movement of the commutator in extracting a token. Closing contact ZR1 will, therefore, first pick up the starting signal relay via coil SRP, complete a hold circuit through coil SRH and at the same time operate the commutator lock KL to release the token. If desired, bolt proving contacts for the starting signal lever lock can be wired in series with coil SRP. The release of the starting signal lever can now be obtained by the operation of the economiser contact shown.

It will be observed from the circuit that the stored release for the starting signal lever will be cancelled by the opening of contacts C3, ZR2 or the N. contact of the lever. Contact C3 is provided to deal with the cancellation of a train movement and is arranged to open when the token is returned to the instrument. Pulling off the starter releases the hold circuit by opening contact N. Relay ZR2 is provided to ensure that where a train has gone into section against a failed starter at stop, cancellation of the stored up release is effected by the first signal received from A. after the insertion of the token at that station even if the Home signal lever at A. has not been replaced. The provision of a resistance in circuit when the Home signal at A. is off ensures that a weak current is sent to B. which will maintain communication but will not release a further key token.

The function of coil KC at A is to set a latch coil in the indicator to a position where the next signal sent from B. to A. will, in rotating the indicator, cause it to show TRAIN COMING FROM.

It will be noticed that in the arrangement described, which is based on British practice, the indication that a train is approaching is only received if B. sends to A. the TRAIN ENTERING SECTION signal.

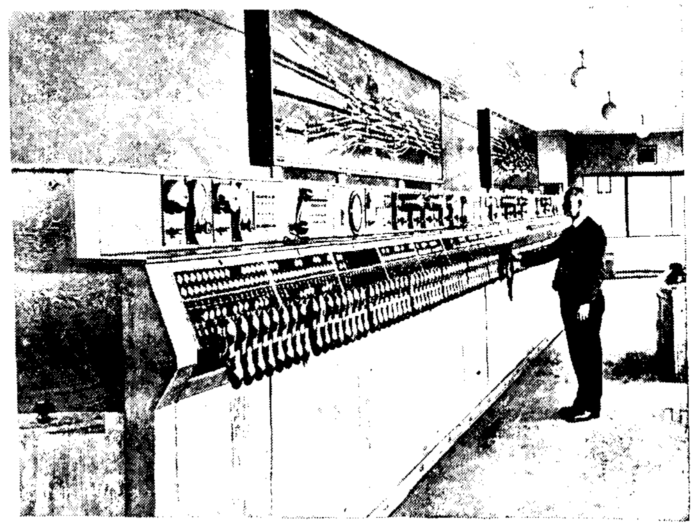
SIGNALLING AND INTERLOCKING

By H. C. Towers, M.I.E.E., M.I.R.S.E., M. Inst. T.

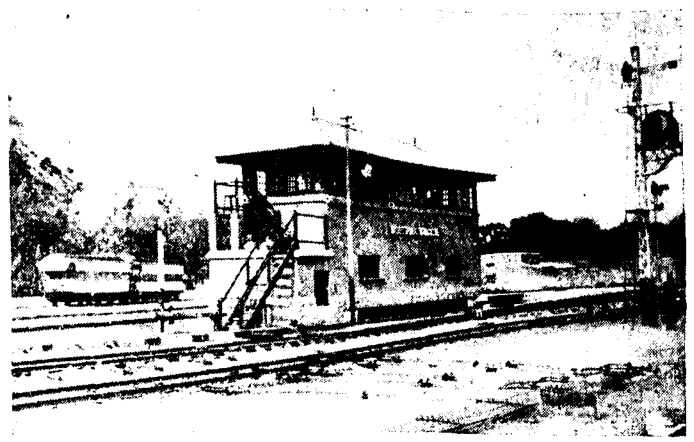
SIGNAL BOXES

THE signal box certainly varies in shape and size and a host of variations can be observed through the carriage window. On some railways they are called signal cabins while in the U. S. A. they are described as signal towers. This term probably arose from the fact that in that country signal cabins are fairly tall, to command a good view of the station yard. Their appearance is therefore changed from the usual English boxlike structure to a building resembling a tower.

In 1843, Sir Charles Hutton Gregory conceived the idea of grouping several point levers together which meant a considerable saving in the number of policemen required. There was no interlocking between these levers, so that points were sometimes set the wrong way and were either damaged by the trains themselves or led to some other minor accident. Later, a primitive interlocking frame was built in which levers working points and signals were concentrated and fitted with a device known and already described, as a lock-ing box. This prevented signals and points being operated when other levers had already been pulled which would lead to a conflicting movement. It was inspired by the comments of a Colonel Yolland, a Government Inspecting Officer, who, while inspecting a small installation in North London, asked the railway Engineer present why he could not think of some arrangement to prevent signals being lowered which would lead to conflicting movements. The first signal box with an interlocked lever frame was built at Bricklayer's Arms Junction on the South Eastern & Chatham Railway in 1856 though the London & Greenwich Railway claims the same distinction with an interlocking frame opened at Corbett's Lane Junction in 1849.



Interior of Bristol West Signal box, British Railways.



Exterior of electro mechanical signal cabin.

In those days the type of signal used was a primitive affair. Generally only a main signal was exhibited and

(Continued from page 31)

Arrangements are, however, available to ensure that the acceptance of a train is indicated at A. before the release of a token at B.

As described the Key Token gives a flexible, safe and simple system with low maintenance and first cost. When used with automatic token exchangers, as illustrated in Fig. to permit through running at speed, it provides economical operation on lines of moderate density. The use of magazine balancers, where required, also provides for out of balance train movements in a safe and efficient manner.

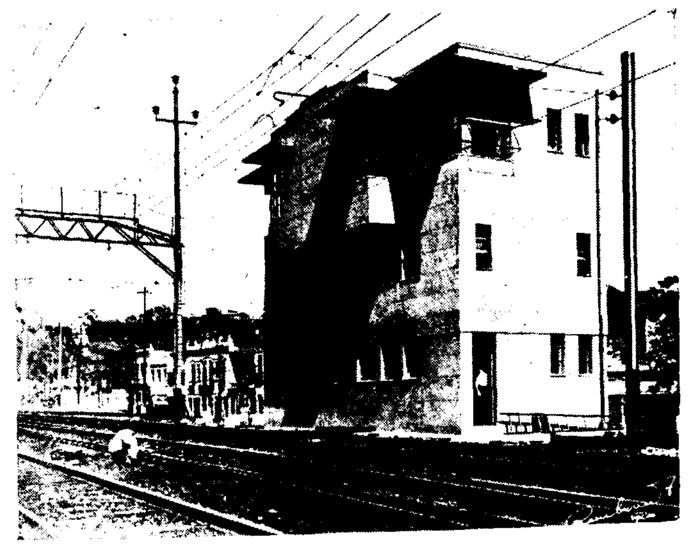
this was at the cabin itself. It was fixed to a post attached to the cabin building. The men working these lever frames are now called signalmen, in India, cabinmen or levermen while in America they are known as towermen or switchmen. Their spell of duty is generally of eight hours duration so that it is necessary to afford them protection from the weather, facilities for cooking their meals and lavatory and washing arrangements. This led to the lever frames being housed in a boxlike structure, the upper portion being approached by a stairway. The top floor is necessary to provide somewhere for the man to stand while working the levers and also to give him an elevated position so that he can more easily see the points and signals under his command. The under portion of the cabin contains the mechanical cranks, rods, wheels, etc. by which means power is transmitted from the tail of the lever to the point rodding working the points or to the signal wire pulling off the signal.

The first signal boxes were made entirely of wood except for the windows. In country districts, the signalman quickly appreciated that these places were, at least for part of the day, their home. Window boxes containing flowers quickly appeared. The railway companies provided a stove, table and chair for the signalmen's meals. Lighting was generally by oil lamps except for towns where gas was in use. In course of progress this type of structure was succeeded by one with a masonry base, and wooden upper structure. The more modern type uses steel sections and beams filled in with brickwork and with a roof of tiles or corrugated asbestos. Larger cabins are built entirely of re-inforced concrete.

At least three sides of the upper portion of the cabin is provided with windows, to give the signalman a clear view all round. Some of these windows are made to slide open so that he can shout to men on the track or trains and also to give ventilation. Modern cabins are provided with sliding steel windows. In contrast to this, there are many cabins today which have no windows at all, the position of trains being indicated electrically on a plan at the back of the lever frame.

Owing to shortage of space, it is not always possible to build signal cabins in their conventional position, alongside the line. It is often necessary to place them over or under the tracks and sometimes in the middle of a long tunnel. Such a case existed on the 9 mile long Gothard tunnel of the Swiss Federal Railways where it was necessary to provide crossover arrangements in the middle of the tunnel. Deep down in the bowels of the earth the atmosphere, hot and stuffy,

Interior of electro mechanical signal cabin in India.
(Photo by the author)



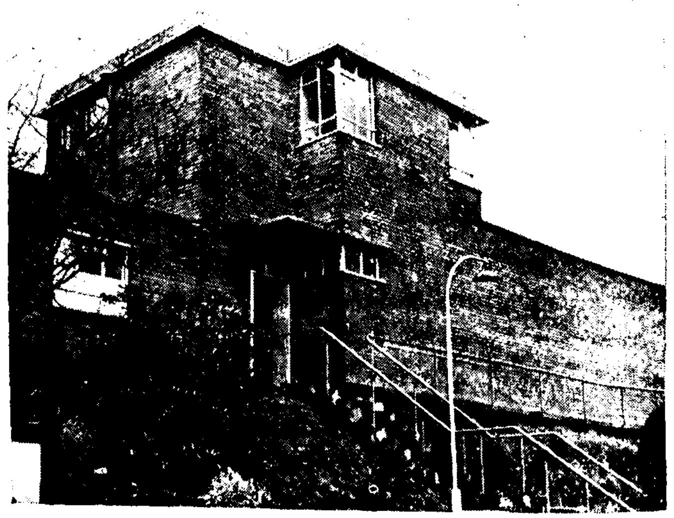
Three storey signal cabin containing power frame. Central Railway of Brazil.

was far from pleasant for the unfortunate signalmen to work in even though ventilating arrangements, as adequate as possible, were provided. Modern signalling has now removed the necessity for these cabins and the crossovers and signals are remotely controlled by power from a signal cabin near the portals of one end of the tunnel. A similar situation existed in the tube tunnels between Kings Cross and Angel stations on the original City & South London Tube Railway. In those days, the trains were not worked by automatic signalling but from one signal box to another by means of electric instruments. The distance between Kings Cross and Angel was fairly long and during the morning and evening business service, when more trains were run than at other times of the day, it was necessary to shorten the section. A signal box called Weston Street was placed half way through and consisted of a small chamber between the tunnels. Access was obtained by means of a spiral staircase by which means the signalman got to his cabin some eighty feet below street level. The old Waterloo signal box, Southern Railway, London, was built over the approach platform tracks and the levers were arranged in two sections so that they could be fitted in the available space. Before Victoria Station, British Railways, was provided with modern power signalling it was worked by mechanical signal cabins. There was insufficient space for one of these cabins between the track and the retaining walls and it was therefore built into the wall itself. It was, from the date it was built, known as "The Hole in the Wall" Cabin.

Power signal cabins particularly lend themselves to a neat and tidy layout. It was explained in an earlier chapter that the usual full size lever frame is dispensed with and signals and points are worked by miniature levers only a few inches high. These are concentrated in a steel cabinet finished in black or dark green cellulose.

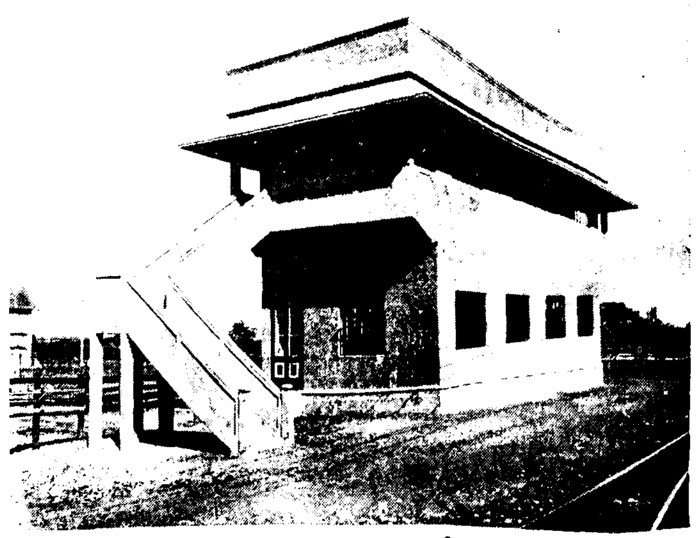
The signal cabins of London Transport are *par excellence* in installation of equipment, interior fitting of the building and facilities for the staff. The inside walls are lined with coloured tiles of pastel shades and the floors covered with red tiles which are highly polished. Adjoining the signal cabin proper is a small room with an electric stove for cooking, sink for washing up, and a small table and chair. At larger cabins the signal linemen's depot is also attached with interior decorations similar to the cabin interior. Steel cupboards are provided for the linemen's clothes, a table and chairs, a desk and a small bench with tools.

The power frames themselves are very highly finished The telephones and train description apparatus are inset as part of the power frame. The illuminated diagram, the map of the area controlled by the signalman, is hung behind the power frame. On this are shown the signals, points, etc. in that area. The tracks are represented by illuminated lines and the passage of trains is shown by sections of the lines being extinguished. The glass covering the diagram has a special acid finish so as to make it entirely non-reflecting. With the use of the illuminated track diagram it is not necessary for the signalman to be able to see his trains. There are several cases on London Transport Railways where the signalman can neither see or hear the trains. It is not necessary for them to do so since every movement of trains, points or signals is electrically repeated in their cabin.



New signal cabin at Ealing Broadway, London Transport Executive.

(Courtesy of London Transport Executive)



Modern ferro concrete signal box on Western Railway, India.

(Photo by the author)

Standardization for saving Steel

A session on Steel Economy was held as a part of the fourth Indian Standards Convention, in New Delhi. In the absence of Sir Jehangir Ghandy of Tata Iron & Steel Co. Ltd., Jamshedpur, Shri S. L. Kumar of Indian Railways presided over this session, which was attended by about 250 delegates. Six technical papers dealing with the various aspects of achieving steel economy came up for discussion which was lively and interesting. The work so far done by the Indian Standards Institution in formulating Indian Standards for saving steel drew a lot of appreciation from the delegates. Apart from the suggestion to use alternative types of constructions with re-inforced cement concrete, the use of pre-stressed concrete was advocated.

It was suggested that timber could be used to a large extent in structures. The delegates from the Forest Research Institute, Dehra Dun pointed out that instead of 3 or 4 conventional types of timber now used in the country, 89 species of timber could be used in all types of structures with spans ranging from 8 ft. to 300 ft. after proper treatment of the timber and by using improved methods of jointing. It was suggested that the sale of so called untested steel should be discouraged and as far as possible work tested and certified steel only should be put on the market. The advantages, limitations and economy of steel in the use of steel tubes and lightgauge sections in structures were brought out. Improved types of re-inforcement such as deformed and cold twisted bars for use with cement concrete were suggested. The advantages of welding instead of riveting in saving steel were enumerated and it was suggested that only trained welders should be encouraged for all welding work. It was also stressed that more and more schools for training of welders should be started and the newly published Indian Standard Specifications and Codes of Practice in the field of welding should form a part of the education curricula of the various technical Institutions in the country. Considerable stress was also laid on the need for adopting the new Indian Standards, both in the public and private sectors of the Industry to effect the desired wide spread economy in the production and utilisation of steel.

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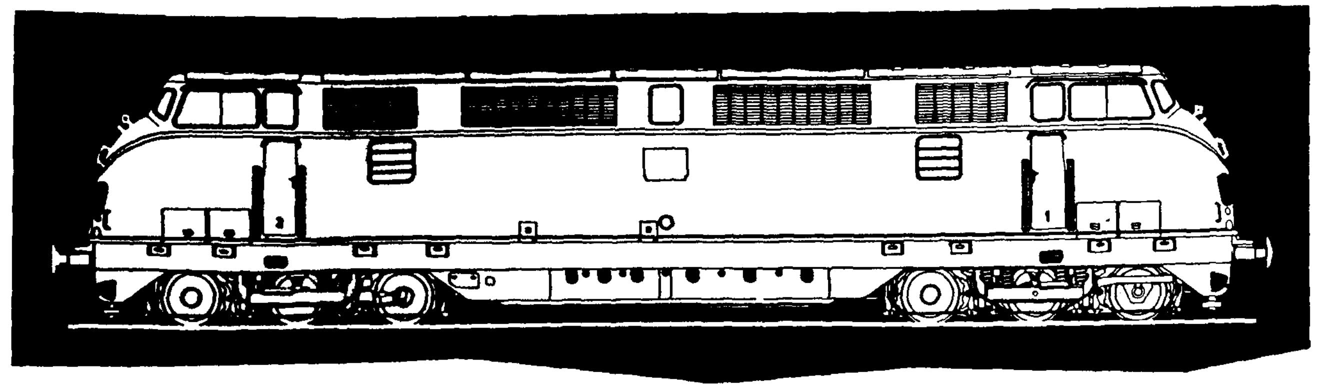

Diesel hydraulic multiple purpose locomotive ML 3000 C'C', the modern and most efficient locomotive of its type.

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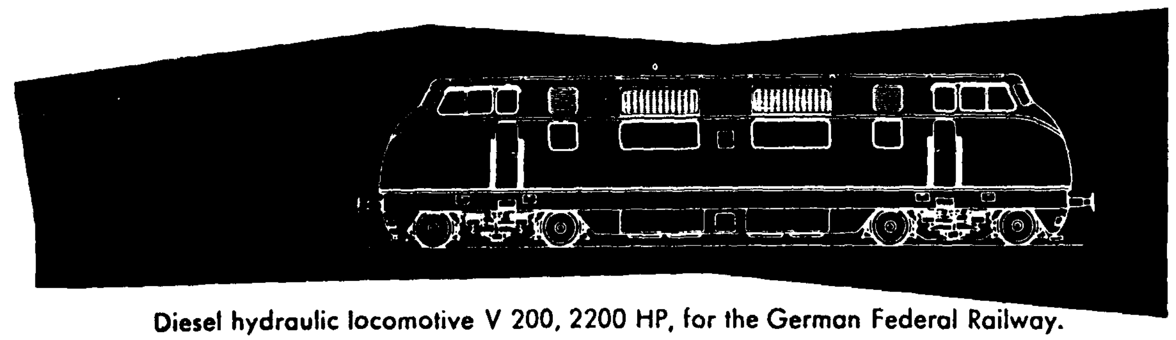

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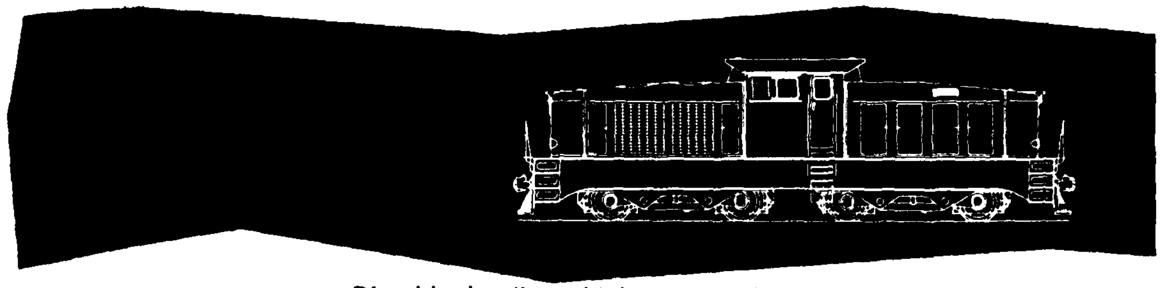
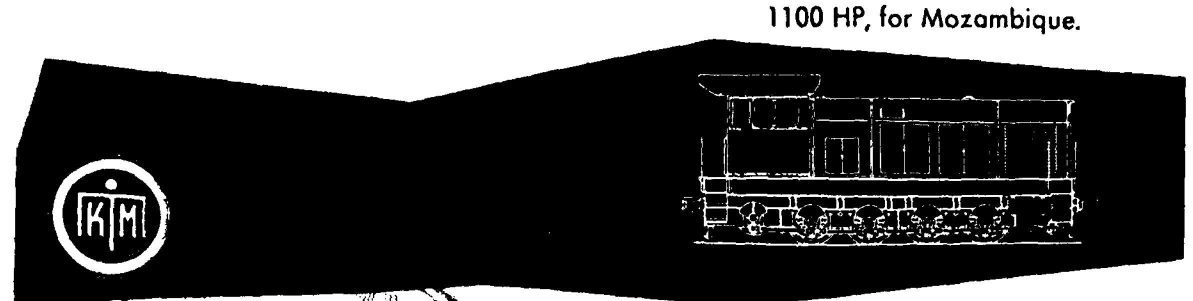


Diesel hydraulic multiple purpose locomotive ML 1100 B'B', 1100 HP, for Mozambique.



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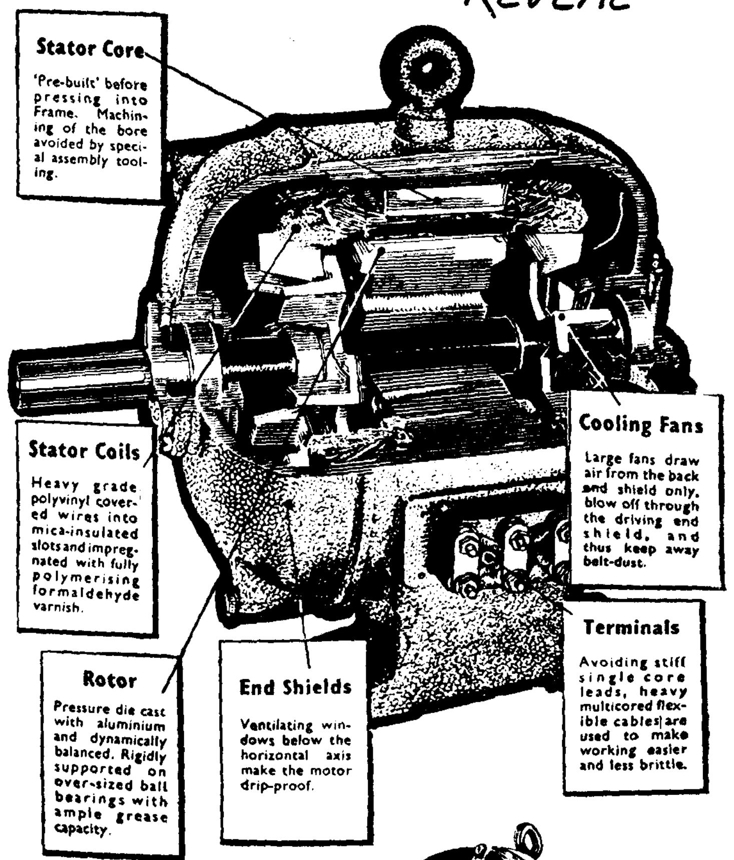

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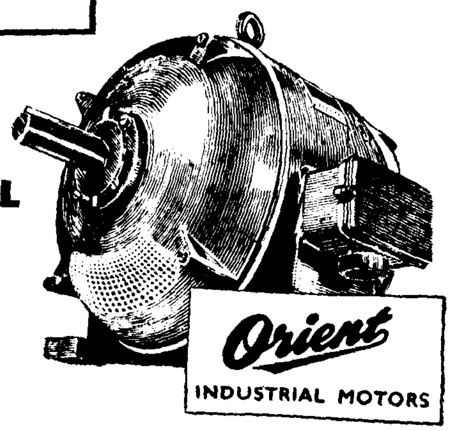

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