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CONTENTS

An Important Announcement

WE have great pleasure in announcing to all our readers and advertisers that we are incorporating a special supplement entitled INDIAN RAILWAYS CHITTARANJAN LOCOMOTIVE WORKS SUPPLEMENT along with our May—July 1962 edition. We need not very much over-emphasize the international importance of this gigantic locomotive building unit of the Indian Railways, in the whole of Asia. The Supplement will contain interesting articles specially contributed by eminent engineers about this largest engineering works in the public sector.

We take this opportunity of appealing to such of those engineering firms who have had the privilege of contributing their mite to this great State undertaking to subscribe by way of technical articles on various aspects of railroad engineering to our above Supplement.

The last date for receiving technical contributions is 10th July 1962. Advertisers desirous of buying advertising space in the above Supplement should intimate the fact to the Technical Editor on or before 10th July 1962 as there is very limited advertising space available.

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Siemens Remote-control equipment for Power Supply Installations

THE significance gained during the last decade by the supervisory control and load-dispatching equipment in the economic and trouble-free operation of power supply systems appears to justify a detailed account of the mode of operation and the capacity of one of the essential building blocks in this field of control engineering, namely the Siemens remote-control selecting equipment.

These selectors (Fig. 1) have found a wide field of application in the control rooms of power supply companies, electric railways and industrial enterprises, and make it possible to transmit dependable and fault-free operational control and supervisory indicating signals.

Since the control and indicating signals are transformed into coded impulse trains, the Siemens remote-control selecting equipment is suitable for supervisory remote-control over any desired transmission channels. These coded messages can be transmitted either over the spare core pair of a buried or aerial cable or over a post-office open-wire overhead line, in which case several stations can be served by a common pair of wires.

The impulse trains can also be transmitted over voice-frequency channels of communication lines, carrier-frequency channels of high-voltage power lines, or over radio channels. When using such h.f. multiple transmission equipment one channel is required in each direction of communication.

THE IMPULSE TYPE OF TRANSMISSION

Each supervisory-control selecting equipment is provided with an impulse transmitter to send out the impulse trains. The number of impulses transmitted in a given time can be adjusted to 12 to 16 impulses per second by means of variable resistors, to suit the transmission conditions in each case.

Every time the impulse transmitting relay is excited, it notches the selector forward by one step and transmits an impulse via the transmission channel to the highly sensitive receiving relay at the other end. The receiving relay then notches forward by one step the receiving selector at the other end, thus ensuring synchronous stepping of the selectors at the sending and receiving ends. Whenever an operating or indicating signal is transmitted, the two selectors are thus stepped through one full revolution and, under normal operating conditions, again assume the "home"

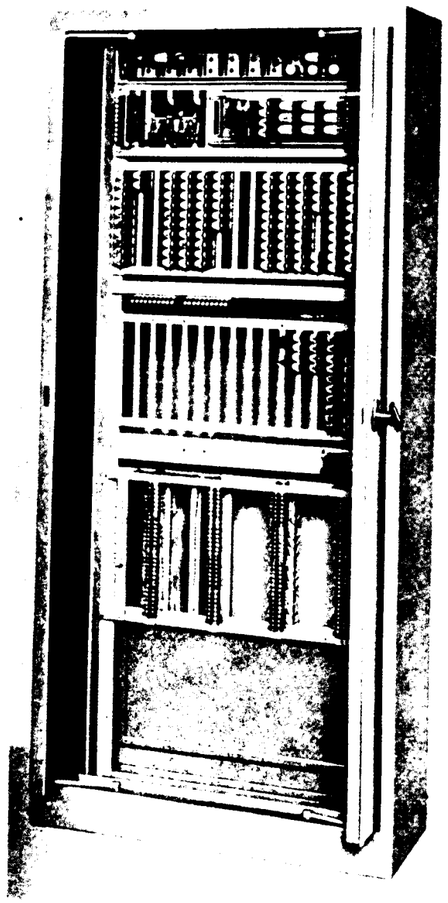


Fig. 1. Typical Remote Control Selector Equipment for Control Centre.

position. Depending on the number of steps available with the type of selector used, 18, 26 or 36 impulses are transmitted over the line.

During the synchronous stepping of the selectors, the operating or indicating signal is transformed into a coded impulse train containing time-variable code criteria as, for example, impulse intervals of a duration which is approximately three times as long as the regular interval between two successive normal impulses. As a result of this long interval, a time-delay at the receiving end, which is energized for the duration of the normal impulse sequence, has sufficient time to drop out intermittently ; its break contact energizes on the relevant step a storage relay which is co-ordinated to this particular step. The storage relay prepares the closing of the circuits for the later completion of the operating or indicating signal transmitted.

The evaluation of the operating or indicating signal stored in this manner takes place only after the two selectors have simultaneously reached their home position.

THE TRANSMISSION OF A REMOTE CONTROL SIGNAL

When the control discrepancy switch is operated so as to transmit an operating signal, two separate contacts are closed (Fig. 2). The first contact, for example c101 ', energizes the associated selector group relay for the respective circuit-breaker group e.g. G1, to which the remote-controlled breaker belongs, and a monitoring relay E1 in the case of an "on" control signal. In addition to starting the transmitting selector, these relays cause it to step up to the relevant group step, for example, a long-time interval, on this particular step.

At the controlled station the combination code signal contained in the transmitted impulse train (h) for group selection, breaker selection and for fixing the direction of operation, closing or opening, is first transmitted to special storage relays in the course of the full sweep of the wiper. On the first selector steps the long-time interval or a correspondingly long-time impulse injected by the group relay at the control point is transmitted to the group storage relay at the

Fig. 2

a. Contact bank of a transmitting selector
a. Rotary magnet of a transmitting selector
C 101 to C 202 control discrepancy switches
D Impulse transmitting relay
E 1, E 2 to E 5 control supervisory relays
F Impulse interrupting relay
G 1 to G 5 Group relays
b. Rotary magnet of a receiving selector
E Impulse receiving relay
G Interval receiving relay
h Impulse train for closing breaker 101
Group selection (steps 1 to 5)
i Direction selection (step 35)
k Breaker selection (steps 6 to 34)

controlled station, and the group relay, e.g. G1, corresponding to the transmitted group code signal is caused to operate via contact g ' of the interval receiving relay on step No. 1.

On one of the following selector steps the storage relay, e.g. Sp 1, for breaker selecting step No. 6 is caused to operate and on this step a selective code signal is received which is dependent on the operation of the associated control discrepancy switch C 101. This then prepares the closing of the selected control-action circuits. Each of the these storage relays is fitted with a number of make contacts which are allotted to the various breaker groups (Fig. 4.). Operation of the storage relay Sp 1, for example thus prepares in each breaker group the closing of the control-action circuit of a breaker with the ordinal index 1, i.e., circuit breakers Nos. 101, 201 for the groups 1 and 2. Which

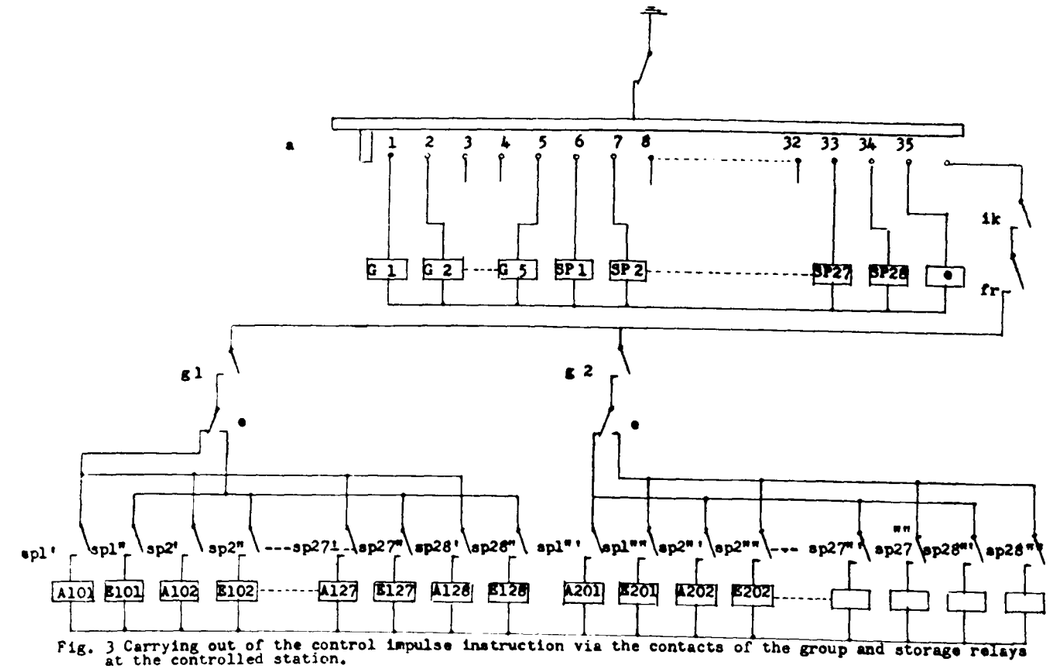


Fig. 3 Carrying out of the control impulse instruction via the contacts of the group and storage relays at the controlled station.

a Contact bank of a receiving selector G 1 to G 5 Group relays
Sp1 to Sp28 Storage relays
e Closing supervisory relay
g Contact long-interval receiving relay
ik contact on impulse monitoring relay
fr Contact on release relay
A101 to A 228 Pilot relays for opening the breakers
E 101 to E 228 Interposed pilot relays for closing the breakers.

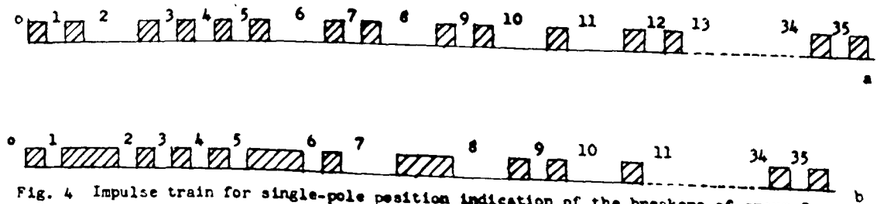


Fig. 4 Impulse train for single-pole position indication of the breakers of group 2.
a with long-time code intervals only (breakers 1,3,5,6 closed and breakers 2,4,7 open)
b with long-time code intervals and long-time code impulses (breakers 1,4,5,6,10 closed and breakers 2,3,7,8,9 open)

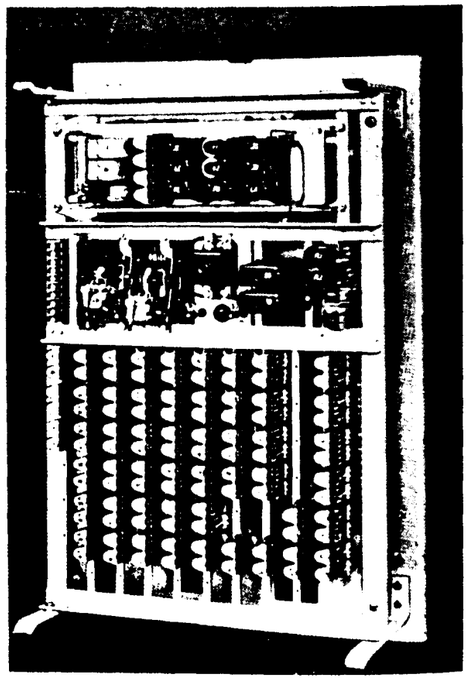
of these breakers will be actually operated upon completion of the control signal, and whether this particular breaker is then closed or opened is determined by the previously energized group relay and by the closing supervisory relay (e) which is operated by a long-time code interval transmitted on the last selector step.

Whether the stored control signal takes effect or not depends upon whether or not the operation signal receiving selector at the controlled station assumes its "home" position in a normal manner on receiving the total number of impulses transmitted. This so called synchronization check signal is a highly reliable precautionary measures for ensuring correct preparation of the closing of the control-action circuits and for the prevention of false control operations or indications. Experience has shown that this check is indispensable. In addition to this the Siemens supervisory-control equipment provides in form of a supplementary impulse monitoring relay a continuous check on the impulses transmitted. This check takes effect during the transmission of the impulse train and prematurely, i.e. before the synchronization check is carried out, interrupts the operation sequence for completing the control-action circuit, whenever the impulse train is affected by disturbance impulses along the line.

The control action is affected by a release relay FR which is energized in the "home" position of the selector and which, via the contacts of the storage and supervisory relays, energizes one of the two interposed pilot relays, for example E 101 or A. 101 for closing or opening the preselected circuit breaker 101. Should the receiving selector at the controlled station not be returned to its "home" position in a normal manner by the impulses transmitted it automatically assumes its starting position after the sequence of operation for completing the control-action circuits has been interrupted ; it is then again ready to receive a repeated control signal.

THE TRANSMISSION OF SWITCH POSITION AND ALARM INDICATIONS

Any change in the positions of a switch or circuit breaker due to remote control, local manual operation or automatic tripping is immediately transmitted by the supervisory control selector equipment through a separate pair of indication selectors to the control point. For this purpose the auxiliary switches of the individual switches or breakers, only one contact of which is required for indicating the closed and open position are connected with position supervisory relays in the selector cubicle ; these adjust themselves according to the position of the associated auxiliary contacts and retransmit the change in the switch or circuit breaker position.



Typical Remote Control Selector Equipment for Substation

Every times the breaker position changes, the position supervisory relays in the uniselector equipment of the controlled station initiate the operation of the indication selector which, on the associated step, transmits the indication code signal back to the control point. The stepping up of the indication selector and the transmission of the impulses onto the line is effected in a manner similar to that described above for the transmission of the control-action signals ; however, in the case of the transmission of a position indication, the impulses-transmitting selector is located at the controlled station and the receiving end selector at the central control point.

In contrast to the impulse train of the control action signal which usually contains only the selective code signal for a single circuit breaker, the indication

impulse train of the supervisory-control selector equipment contains indication code signals for the switches and circuit breakers of an entire breaker group (Fig. 4) Whenever the position of a switch of a certain group changes, the positions of all breakers of that group are transmitted and the indication signals again checked on the mimic diagram.

The group method of indication transmission has the advantage that on the simultaneons tripping of several breakers of one group, the corresponding indications are given within one sweep of the wipre-contact. With simultaneous changes in the position of 28 breakers, i.e., the closing of 28 alarm contacts, these indications could be transmitted within a total time of approximately 3 to 3½ seconds.

Should an indication impulse train be so impaired by disturbance impulses as to prevent the receiving end selector at the central control point from reaching its "home" position this selector is automatically returned to its home position after the incoming impulses have ceased and the storage relays have been de-energized so that it is again ready to receive another indication signal. Since the impeded indication must not be suppressed but, if possible, repeated immediately, Siemens supervisory control equipment for large installations is provided with an automatic high-speed supervisory check relays. Following the detection of an impeded indication, the indication group from which the impeded impulse train was received is immediately caused to repeat the signal. Should repeated indication signal be again impeded, a fault lamp lights up and an audible alarm is sounded. The operating personnel can then press the check key and initiate a general supervisory check on the indications from the remote-controlled station.

THE CAPACITY OF THE SELECTOR EQUIPMENT

Thanks to the simple group combination, the Siemens supervisory control equipment permits extension to meet all requirements encountered in practical operation with only one pair of wires or one transmission channel in each direction for the operation of the equipment. This practically unlimited capacity is substantiated by the following considerations:

With a 36 unit selector. there are, after deducting the number of steps required for special indications, 33 active steps available. If only long time intervals are used for code signals and 10 control or indication groups are formed the 23 steps remaining after deducting the group steps can be utilized tenfold, that is 230 switches or breakers can be remote controlled and supervised. If in addition to the long time code intervals long time impulses are provided as code signals for the group steps, the number of groups can be increased to 20, thus raising the capacity of the selector equipment to 460 switch position signals or alarm indications and instructions. If the individual indication steps are utilised twice by inserting both long time code intervals and long time code impulses the Siemens sl selector equipment permits extension upto 920 indications and a corresponding number of operation signals without the transmission time for the position indications of 46 switches of one group exceeding 4 seconds.

In practice, however, this capacity of the Siemens selecting equipment is seldom fully utilized since such high requirements are hardly ever encountered in supervisory control installations and since the number of multi-contact relays required would result in a disadvantageous and overcrowded switchboard design. The large capacity unit designed on the plug in type principal can therefore be extended for a total of 360 single pole position and alarm indications while the medium capacity unit of the plug in type permits transmission of 180 indications plus a corresponding number of instructions signals. The floor mounted switchboards in a design without interchangeable chassis have a similar capacity while the small capacity equipment arranged in wall mounting cabinets provided for 30 to 70 indications depending on the size of the cabinet selected (Fig. 6). The practical extensibility of the Siemens supervisory control selecting equipment is therefore not limited by design considerations, but only by the type of selector or enclosure, which should in each particular case be selected to suit the expected ultimate extension of the supervisory control system.

CONSTRUCTIONAL FEATURES

To suit local conditions the selecting equipment can be supplied in the form of switchboards or racks. Racks are mainly intended for installation in central operating rooms where as with large telephone exchanges clean rooms are available for the installation of the selecting equipment. In all other cases preference should be given to the switch board type. For smaller installations the selecting equipment is assembled in dust tight wall mounting cabinets with hinged frames; for medium and large installations it is mounted in dust tight floor mounting cubicles.

The floor mounting cubicles can alternatively be arranged on the plug in type principal. With this method of construction the selector cubicles are provided with the necessary cabling for the ultimate capacity and can be equipped with as many plug in type chassis as are required by the particular stage of construction. The latter are suitable for a very wide range of remote control and supervisory indicating operations. This type of constructions simplifies the addition of equipment for future extensions.

For generating and evaluating the transmitted impulse trains, a replaceable relay chassis fitted with knife-edge armature relays (Fig. 7) is used. This is connected to the actual selecting equipment by plug in contacts and can, in the event of faults, be easily replaced by a spare unit.

The selecting equipment can be supplied for operation on either 24 V or 60 V d.c., voltage fluctuations from—10% to + 15% of the rated voltage being permissible.

THE APPLICATION OF THE EQUIPMENT

The problem referred to at the beginning of this article have been safely and satisfactorily solved by Siemens supervisory control equipment in a great number of important load dispatch and supervisory remote control installations both in Germany and abroad ; some of the equipment has been in service for over 25 years and has given complete satisfaction. The extent of its application and the confidence placed in its dependability by the managements of various companies are illustrated by the fact that Siemens have supplied equipment for the following control and signalling functions to more than 150 electricity supply companies, electric railways companies and industrial enterprises.

Remote control and supervisory indication of 10,000 circuit breakers and isolating switches.

Supervisory indication of a further 18,500 circuit breakers and isolating switches.

Transmission of 10,500 alarm, control and tap-changing signals.

Transmission of 1,100 earth fault indications.
Selection of 2,650 telemetering values.
Transmission of 2,200 various instructions.

With regard to these figures it should be noted that some of the remote controlled and supervised switches are installed in important 110 kV or 220kV transformer and distribution substations serving for the power supply of areas with a great many consumers.

With the ever increasing requirements to be met by supervisory remote control techniques as a result of modern interconnected systems and increasing automation, the field of application of the remote control selecting equipment will, due to its adaptability and freedom in the selection of the transmission channels for the impulse trains, continue to expand. The selecting equipment will continue to represent an important building block for the operational dependability of modern power supply system.

LINE FAULT LOCATOR

A line fault locator which can detect the position of actual breaks or arching faults in overhead power lines has been developed by a British firm. It can also detect ice build up on the line or excessive oscillation of lines in high winds leading to conductor clashes and damage to sheathing. It is suitable for use on all transmission lines up to the highest voltages. Automatic photographic recording is provided to deal with transient faults with facilities for short term viewing for monitoring. The unit has been designed for simple operation in manned or unmanned stations and uses normal station batteries to make it independent of mains voltage fluctuations.

The locator operates on a "radar" pulse system in which reflection occurs from any discontinuity in the line. A transmitted signal, generated within the locator, consists of a number of 400-volt peak to peak five microsecond pulses at a mean frequency of 1,000 kilocycles per second at five millisecond intervals. These pulses are coupled to the line and transmitted along its entire length. All discontinuities on the line represent a change in transmission characteristic and cause reflection. Discontinuities may be small, as with towers, or large as in the case of actual faults. Reflected pulses are received by the locator and displayed on cathode ray tube for visual or automatic photographic record. The accuracy obtainable is one per cent of line strength, the minimum range for fault recording is one mile, and depending on local line conditions, the maximum range lies between 80 and 100 miles.

Application of Sub-zero Technique in Assembly of Drive Pins for New British Railways Locomotives

By C. C. LILLEYMAN, A.M.I.LOCO.E.
Technical Adviser, Owen & Dyson Limited

A further stage in the British transport Commission's modernisation plan has now been reached by the introduction into service of the main-line A-C Electric Locomotives. 25 such Locomotives were ordered from the Associated Electrical Industries, who are the main contractors. The Birmingham Railway Carriage and Wagon Company are responsible for the actual building of the Locomotives and Owen and Dyson Limited have supplied the complete Wheels and Axles. Implementing many unique and revolutionary features these locomotives are undoubtedly a land mark in British Railways evolution. Operating on a 25 kV single phase system, using current at industrial frequency, each Locomotive is capable of hauling a 475-ton Passenger train at 90 m.p.h. and a 950-ton mineral train at 55 m.p.h. They are intended for service on the main line between London, Manchester and liverpool as soon as electrification has been completed and like others of their class to follow will be suitable for use in the latter development of main line electrification elsewhere.

Used for the first time on any British Railways locomotive is the 'Alsthom' quill type drive associated with a system of rubber cone pivot body suspension and incorporating a flexible link drive to the wheels (Fig. 1.) These features combine to give good riding characteristics and reduce unsprung weight and maintenance costs.

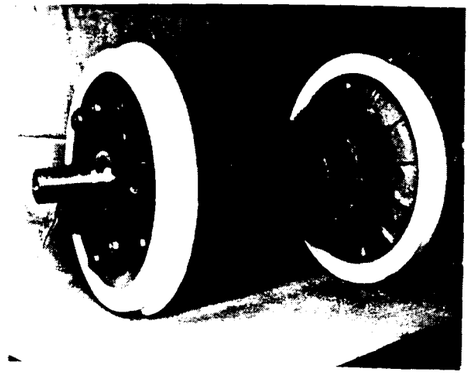


Fig. 1. Complete wheel pair with axle boxes removed.

From the reduction gear on the motor the drive is taken through a hollow sleeve to a universal link assembly which in turn drives the road wheel. Four links are used, bushed at each end with a 'Silentbloc' bush. The drive ends of one pair of links are attached to the hollow sleeve of the reduction gear and the ends of the other pair connect with drive pins fitted into the road wheel. Thus for each road wheel there are two drive pins anchored in the wheel and two similar pins fitted into the resilient quill attached to the hollow sleeve over the axle and protruding through holes in the road wheel web. These four pins are interconnected by the link assembly which in turn is anchored to a floating ring or spreader on the outside of the wheel (Fig. 2). The link assembly is positioned by keys locating in keyways on each driving pin.

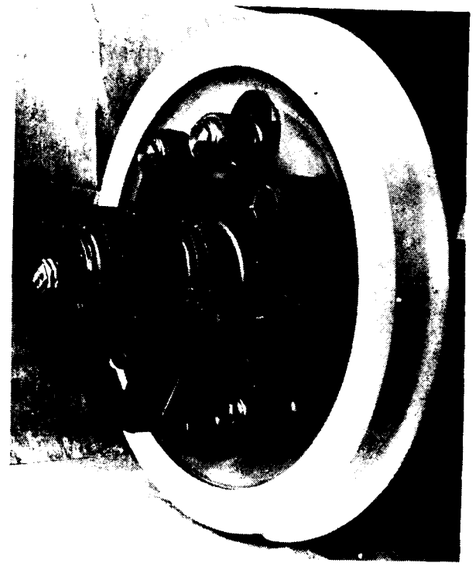
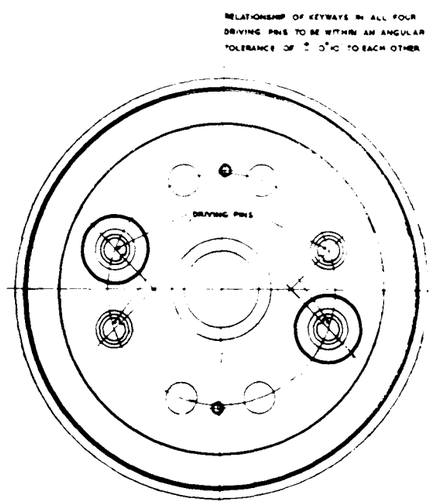
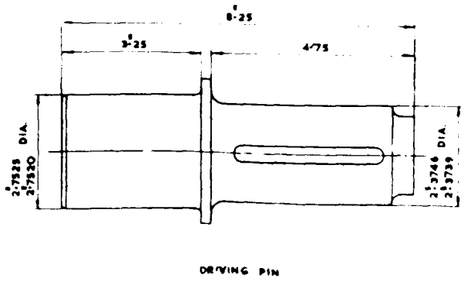


Fig. 2. End view on road wheel showing arrangement of flexible link drive



Obviously, the position of the keyways in all four pins must bear close relationship to each other and in fact the maximum permissible variation in angular position is plus or minus ten minutes of a degree as shown by the diagrammatic layout in Fig. 3. The problem at Owen and Dyson was how to achieve this degree of accuracy on a production basis. To use a hydraulic press would involve cumbersome equipment and jigs which in themselves would be detrimental to precision.

The problem was successfully solved by fixing the driving pins and safety pins (two of which must also be fitted into each wheel) into the road wheels by the sub-zero assembly technique in the following manner.



The keywayed portion of the driving pin (Fig. 4) is loaded into a jig having a spring loaded key which locates in the keyway of the pin. This key in the jig is accurately positioned in relation to a hardened and ground peg fitted into the end of an arm integral with the jig bore and at a radius of 12.372 inches. This radius is vitally important and is, in effect, the hypotenuse of a right-angled triangled whose three points are the centre of the road wheel bore, the centre of the driving pin and the centre of the hardened and ground peg. Another jig, located in the road wheel bore, has pressed into it a jig bush at a given radius from the centre of the wheel bore.

The driving pins which are now jigged up have their shanks immersed in liquid nitrogen at a temperature of minus 194 C. After being immersed for a specified number of minutes, the pin complete in jig is removed and the shank dropped into its mating bore in the road wheel. This operation is illustrated in Figs. 5 and 6. Actually there is plenty of time in which to

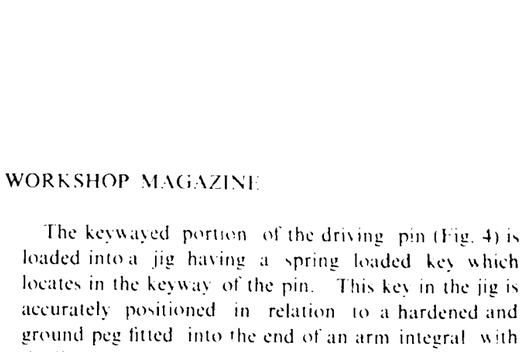


Fig. 5. 'Frozen' pin complete in jig being inserted into road wheel

rotate the pin in its housing before expansion completes the final fitting.

It is during these vital seconds that the peg on the end of the jig arm is located in the bush of the jig fitted into the wheel bore. With this completed, the last and only 'mobile' point of the imaginary triangle is fixed and the positional accuracy of the keyway in the driving pin is assured. Two jig bushes are fitted into the wheel bore jig at 180 to each other. Thus it is possible to repeat the operation for the remaining driving pin without removing the wheel bore jig.

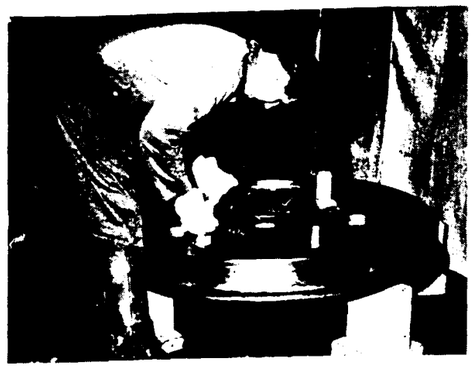


Fig. 6. Note 'frosted' drive pin and safety pin already in position.

One flask of liquid nitrogen is sufficient for 24 pins and is an ideal medium, being inert and non-toxic.

Complete sets of jigs have been designed and made at Owen and Dyson and the invaluable experience already gained has now enabled the whole operation to be refined to an outstanding degree of precise simplicity at minimum cost. At the present time two men can assemble 24 driving and safety pins to a guaranteed accuracy inside 1.1 4 hours.

Driving pins that have been assembled by this method have been pressed out of their housings and successfully subjected to metallurgical and surface finish tests.

Once the driving pins are correctly assembled in the wheels it is very important that the wheels be prevented from rotating during assembly on to the axle—a characteristic by no means uncommon when pressing wheels on to axles. To obviate this possibility two special 'bobbins' per wheel were machined having their bore locating on the driving pins assembled in the quill arms of the hollow sleeve on the axle. The outer surfaces of the bobbins are pushed into two hand holes conveniently placed in the wheel webs and bored out to close limits for this purpose.

In view of the many problems connected with press fits, it is evident that, size permitting, the sub-zero method of assembly gives a more than satisfactory alternative to conventional methods being cheap and simple, yet offering an important contribution towards greater precision.

Certain features of this technique will, no doubt, find application in other fields—and particularly in connection with the manufacture of Rolling Stock—where its potential advantages can be fully implemented.

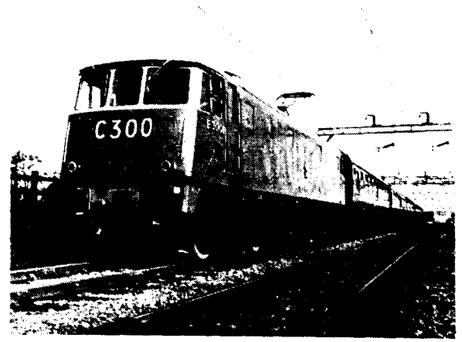


Fig. 7. Front and side view of locomotive E.3001 25 kV. A.C. 50 c/s for British Railways.

The task of hauling phosphate ore under rigorous climatic conditions in Tunisia will be handled by four diesel-electric locomotives ordered from the General Electric Company.

The American builder has announced an order for four of its 600/540-horsepower U5B four-axle locomotives from the Chemin de Fer de Gafsa (Gafsa Railway), which connects the Mediterranean port of Sfax with phosphate mines approximately 300 kilometers inland.

Climatic conditions in Tunisia require that the locomotives operate in arid, sandy atmospheres with temperatures up to 50 degrees Centigrade.

The four-axle U5B is powered by an eight-cylinder Caterpillar D-379 diesel engine, which provides power to four GE-761 traction motors through a GT-601 General Electric generator.

Delivery of the locomotives is scheduled for June, 1962.

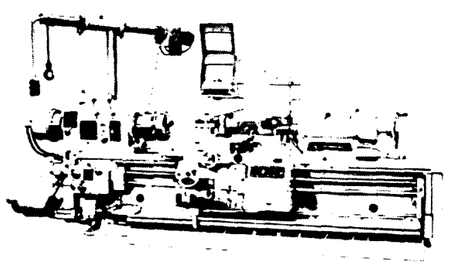
Czechoslovakia - the Leading Machine Tool Producer

IN the field of Machine Tool production Czechoslovakia is backed by many years of tradition which dates back to the days preceding World War I. The TOS Celakovice Works, which celebrates its 50th Anniversary this year and whose products are known under the TOS-VOLMAN trade-name throughout the world, and the SKODA Works which commemorated its centenary last year, provide an example of this development.

Due to the high technical standard of her machine tools Czechoslovakia ranks third among the leading machine tool exporters in the world. By the end of the second 1955-60 Five-Year-Plan the machine tool industry will show a considerable development. New production increases are scheduled for the following years.

The main characteristics of Czechoslovak machine tools are improved fundamental machine tool features with regard to precision, dynamic and static rigidity, as well as a high degree of mechanization and automation.

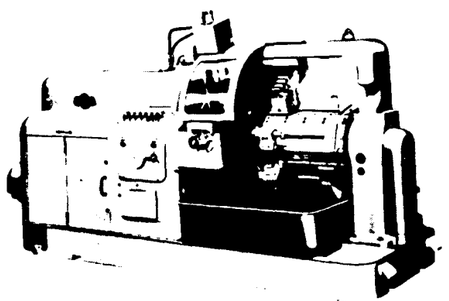
All Czechoslovak lathes can be equipped with a hydraulic copying attachment, and some with attachments for copying of non-rotary shapes. The highly efficient Czechoslovak SU35, SU50, and SU63 lathes with the IKS hydraulic copying attachment,



can be provided, in addition, with a simple equipment which permits work in an automatic cycle. Thus the universal unit becomes a simple semi-automatic repetition lathe which can also be successfully employed for machining of parts in small batches. This is advantageous as the machine can be easily adapted to normal turning without it being necessary to dismantle the attachment.

SP series semi-automatic repetition lathes with programme control are the highest achievement in the field of copy-turning. Their special feature is a fully automated working cycle with two carriages operating simultaneously. Moreover, the type SP 25 permits machining of shafts stepped on both sides at one clamping. Either of the two carriages can repeat the cut four-times, the contact tracer not being in contact with the former plate during the first three cuts. The required speed and feed changes are automatically carried out during the working cycle, and work may proceed under the most advantageous conditions. Setting up of the machines is considerably facilitated by a system of punched cards prepared in advance.

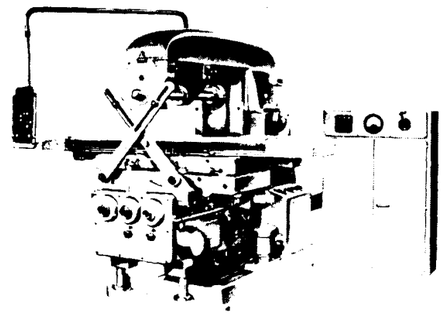
The AB 80 camless single-spindle automatic incorporates an extensive automatic working cycle. The machine is designed for work both from bar stock and in chuck. It is also suitable for machining of semi-finished parts which can be inserted either manually or with the use of a magazine feed attachment. Cams being not required for machining, and the setting-up of the machine taking just as long as the adjustment



of a turret lathes, even small batches of parts can be economically machined. In a great number of cases the AB 80 automatic replaces the turret lathe, being superior to the latter with regard to both output and

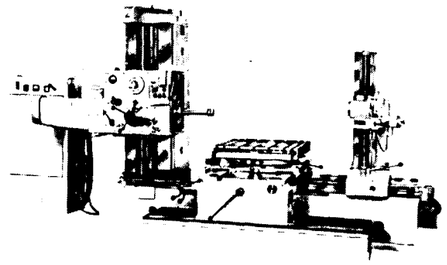
quality of work. Thus, for instance, an almost 100 per cent higher output is obtained on the AB 80 automatic in machining of sliding gear bodies from forgings as compared to the turret lathe. The drive of all motions of this machine as well as the feeding and clamping of stock are carried out hydraulically. The automatic cycle is controlled by means of stops and microswitches.

In the milling field, new series of knee-type milling machines have recently been developed such as the FB 40 and FB 50 millers which are supplied already to-day in horizontal, universal or vertical design. Compared to conventional workshop millers, these machines are noted for a high rigidity of all parts, being also suitable for machining of intricate



workpieces in an automatic working cycle. All controls are concentrated on the control panel. The design of these machines incorporates the latest advances of machining technology together with a wealth of experience gained from the manufacture and use of older types of machine tools both at home and abroad. The machines have been successfully adapted for use with sintered carbide tools as well as for climb milling. Their servicing has been simplified and automated. They can be provided with programme control by means of punched cards or tapes. The special feature of these machines consists in the simultaneous change of all three directions of feed, so that milling of bevelled surfaces is possible while unproductive times are reduced. The tools are protected against undue wear during the return movement by lowering the knee by 0.5 mm.

The development of medium size horizontal boring and milling machines aims also at increasing considerably the rigidity of the machine frame. Series WH horizontal boring and milling machines which will be produced in three sizes with work spindle diameters of 63, 80 and 100 mm, represent the most progressive trends among other machines of similar kind.



High accuracy is obtained by means of a perfect optical equipment for setting of co-ordinates and the modern mounting of the nitrated spindle. In addition to the advantages offered by similar smaller types of machine, the WH 100 boring and turning milling machine permits setting of co-ordinates by programme control as well as their contactless measuring and numerical reading on the headstock body. All feeds are infinitely variable. The special accessories considered for this type of machine provide for milling, surface grinding, boring, and grinding of papered holes.

The grinding machines much appreciated for their high technical standard and reliability, are aimed to new improvements and complete automation. Unit head machines in combination with a measuring station, the magazines and feeders of which can be arranged in production lines, are also being developed. Among those newly introduced the BB 6 centreless grinder meets the highest standards of a fully automatic machine. It serves for multiple production of accurate and high precision parts of 1.5 to 63 mm in diameter, being provided with a semi-automatic plungs grinding cycle and a special attachment for automatic adjustment of the worn grinding wheel. Due to high precision and the special accessories which enable the machine to be fully mechanized, this grinder is especially suitable for automatic machining of antifriction bearing rollers, tapered rollers, and similar parts produced in large batches.

The new machines call, of course, for efficient technical and consultation service, so that it will ever more be necessary in future to offer with the machine also the technology of the part. These facilities will be provided by Czechoslovak factories through their

representatives in India by M s Batliboi & Co., Bombay to the required extent.

Czechoslovak machine tool producers will be confronted in the coming years above all with the task of introducing on the market new and up-to-date machines with a high degree of productive efficiency. This development is justified by Czechoslovakia's own needs on the one hand, and the customers' demand for advanced production technologies on the other.

AEI HI-FI IN U.S. TRADE CENTRE

Hi-fi sound amplifying equipment has been installed by Associated Electrical Industries Limited in the United States Trade Centre in London. This is an exhibition centre where ranges of American-made goods are displayed by the manufacturers themselves or by their accredited U. K. importers to the trade in Britain. The system, ordered by the U. S. Embassy from the Sound Equipment Group of AEI Electronic Apparatus Division, is used for making announcements but later it is intended to relay music.

The large size and awkward shape of the centre presented problems which made it difficult to obtain good sound coverage. Furthermore, the difficulties were increased when exhibition stands were erected. These were overcome by careful siting of selected loudspeakers on suitable baffle boards which were substituted for the existing acoustic tiles of the ceiling at certain points. By using an AEI high-fidelity amplifier unit with a good quality microphone, announcements can be heard very clearly and there is very even distribution over the entire hall. This in spite of the usual high level of noise in exhibitions of this kind.

* * *

AEI HEATING EQUIPMENT AT THE ASEE EXHIBITION

AEI Heating Department will be displaying Pyrobar heating elements and AEI infra-red projectors on Stand K12 at the ASEE Exhibition which was opened in March.

The Pyrobar metal sheathed heating elements will be shown incorporated in typical products, ranging from space heating equipment for recreational halls to chemical process heaters. The ease with which Pyrobars can be bent and formed will be demonstrated and visitors will be able to try this for themselves, using the AEI portable bending tool.

The Pyrobar elements are finding increasing application both in industrial processes and as part of manufactured products. Since the quantity of heat they give out can be accurately controlled, they are ideal for use in heating process vessels.

The display of AEI infra-red projectors will show how easily these efficient heating units can be built into complete ovens or process plants. Typical applications include stoving, in the paint and plastics industries.

* * *

A "cheatproof" teaching machine has been produced by a British electronics firm and a trial batch is to be built and tested in a number of Edinburgh schools. Tests to cover a wide range of teaching conditions and grades of students will be carried out and analysed in co-operation with Dr. Keith, Edinburgh Corporation's Director of Education.

The prototype machine has been built at the Edinburgh research laboratory of Ferranti Ltd. The design of the machine, a simple looking black box with Perspex windows and push buttons, is based on a system of presenting written information to a student in short stages, each sequence being followed by a question to test the student's knowledge to date.

One form of proceeding is to give about five different possible answers, the student selecting one by pressing one of five buttons. The button pressed tells the machine if the pupil is bright, normal, or requires further instruction. For the bright student, the machine presents more advanced information and questions. For the not-so-bright student it goes back to an earlier stage to repeat and explain in greater detail until by question and answer the stumbling block to learning is found.

Ferranti's Edinburgh experiment is to decide if this or other systems are most efficient at teaching. They are not only producing the machine but also the paper roll on which questions are framed. This has to carry a code to tell the machine how far on or back it has to work to suit each student. Ferranti's believe that the machnines can be of greatest use in helping teachers to deal efficiently with all grades of students at the same time when many different speeds of teaching are needed. Other fields of application are in teaching apprentices and in correspondence courses where students can benefit by getting work corrected immediately.

Tambaram-Villupuram Electrification

By S. P. TONSE
Chief Electrical Engineer, Southern Railway

ELECTRIFICATION of the double line section from Madras Beach to Tambaram, a distance of 30 route kilometres was carried out in the years 1928 to 1931 as part of the Madras Improvements Scheme. The system of electric traction adopted was 1,500 volts DC which was considered the best at that time. The electric services were opened for traffic on May 11, 1931.

The service which carried 3 million passengers in 1931 has now to handle nearly 46 million passengers annually as shown below :

Year.	No. of Passengers carried (in millions)	Index.
1931—32	3.3	100
1942—43	13.0	391
1950—51	30.7	926
1958—59	40.1	1,209
1960—61	45.8	1,388

For the run of 30 kilometres from Madras Beach to Tambaram, electric trains stopping at all stations take 48 minutes. In addition to 30 electric multiple units, 4 freight locomotives are also in regular service from 1931. The latter are utilised for clearing loads between Madras Harbour and the Railway's marshalling yard at Tambaram and are also pressed into service during the peak hours to operate additional train services in the suburban section.

Electrification of the main line metre gauge section from Madras Egmore to Villupuram, a distance of 160 kilometres, was originally sanctioned on 3,000 volt D C system. After detailed investigations of various alternatives, a decision has now been taken to adopt 25 kV A. C. single phase, 50 cycle system of traction for this project. The work is estimated to cost Rs. 4.6 crores and is expected to be completed by 1963. This is the first metre gauge main line section to be taken up for electrification on the Indian Railways Salient features of this project are detailed below :

LIGHTER OVERHEAD EQUIPMENT

The wiring over the track, which is termed 'overhead equipment,' will be similar to what is being installed over hundreds of miles on the broad gauge sections on the Eastern and South-Eastern Railways. The currents to be handled under A. C. traction are very much less due to the high voltage and the overhead equipment would, therefore, be of light construction. The steel masts required for the supports will be galvanised in the Railway's galvanising plant at Chittaranjan. The design and layout would be laid out to suit future doubling as and when traffic developments warrant.

The necessary power will be obtained from the grid system of the Madras State Electricity Board at 110 kV at Kadapperi (near Tambaram). Acharapakkam and Villupuram. The Railway will provide substations containing transformers, switchgear and control equipments at these places to make 25 kV A. C. power available for feeding the overhead wires. These sub-stations as well as a number of intermediate switching stations will be push-button controlled from a Remote Supervisory Control Centre which will be established at Madras Egmore.

Sixteen locomotives of the mixed traffic type (i. e. suitable for both goods and passenger service) are being manufactured in the Chittaranjan Locomotive Works. These locos will be capable of hauling 1,400 tons trailing loads on goods trains and 16 coaches on passenger trains, compared to 1,000 tons and 14 coaches respectively now possible with steam traction. Trains over Madras Egmore-Villupuram section would be speeded up by about 1 hr. 30 mts. for passenger trains and 45 mts. for mail and express trains and two hours for goods trains.

With A. C. traction, it would be necessary to replace the overhead telegraph and telephone wires running parallel to the track by underground cables. The Posts & Telegraph Department will be doing this work. The cabling would incidentally provide better and more efficient service.

ALTERATIONS TO SIGNALLING SYSTEM

Other ancillary works to be done include alterations to signalling equipment and circuits to make them suitable for A. C. traction, cabling of power distribution lines, providing increased clearances under bridges etc.

In the matter of technical 'know-how' required for execution, the Southern Railway is being assisted by the Railway Electrification Administration, Calcutta, who are currently doing large scale electrification on the 25. k.V. A. C. system on the Eastern and South Eastern Railway.

IMMEDIATE EXTENSION TO VANDALUR

As a first step, it has been decided to complete the work from Tambaram to Vandalur early so that the benefits of electrification could be extended to the extent possible for passengers on the section, especially the workers and staff of the Standard Motors Factory at Perungalathur. With this object in view, although the overhead line will be constructed to suit 25 k.V. A. C. system, for the present, it will be energised on 1,500 volt D. C., as a continuation of the Madras Beach-Tambaram suburban section. This work is expected to be completed before the end of this year and a few trains introduced on this section early in 1962. The contract for the supply and erection of overhead equipment of this section has been awarded to Messrs. British Insulated Callenders' Cables Ltd., U. K.

The conversion of the Madras Beach-Tambaram suburban section from D. C. to A. C. has been programmed to be completed in 1965. When this work is completed, there will be a unified system of traction from Madras Beach to Villupuram. Substantial addition to the electric multiple unit stock will also be made on conversion and it is expected that they would provide some relief from the overcrowding conditions now experienced in the electric suburban trains.

Electrify and or Dieselise the Railways in Southern Region

WE are at the threshold of the Third Plan and yet, one does not see any prospect of the Southern Railway attaining greater efficiency, either in clearance of goods traffic or reduction of overcrowding in passenger trains. The reason is not far to seek. The Second Plan included very little expansion and additional facilities. May be, crores had been spent on patch doublings and remodelling of yards and provision of bigger buildings at stations. These essentially are items of greater convenience, but have brought no achievement of quick transport. The slogan as now oft-repeated is the doubling of the line from Jalarpet to Erode and extension of electrification from Tambaram to Villupuram. Of what littte avail are these ? On behalf of the intelligent travelling public and the suffering industrialists of South India, an assessment of the situation as obtained is long overdue and we hope to convince in the ensuing paras, the Railway Moghuls seated in the capital of the Government of India, that the solution from all points of view—including the economics of capital and annual working expenditure and operational efficiency—is that the Southern region must be electrified and dieselised.

The new Passenger Time Table has come out on the April Fool's Day and with it the commencement of the second year of the current Third Plan. One will be pardoned for bringing to the notice of the public some items which are of befooling nature, but which the discriminatory Southerner would not swallow. Day in, day out, one hears that the speeds are improved up. A distance of about 70 kilometres between Madras and Arkonam had been working as a double section for many decades. Pacific Locomotive Enquiry Committee Members, including the world famous locomotive expert Mr. Stanier and later, French experts had travelled on the double section with old types of locomotives, attaining during the tests, high speeds of between 65 and 70 miles an hour. To record that the running time of the Bombay Mail from Arkonam to Madras is 105 minutes working out to 0.6 kilometres per minute or 24 miles per hour, is not April Fool's joke. Thank God that in the year 1962, the speed is not much less ! One is fancifully reminded of the days when the Banglaore Express, leaving Madras Central at 13-00 hrs. after a quick lunch, steamed into Bangalore in time for dinner, with a running time of 6½ hours. Powerful locomotives like WPs did not exist then. During the South Indian Railway Company time, one used to get into the Ceylon Boat Mail at about 21-00 hrs. and reach Tanjore near about 4/45 hrs. in the early hours of the morning and reach Tiruchi at twilight. The average speed now on this practically level section is 48 kilometres per hour. equivalent to nearly 24 miles an hour whereas in 1940s, it was nearly 30 miles an hour. The easy explanation that had been offered sometime back was that there had been bunching of trains in Madras Central. This does not apply any more, as Madras Central Station has been remodelled with complete automatic electric signals in Basin Bridge area and for Madras it is in progress. If locals are to run at the same time, surely speeding up is possible by provision of diesel locomotives, which have far better and higher cruising speeds and acceleration and deceleration. Workmen right from Arkonam visit factories which are fast springing up at Ambattur, Perambur, Tiruvottiyur, to name only a few. Gigantic developments have baen planned by the Defence Ministry. The Defence Ministry, make note, is set for implementation in phenomenal time of its projects. The Defence Minister, by the way, does not believe in too much publicity, but does his part silently. He hates press propaganda methods as are adopted by the Railways. What a halo about frequent reports in dailies about development of the Integral Coach Factory, Remodelling of Madras Central station, turning a sod in Salem area, opening of a bigger station at Cuddalore, Chidambaram, etc. Are these found necessary to counteract the very little that the Railways have done for the South, both of planning and by execution ?

The other day, the General Manager of the Southern Railway lamented aloud that passenger earnings were going down ! If the public is to patronize the Railways, it can only be under conditions dictated by or favourable to them, a seat-cum-sleeper accommodation for every traveller in the lower class and a berth in the Upper class, to be allotted in reasonably short time and not waiting at a queue before the Reservation and Enquiry Offices and cover long distance journeys in reasonably quick time. With crores of rupees that had been sunk as Railway capital in recent years, is it

too much to ask that the average speed per hour for Mails and Express trains between important junctions is stepped up to 40 miles per hour and 30 miles per hour for Broad Gauge and Metre Gauge respectively? It would not be far cry if the Railways decide to dieselise electrify the south. This is imperative from other aspects as well. The speeding up is only incidental. Coal has to come from long leads of nearly one thousand miles from Bengal and Bihar True, Singareni, nearer south has stepped up production, but this is all required for industries. The coal from Madhya Pradesh and Vindhya Pradesh is totally unfit for locomotives and hence, it is high time that the Railway Board delete this source from their books. Coal is carried to the south by wagons and by mostly old steamers, termed, 'colliers'. Considerable money has been spent to instal mechanised equipment for handling coal at Madras Harbour, but it is not very difficult to switch this over for ore traffic. The reduction in coal movement to the south will release line capacity and wagon capacity for movement of other essential commodities like Cement, Foodgrains and finished products from steel factories which are all concentrated in the North-Eastern area. We see daily in the papers that there is huge accumulation of such products, awaiting allotment of wagons and movement thereafter. Statements by Railway Board on the easing of the wagon situation and the counter-statements by the Steel, Mines and Fuel Ministry regarding accumulation at pit-head are all common features. The public only know that due to shortage of coal, production in cement factories in the south could not be stepped up, though capacity has been developed. Labourers fail to earn higher pay and valuable equipment is not worked to full capacity. So let a radical solution be thought of in a bold and realistic manner.

The North-East line between Vijayawada and Madras should be dieselised and as second stage, between Bezwada and Waltair. The line capacity is insufficient and taking the average cost of about ten lakhs per mile for doubling, it involves a capital expenditure of thirty crores. The maintenance of track on a coastal line is also costly. With the doubling, it is going to be another 250 miles to be maintained at high cost for the next five years, which would be the minimum time for settling down of the sub-soil ballast, etc. Thereafter, the vagaries of the weather like monsoon, rain and others would contribute greatly to the enormous expenditure for maintaining the track for running trains at high speeds. It would have been a far more economic proposition if powerful diesel locomotives of 2,000 H.P. had been obtained and placed on this line for movement of goods traffic and with less powerful locomotives for passenger traffic. The requirements would have been of the order of not more than 100 locomotives at a cost of about twelve crores. What would then be necessary is to revise track standards and improve the same for running trains to a maximum speed of 75 miles per hour on passenger trains and 50 miles per hour on through goods on single line. Even if this costs about five crores more which is on the liberal side it is economical. For doubling, it would cost the Railways a capital expenditure of 13 to 15 crores and additional maintenance expenditure of nearly two crores per annum, made up of

(a) the savings in maintenance of additional doubled track ;

(b) increased availability of wagons released from coal loading ;

(c) speedier movement of freight trains which would run between long stretches of important stations hauling heavier loads ;

(d) feeding the industries in the south regularly of their requirements of raw materials, finished products, etc.

The fuel bill of the Southern Railway represents very nearly 25% of the total working expenses. The annual coal expenditure in lakhs, as compared to the other Railways, is of the order given below. For easy comparison, the coal bill has been equated on other Railways, to the same traffic as has been moved on the Southern Railway about two years back :

Railway.	*Annual coal bill in lakhs of rupeees*
Southern	1350
Western	950
Central	790
Northern	690
South-Eastern	650
Eastern	580

It can easily be seen from the above that the Southern Railway is paying through its nose almost two and a half times the amount paid by the Eastern Railway, which is situated in the coal area. Apart from the cost of coal, the supply position has always been a matter of great anxiety. During the months of December 1961 and January 1962, the position was so

precarious that even Mail, Express and Passenger trains were late to the extent of 50% in the Southern Divisions. The Expert Committee on Coal consumption on Railways, under the presidency of Shri Karnail Singh, who now holds the No. 1 post of the Railways, specifically pointed out a few years back that " The Madras—Erode section is a fit case for electrification ". He also added that electrification is to be undertaken as rapidly as foreign exchange funds permit, preference being given to sections on which high traffic density makes the test an operational necessity.

It is understood that a scheme has been put forward by the Southern Railway for electrification of Jalarpet-Olavakkot main line section of about 210 miles. This section has very stiff gradients of 1 in 70 between Salem and Jalarpet and 1 in 95 between Salem and Erode and sanction has been given for doubling of a length of about 40 miles. Despite the doubling, the line capacity would not be considerably improved, except by double-heading of all goods trains under steam traction, and with banking this means a third power in the stiff section. In the Third Plan, for this purpose, it is proposed to spend about twenty crores on patch doublings, which includes cost of locomotives also. The policy of the Railway Board which has been issued in 1960 is clear, that " As doubling is costly, this may be proposed only as a last resort after the alternative methods of increasing line capacity such as opening of crossing stations, increase of speed of trains, improvements to signalling had been considered ". The policy to be now laid is for electrification so that the speeds of trains can be increased, duly justified by the pattern and density of traffic which is offering during the Third Plan.

It is difficult to be convinced that the homing of diesel locomotives in the thickest of the coal area is either economical or inescapable. The transfer of 100 locomotives from Eastern Railway to operate trains between Waltair and Madras would only be the easiest and quickest solution. With the present maximum speeds, there will be a spurt in greater clearances and in about a year or two, with the strengthening of the track for maximum speed of 50 miles per hour for goods trains, the clearances south of Bezwada would burst the targets even in the fourth year of the Third Plan.

The area south of Madras upto Jalarpet and even Coimbatore on the Broad Gauge and upto Trichy on Metre Gauge is ideally suited for electrification. Madras is the pioneer in building up an electricity grid in the South. Neyveli is soon to put into this grid, millions of units of electrical power. The potentiality for further more power from Neyveli and other sources exists. The Madras Grid system has planned to improve the installed capacity in M. W. to the extent of 1630 M.W. against 708 by the end of 1961 and 275 by the end of 1956. The Madras State Government had confirmed some months back that they would be able to give full power supply for the electrification schemes of the Railways. The increase in line capacity is possible with electric traction, the broad reasons being :

(i) electric locomotives have high acceleration and deceleration characteristics. This means, highest speeds can be attained even in small sections :

(ii) due to high factor of adhesion, they haul heavy loads in gradients. They can also start heavier loads from stations which are situated in gradients ;

(iii) the regenerative braking system on electric locomotives provide for safety of running with maximum speeds down the ghat sections.

Apart from the considerable saving of time, due to watering and fuelling, the problem of water shortage which arises during summer—which incidentally is the peak period for maximum movement of traffic—would diappear. (Incidentally, with double-headed trains, the watering problems are far more difficult). From an operational point of view, trains hauled by electric locomotives can be crossed with greater accuracy, avoiding detention to trains. Financially speaking, it has been deduced by experts that the total savings in the annual working expenses would be of the order of five crores for an electrification scheme, to the extent of about 200 miles, in difficult sections as in west of Jalarpet. The electrification would also completely cut out the necessity for doubling, which is not only costly, but difficult for execution in ghat sections as between Jalarpet and Erode. The electrification of the single line on the Metre Gauge up to Villupuram, including area from Salem to Cuddalore, is an easy affair. The electrification of the coastal line may be undertaken at later stages when the traffic warrants the same. One gathers that a scheme has been put forward for the electrification of the single line between Jalarpet and Erode on a priority basis and extension of the same between Jalarpet and Madras. The electrification between Jalarpet and Bangalore is also of easy execution. Thus an integrated electrification scheme

is of urgent necessity. It should not entail considerable foreign exchange, as this can be carried out in stages in the course of next five or seven years, building up capacity in the Heavy Electrical Projects which are on hand at present. What is required is a reappraisal of the products to be turned out from them and laying down priorities. There are considerable ancillary services in the south that have developed, as also in the Central and Western India, with whom contracts can readily be entered for 10 to 15 years, for supply of electrical equipment, not only for the initial scheme, but also spares for maintenance and repairs of electric locos and traction lines.

This co-ordination for integrated scheme of electrification in the south, from the Private and Public sector fields is long overdue.

The Broad Gauge line west of Erode and the whole of Madura Division have to be worked with diesel locos. Golden Rock Shops can develop as first stage, the maintenance of these locos, but in later years, manufacture of Metre Gauge Diesel Locos would become a necessity. It has been accepted that concentration of locomotive building in one area is inadequate to meet the requirements of the Southern region below the Vindhya mountains. There is great talent in the South and the building up of a Diesel Loco Factory could be achieved in quick time. The economics of diesel operation, reflected in more naya paisa per mile, is more than offset by the advantages to the industry and the potentiality for development of ancillary industries in the South, offering more employment, particularly in Ramanathapuram, Tinnevelly and Kerala areas. The development of an Iron Ore Plant in Salem area would call for considerable increase in rail transport. With a refinery functioning in Bombay, the movement of diesel oil via Cochin and Tuticorin ports would bring down the cost of diesel operation considerably. With more and more oil find in Western area, dieselisation of the Madura Division and the West Coast broad gauge line would become all the more imperative. This would also release considerable tank wagon capacity for movement into the interior, and also loading capacity from Western India and Hyderabad areas for traffic other than coal, etc.

It is not yet too late to give fresh thinking to this problem of quick and adequate rail transport for the Southern region. A re-appraisal of the requirements of the South for the Third Plan should immediately be made by appointing a High Power Technical Committee consisting of Members from Western Europe and U. S. A. so that practical men who had in recent years engaged themselves in elaborate change-over from steam to diesel and electric power, could give a working scheme spread over a period of five to seven years, for completion by the middle of the Fourth Plan. The Committee should be given the freedom to apportion the workload as between Private and Public sector, with a view to limiting the foreign exchange to the minimum and programming of the development of the ancillary industries in the electrically-minded South for maintenance and repairs of electric stock and for building and maintenance of diesel locos and apportion priority works for the Heavy Electrical Projects, or an ancillary to the same in the South.

The Indian Railways began electrification for the first time in 1925 with 1500 V. D. C. for 240 miles in the Bombay and Madras regions. Later, with 3,000 V. D. C., they extended it for 90 miles in Calcutta region. In 1957, the single phase industrial frequency system had been decided upon in electrification programme included in the Second Five Year Plan. This programme contemplated electrification of about 869 miles to cover the following sections: Durgapur to Mughalsarai; Asansol to Rourkela, Khargpur to Dangoaposi via Tatanagar, Tambaram to Villupuram and Calcutta city region.

The first single phase locomotive was put on trial in Rajkharsawan-Dangoaposi section in December 1959 for a length of 46 miles. The second phase was completed on 22 12 1960 with the inauguration of Asansol-Dhanbad section Let the South, which is already the leader in Electricity production and distribution, have its due quota of quick and adequate transport without any more dilly-dallying. Let India, through the South, lead in Dieselisation Electrification of Transport and be on a par with other countries, at least in the thinking part of it, though not to a gigantic scale, in radical reforms of Regenerative Transport.

SALEM—BANGALORE RAIL LINK

WILL HELP TRANSPORT LIGNITE FROM NEYVELI

By Our Special Correspondent

THE first step in the construction of the Salem—Bangalore metre gauge railway line was taken in January when Mr. K. Kamaraj, Chief Minister, turned the first sod at a formal function in Salem.

Mr. Kamaraj said that the new line would facilitate movement of lignite from Neyveli to Salem where a steel plant was proposed to be set up.

VIRUDHUNAGAR TO MANAMADURAI

Work on line to be started in February

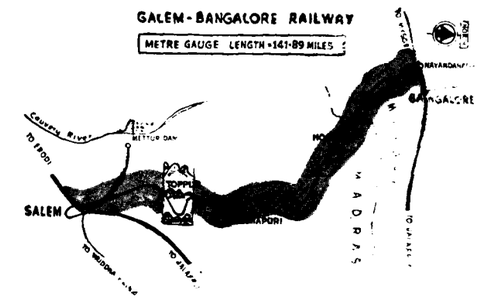
It was announced amidst cheers on the occasion by the Deputy Minister for Railways that construction work on the Virudhunagar—Manamadurai rail link would be inaugurated in the first week of February. This is a Rs. 2.5 crore scheme which has been approved and justified on operational grounds.

The double line from Danishpet to Thimmapatti on the Salem—Jalarpet section was also opened for traffic.

Mr. Kamaraj cut the first sod for the construction of the new line to the accompaniment of music and a loud burst of crackers. The function was held in a specially erected shamiana. The precincts of the station were tastefully and attractively decorated. Dr. P. Subbaroyan, Union Minister for Transport and Communications, Mr. K. F. Patil, Minister for State Transport, Mining and Food, Government of Mysore, and Mr. Karnail Singh, Chairman of the Railway Board, were among those present on the occasion.

Mr. H. D. Singh, General Manager, Southern Railway, in the course of his welcome address, furnished details about the new line. He said that with the mining of lignite and development of power at Neyveli, production of steel and pig iron from the iron ore deposits in the Salem area seemed a distinct possibility. With the Kundah hydro-electric scheme progressing, the power potential of this region was encouraging. At the other end, Bangalore had held its mark in the industrial map of the country. The linking of the two towns, Salem and Bangalore, with a railway line would meet a long-felt need and would usher in an era of industrial prosperity for the entire region, he said.

Associating himself with the function, Mr. Patil, Mysore Minister, observed that Mysore and Madras were sister States whose progress was inter-related. He expressed the hope that the construction of this rail link would be executed with the utmost expedition.



Referring to the needs of Mysore State, the Minister said that Mysore had proposed six new railway links for inclusion in the Third Five-Year Plan but the Planning Commission had included only two schemes, namely the Bangalore—Salem and Hassan—Mangalore lines. He appealed to the Planning Commission and the Railway Board to reconsider the decision with regard to the other links which were vital and on which the future economic and social prosperity of Mysore State greatly depended. Pleading for a categorical assurance that under no circumstances would there be any re-thinking on the Hassan—Mangalore railway line, he urged that an early inauguration of this line might be arranged and the work completed as expeditiously as the Salem—Bangalore line.

RISE IN VOLUME OF RAILWAY TRAFFIC

Mr. Karnail Singh, Chairman of the Railway Board, referred to the arduous task before railway men and observed that encouragement given by the public helped them greatly. "We railwaymen never forget kind words" he observed and added "because they are so rare." Referring to the volume of traffic

handled by the railways, he said that the railways were moving goods or freights to the tune of 2,60,000 million tons in 1950—51 and during the subsequent ten-year period, the traffic had more than doubled. Forty-five lakhs of passengers bought tickets every day. He said that the Railway Board was always interested in finding ways and means of developing and providing new communications and amenities.

After turning the first sod, Mr Kamaraj said that the people of this area had been urging the need for the execution of this new line and he was glad that the scheme had materialised. This was a vital link to facilitate the industrial development of the area. Side by side with industrial development there should be a corresponding increase in the transport facilities also. These transport facilities should be planned in the proper way so that they might give the maximum return. Having regard to the fact that the country was still in short supply in respect of necessary materials such as iron and cement, construction work such as the laying of new railway lines had to be planned in accordance with the availability of these materials. Otherwise, they would have taken upon themselves more than they could accomplish.

Referring to the possibilities of industrial development in the Salem area, he said, with good prospects for the setting up of an iron plant, there could be no doubt that in the Salem area there would be quick industrial development and would bring in its train economic prosperity to the people of the area. Mr. Kamaraj expressed his gratitude to the Central Government and the authorities concerned for having taken steps to put through this project.

Dr. P. Subbaroyan, Union Minister for Transport and Communications, referred to the procedure adopted in the execution of the various development projects including new railway lines and observed that it was not possible to get what all they asked for. These projects were being sanctioned and executed after taking into consideration the financial resources and other relevant factors. After examining various schemes in all their aspects, the Planning Commission placed its proposals before the Central Cabinet and the latter had, he mentioned, power to change the recommendations of the Commission. It was not correct to say that the planning Commission was "a Government within a Government". The final responsibility was, however, with the Central Cabinet.

Dr. Subbaroyan said he was glad that the Chairman of the Railway Board had assured them that the Salem Bangalore line would be completed in 2½ to 3 years.

Mr. C. R. Narasimhan, M.P., next spoke, expressing gratitude to the Central Government and the Planning Commission for sanctioning the project.

Mr. S. V. Ramaswami said that it was a great day in the history of South India in general and Salem district in particular. The question of construction of the Salem Bangalore link had been before Parliament and the public for a very long time. In the context of the economic development under the impact of the Plans, the increasing tempo of industrialisation of the country and the urgent need for developing the means of communication; the position was reviewed and the Salem Bangalore rail link was considered. Finally, the implications were worked out minutely and it was found justifiable. This line was justified in the context of the Neyveli Lignite project which would facilitate the movement of lignite to Mysore area and the movement of high grade iron ore from Mysore State to Cuddalore port for export to eastern countries and also facilitate the setting up of steel plants both in Salem and Mysore areas, it would also generally help the economic development of the Southern States. Along with this, two other railway lines had been approved, namely, Hassan-Mangalore and Virudunagar Manamadurai links.

Mr. Ramaswami added that out of a total of Rs. 17.5 crores to be spent on railway constructional works roughly about Rs. 10 crores would go out as wages. "It is the policy of the Ministry", he observed, "to see that the maximum amount of money reaches the workers themselves out of the construction expenditure".

Mr. G. P. Warrier, Engineer-in-Chief of the new construction, proposed a vote of thanks.

SALIENT FEATURES OF SCHEME

The proposed railway line will run to a length of 140 miles and is estimated to cost about Rs. 8 crores. The project is expected to be completed in 1965.

The new line will connect the two industrial cities, Bangalore and Salem, the headquarters of Salem district. Bangalore has already earned its industrial eminence, and Salem, with the many industries springing in the neighbourhood, will develop further consequent on the laying of this new line. This line will form an arterial route from North to South enabling the movement of raw materials and finished products.

The proposal for the construction of a Metre Gauge line to connect Bangalore to a suitable point between Jalarpet and Erode was considered ever since 1913, when the Narrow Gauge section from Morappur to Hosur through Dharmapuri came into commission. The Narrow Gauge line, due to its inherent limited capacity, could not adequately serve the traffic and had to be closed down in 1941. Since then, proposals were examined for constructing a Metre Gauge line in lieu of this Narrow Gauge line and connect it up to Bangalore. After a good deal of examination, it was found more advantageous to connect Bangalore to Salem, retaining only the Dharmapuri—Hosur portion of the Narrow Gauge alignment and making a short cut to Salem. This conclusion which was arrived at in 1951 was subsequently strengthened by the result of the preliminary Engineering and Traffic Survey conducted in 1956, as a result of which, the scheme was found feasible.

This new Metre Gauge line will run through the Salem district of Madras State and Bangalore district of Mysore State, 107 miles in the former and 33 miles in the latter. The line has to run through three distinctive topographical regions, the plains between Salem and Toppur, Toppur Ghats and the plateaus beyond. In the Toppur Ghats, the line has to climb through an elevation of about 500 ft. in a distance of 10 miles crossing the various spurs of the Eastern Ghats through a few tunnels. There are more than 500 bridges to be built between Salem and Bangalore. At Dharmapuri, the line will join the abandoned narrow gauge alignment and from there onwards upto Hosur, it will follow the Narrow Gauge alignment, a distance of 57 miles. From Hosur, the line will run on the undulating plateau section of the Bangalore district and join the Metre Gauge system at Bangalore City. Partly, the construction of this line fulfills the repeated requests from the public of this area for the restoration of the dismantled railway line, with the added benefit that a through connection is now established between the northern and the southern Metre Gauge system, thereby forming a through arterial route.

The work on this Project is, it is mentioned heavy, particularly that in the Toppur Ghats, and it will take three to four working seasons for completing this Project. There is also the factor that there is great demand for critical materials like cement and steel from all over the country. However, it is expected that the Project can be completed in 1965.

Simultaneously with the construction of this Project, there are also heavy line capacity works going on between Jalarpet and Erode so as to augment the capacity of the Broad Gauge line. With the increasing tempo of industrial activity as also agricultural production in the whole country, there is heavy demand for increased transport facilities and to meet this, this new line as well as the doublings and other line capacity works in this area are expected to fulfil the requirements.

AEI DIESEL ELECTRIC LOCOMOTIVES FOR NYASALAND

Associated Electrical Industries announce that its Traction Division has just received an order for eight 1200 h. p. diesel electric locomotives from the Nyasaland and Trans-Zambesia Railways.

The mechanical parts of these single-cab 81 ton Co-Co locomotives will be made by Metropolitan-Cammell Carriage and Wagon Company, Limited at their Birmingham Works. The diesel engine will be the Sulzer Type 6 LDA 28 B. This engine is being used extensively on British Railways Type 2 locomotives and 233 of them are being supplied with AEI electrical equipment: the main traction generator is similarly based on the same AEI generator used on these Type 2 locomotives. The traction motors are of the latest AEI Type 253, a force ventilated motor with an extremely high power weight ratio, achieved largely by the use of silicone insulating materials. Once again this motor is the same as that being currently supplied for the 57 Type 2 locomotives recently ordered by British Railways. Motors and Generators will be made at the Sheffield and Rugby Works of AEI and the control gear in their Trafford Park, Manchester Factory.

These 3′—6″ gauge locomotives will be used for hauling freight on the steep grades of the Nyasaland Railways, reaching 1 in 44 with a maximum altitude of over 3800 ft. The top speed of the locomotives is scheduled at 50 m. p. h. and initially they will operate on the 335 mile stretch between Dondo, near the port of Beira in Mozambique, and Blantyre in Nyasaland.

All eight locomotives will be delivered in 1963.

ECONOMICS OF METAL CUTTING

By

Shri Achuyt Ghosh, B.E.(Mech.)
Shri Amitava Gangulee, B.E.(Met),A.M.I.I.M.

INTRODUCTION

THE concept of economy is not a new one, as a matter of fact it can be traced back as far as Aristotle's time. But introduction of studies in the economics of metal cutting is of a comparatively recent origin. The word 'tools' meant carbon steel tools for the past few centuries but now it includes the spheres of alloy steel tools, ceramic tools and other powder metallurgy products. The days of carbon steel tools are gone and even the extensive use of high speed steel tools are also decreasing giving way to cemented carbide tools and ceramic tools. As for the production practice in our country we have to be satisfied with high speed steel tools, which even has to be imported to meet our country's demand. However, with the advent of alloy steel industry in our country, we hope to be self-sufficient about high speed steel within a short time, and only then we can look forward for the next stage of development namely the extensive use of carbide tipped and ceramic tools. Hence, for the present moment our object should be to achieve the maximum cutting efficiency at minimum cost with the existing tools.

MECHANICS OF METAL CUTTING

During cutting of metals, the metal is removed in the form of chips. Ernst in 1938 proclaimed that there are only three basic types of chips in spite of all the complex variations. They are :

(a) Discontinuous,
(b) Continuous and
(c) Continuous with Built-Up-Edge (BUE).

For a general idea we can discuss the formation of continuous chips only, which can be assumed to be the ideal case.

Here, (Figure-1) the material is compressed as it approaches the cutting edge of the tool and after passing the elastic stage becomes plastic. Flow takes place partly along the tool-face and partly upwards away from the tool-face, until ultimately a shear plane is established. As each successive element of the material passes through the shear plane, sliding along the crystallographic slip plane occurs until it is arrested by the keying action analogous to the work-hardening mechanism. The shear movement is then transferred to the next element passing through the shear plane, and the process thus repeats resulting in the formation of continuous chips, which have a smooth layer of highly compressed material on the side sliding in contact with the tool-face.

The ideal orthogonal cutting, where the cutting edge of the tool is set perpendicular to the direction of tool

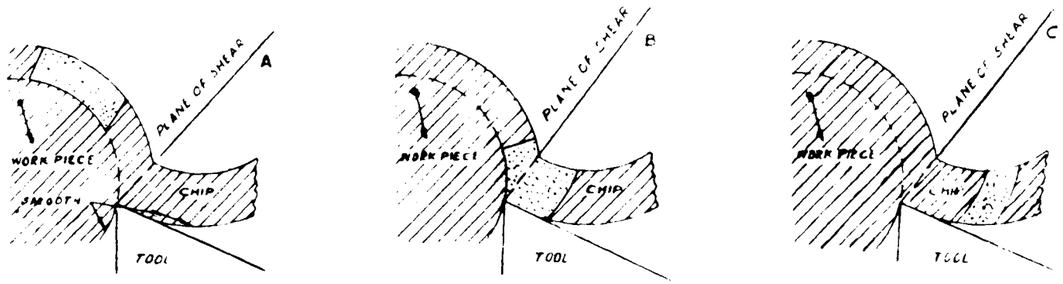


FIG. 1

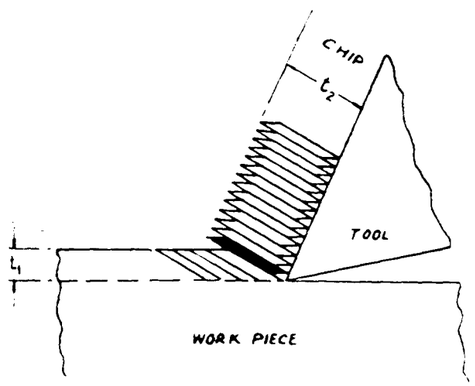
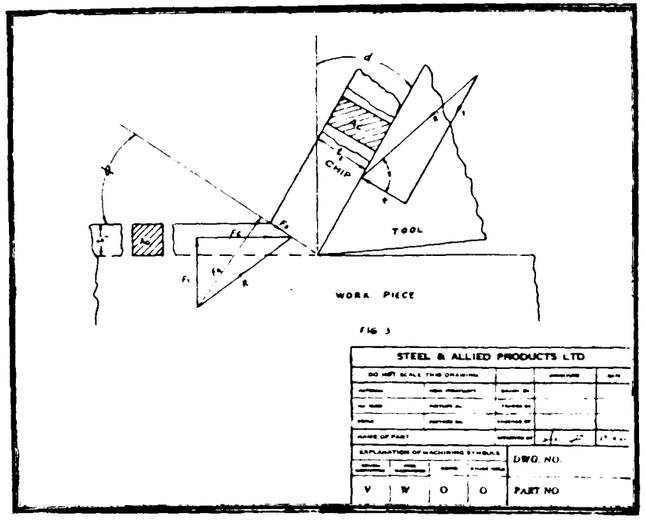


FIG. 2

travel and only single straight line cutting edge is active, can be represented by Piispanen's model of cutting process (Figure-2). The formation of chips appears to proceed in thin lamellae of metal like a pack of cards. One such lamella which has just been removed is shown black. In reality, the lamellae are quite thin and the chips are of uniform thickness.

The analysis of forces during metal cutting can be shown thus :



(Figure-3)

where Ao = Cross-sectional area of chip before removal.

Ae = Cross-sectional area of chip after removal.

t_1 = Thickness of chip before removal.

t_2 = Thickness of chip after removal.

α = Rake angle of tool

O = Angle between plane of shear and generated surface (Shear angle).

Fs = Shearing force required to shear the metal in the shearing plane.

Fn = Compressive force normal to shear plane.

Fc = Force component along the direction of tool travel.

Ft = Force component perpendicular to the direction of tool travel.

F = Frictional resistance to chip sliding on tool-face.

N = Normal force.

Merchant developed a force system for orthogonal cutting assuming that the chip is a body held in stable mechanical equilibrium under the action of forces exerted on it at the tool point and at the shear plane, neglecting the action of a small couple arising from the fact that the ballancing resultant are not collinear (actually this couple is partly responsible for curling the chip). On the assumptions that the entire force system lies in a single plane, the resultant force R has two basic components Fc and Ft. Fc is the force component in the direction of tool travel and determines the work required to move the cutting tool. The component Ft does not work, but both the components produce deflection of the tool relative to the workpiece. As the chip passes over the tool with a definite velocity, it may be considered that at any instant it is in stable equilibrium at the tool-face under the action of forces F and N.

TOOL WEAR

From the above analysis we find that there are mainly two forces acting on the tool ; one F, the frictional force which tries to push the tool bit inside the holder and the other one Fc, the cutting force which tries to bend the tool bit or break the edge. Both the components increase with increase of speed and feed of cut.

The first component can be reduced by properly orienting the tool geometry to the maximum advantage. The effect of the second component can be nullified to a great extent by selecting harder tool material, with less chip-tool interface friction coefficient.

Two typical examples of tool wear are shown here (Figure-4 and Figure-5).

Fig. 4. Tool failure by crater formation

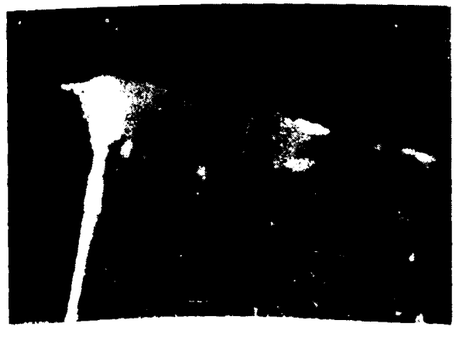


Fig. 5. Tool failure by edge wear

CUTTING FLUIDS

The additional effect of the chip sliding on the tool-face is constant wear of the tool face. To minimise this effect, we can take help of cutting fluids, which perform dual function of chip-tool interface lubrication and cooling.

The action of cutting fluid as a chip-tool interface lubricant is very complex and requires more investigation for any positive statement. But the latest theory borne by experimental facts says that the contact between the chip and the tool occurs between the ridges (aspiritis) of both surfaces (as we shall see later). So the actual contact area is very small (being of the order of micro-sq. cms.) Due to the normal chip-tool interface pressure tremendous strain occurs at the contact points (Figure-6) and the metals get welded together to form an alloy. If the shear strength of the tool material is less than that of the alloy thus formed, some portion of the tool material will be taken away with the chip. It is assumed that the cutting fluid gets access to the cavities by capillary or some other action and enters into some chemical reaction with the chip-tool alloy, producing a semi-solid compound. If it so happens that the instantaneous alloy produced by them has got less shear strength than the parent metals, shearing will take place at that zone and wear will be much reduced

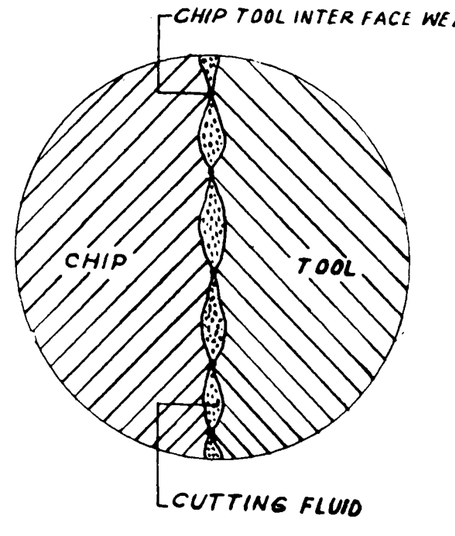


FIG. 6

The capillary action of the cutting fluid occurs only at lower relative velocity of chip with respect to tool. So at higher speeds, lubricating action of the cutting fluid is almost negligible and the cooling action predominates.

As evident from the above facts, some particular cutting fluid will act best with regard to some particular work material and tool material. Any general, all-purpose cutting fluid is yet to be discovered. Hence choice of cutting fluid has got a great influence on tool life.

WORK MATERIAL

Since we have seen that the shear strength of the work material influences the shear angle, and hence the rake angle, it is very important that the shear strength of the work material should be of proper magnitude. The shear strength in turn is proportional to the tensile strength which is merely a function of hardness which is again dependant on composition and heat treatment. To facilitate continuous chip formation, the ductility of the material (which can be estimated from the difference between the maximum stress and the breaking stress—more the difference more the ductility) is also an important factor.

In ferrous metals, both the hardness and ductility are dependant on the nature, quantity and mode of dispersion of the foreign elements present. The

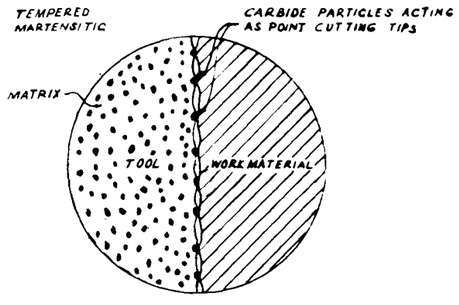


FIG. 7

common alloying elements that are present in commercial steels are Carbon, Silicon, Manganese, Sulphur, Phosphorus, Chromium, Molybdenum, Tungsten, Nickel and Cobalt. The general effects of these elements may be seen from Table-I :

TABLE—I

Elements	*Effect on hardness*	*Effect on Machinability*	*Carbide formation*
Carbon	Increases	Decreases	—
Silicon	Increases	Increases a little	Demotes
Manganese	Increases	Increases	Demotes
Phosphorus	Increases	Increases	Promotes
Sulphur	Increases	Increases	Promotes
Chromium	Increases	Decreases	Promotes
Nickel	Increases	Decreases a little	Demotes
Tungsten	Increases	Decreases	Promotes
Molybdenum	Increases	Decreases	Promotes
Cobalt	Increases	Decreases	Promotes
Vanadium	Increases	Decreases	Promotes

The austenitic grain size of the material also influences the machinability of the material. A coarse grained structure is favoured for rough machining whereas a fine grained structure is essential for a fine finish by machining.

The heat-treated state of the work-material is also a very important factor, which is affected by each of the abovementioned element in its characteristic way. However, in view of the fact that high hardness of the work-material requires excessive force resulting in heavy tool-wear, it is always advantageous to have the material in a normalised or annealed state.

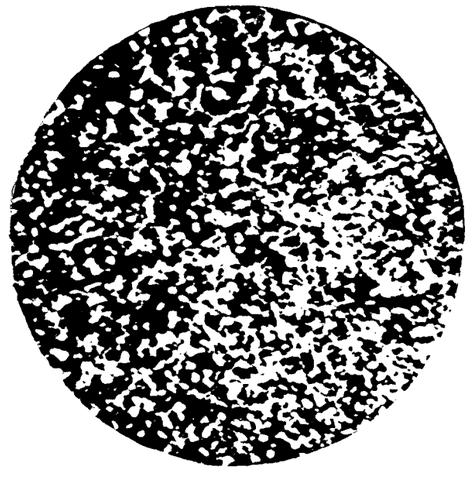
In cases of steels having high carbon content or high amount of carbide forming alloying elements, massive particles of hard and abrasive carbides exists in the form of a network (at the austenitic grain boundaries), causing an accelerated tool-wear. To minimise this harm it is advisable to give the material a spheroidising treatment so that the carbides are dispersed in the form of globules in a continuous matrix of soft ferrite.

In the case of non-ferrous work-materials there is seldom any trouble except in the very rare cases of heat-treatable alloys. In most cases a suitable heat-treatment will solve the problem.

A common problem for non-ferrous metals is the clogging of the gullets when cutting with a multiple teeth tool. The minimum TPI permitted for the section will solve the problem.

X 750

Fig. 8. Low Tungsten Steel after hardening



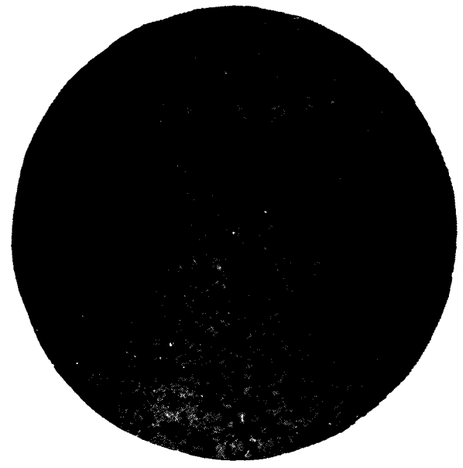
X 750

Fig. 9. Low Tungsten Steel after tempering

In practical cases however, a choice about the work-material is seldom allowed thus making the tool a variable factor.

TOOL MATERIAL

Having apart the question of ceramic tools or



X 750

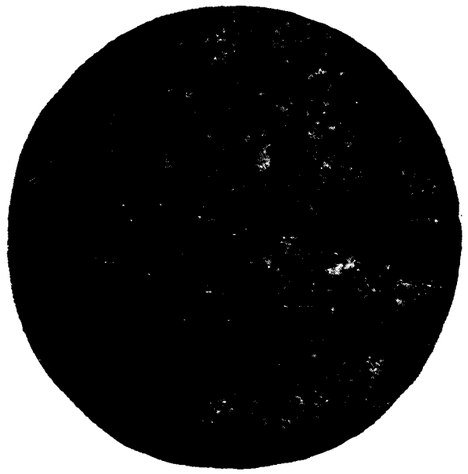
Fig. 10. High Speed Steel after annealing

X 750

Fig. 11. High Speed Steel after hardening

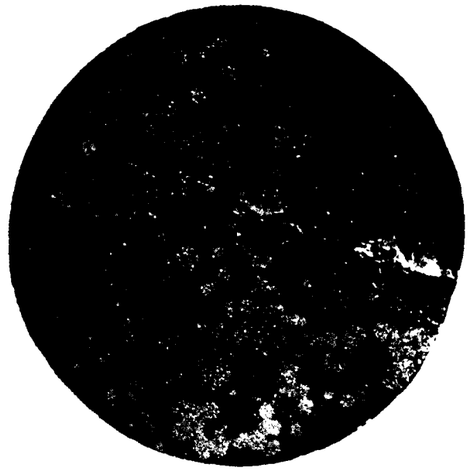
cemented carbide tools and other powder metallurgy products, the most common tools are generally made from three classes of steel :

(a) Carbon steels,
(b) Low alloy steels and
(c) High alloy steels.



X 750

Fig. 12. High Speed Steel after single tempering



X 750

Fig. 13. High Speed Steel after double tempering

In all these steels, however, the goal is to achieve a uniform distribution of coarse globular carbides in a matrix of softer but tougher tempered martenside. These carbide particles acts as small ' cutting tips ' or ' point cutters ' when the softer matrix has worn out (Figure-7).

The ideal condition for cutting is reached only after careful heat-treatment. If the steel is over-heated during heat-treatment eutectic formation at the grain boundaries along with considerable grain coarsening occurs resulting in high susceptibility to wear. The best way to ensure the quality of heat-treatment is to have a look at the micro-structure. Some standard micro-photographs are given here (Figures 8 to 14).

In case of high alloy steels (e. g. high speed steel) the heat treatment requires extreme care. The high temperature used to get the carbides in solution may burn the steel if too long a time is used.

However, heat treatment of tools is generally and entirely the tool-manufacturer's headache. And luckily the tools that are available in the market are generally heat-treated to standard specifications.

CONCLUSION

Even when operating under ideal conditions the performance of tools generally follows an exponential path, (Figure-15) having a general equation :

$$\frac{dp}{dt} = a.e - bt$$

where $\frac{dp}{dt}$ = Performance level

t = Time

' a ' and ' b ' = Constants depending on physical conditions.

On logical grounds, it is obvious that it is not economic to operate with a tool when :

$$\frac{d\left(\frac{dp}{dt}\right)}{dt} > \text{or in other words maximum}$$

economic tool life is upto that when $\frac{d\left(\frac{dp}{dt}\right)}{dt} = 1$

or, $-a.b.e.^{-bt} = 1$

$\log_e a.b.$

or $t = \frac{}{b}$ = Maximum economic tool-life = T

This time period T is the maximum period upto which a tool should be used at a stretch. If possible it may be used again only *after* proper grinding or dressing.

Thus we find that for economic metal cutting we should use :

(a) The proper tool with proper heat treatment and geometry,

(b) The work-material in the proper structural condition.

(c) Proper feed and speed and

(d) Proper cutting fluid.

X 750

Fig. 14. High Speed Steel when burnt

Since tools are marketed with proper heat treatment, all the other factors are under the direct control of the consumers, proper manipulation of which will result in the most economic use of tools in metal cutting.

ACKNOWLEDGEMENT

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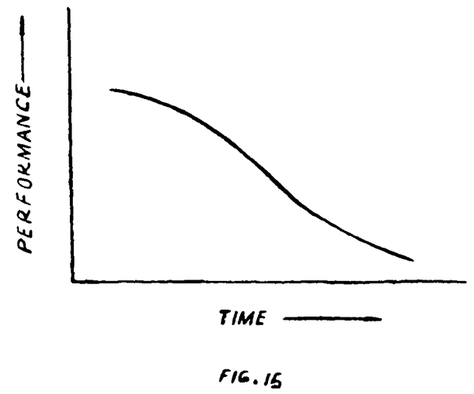

FIG. 15

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P. V. C. CABLE INDUSTRY — PROSPECTS AND PROBLEMS

BY K. R. S. VARADHAN

ANCILLARY items of manufacture on a small scale basis, organised and perfected by modern technology, form an essential adjunct to the development of a balanced and progressive industrial economy. India, before freedom, had dreamed of a perfect blend of both large and small units, distributed throughout the country. Economists, industrialists and Statesmen had spoken and written much on this subject. The Country's five-year plans laid special emphasis on such a development to reach the goal of plenty and prosperity.

During the last fifteen years, goaded by these words and confident of Government support many practical men of action ventured into the field of manufacture of ancillary products. Bombay and its environs naturally show striking example of this constructive effort. The trend is spreading to other regions of the country as well.

Automobile manufacturing involves over a thousand items of products. With the establishment of a strong Automobile Industry in India the future for items, ancillary to this Industry has attracted the attention of progressive persons. The Indian Cable Industries at Pimpri, near Poona is an example where Finolex PVC Insulated Cables are being manufactured according to British Standard specifications from the end of the second World War. The latest german automatic machines are employed. The products are on the approved list of Governments, Railways, the Post & Telegraphs, Telephones and the Automobile Industry in the Private Sector. From very modest beginnings, the industry has grown by sheer virtue of quality and efficiency to a size whereby the manufacturing activity has now shifted to a large plot near the Antibiotic Plant at Pimpri. The question now is whether the Government is really benevolent towards Small-Scale Industries, since the restrictions on the import of P. V. C. Composition—an essential raw material curbs the future plans for progressive expansion. Good many other Small Scale enterprises are similarly complaining about Governments' indifference.

Finolex PVC Cables were first introduced by the Indian Cable Industries and they are now being used by the Indian Telephone Industry, the Defence Establishements and the Indian Automobile Industry. They are also used extensively throughout the country for house-wiring purposes. On the part of the manufacturers, therefore, they have successfully overcome all technical manufacturing problems and have fulfilled the requirements of ancillary industries in the field of Automobiles and Telephones. They are now faced with the difficulty in procuring the necessary import licence for PVC composition which is one of the essential raw materials. It is indeed surprising that the Licensing Authorities do not even consider the essentiality certificate granted by the State Director of Industries while determining the necessity for granting the import licence to this particular industry concerned.

This is a specific instance. There are as already observed, many other Small Industries who are experiencing in practice that Government's support is not so readily forthcoming. It is, of course, difficult to say where exactly is the hurdle—is it administrative or is it of policy ?

A curious feature of the import policy is the rather anomalous position whereby the Indian Telephones, largely due to unavailability of an adequate supply of PVC Cables from internal sources, are allowed and provided the necessary foreign exchange for importing cables from abroad.

The Industry is fully equipped to supply all the present and forseeable future requirements and also to export, but production is handicapped by restrictions on import of PVC composition, the foreign exchange component for which is definitely much less than for the fully manufactured product.

A careful study of the economic development of some of the western countries will reveal the fact that the part played by the Small Scale units acting as suppliers of ancillary products in an assured flow and of reliable quality has been mostly responsible for their country's pre-eminent position in the World of Industry. India needs to adopt similar methods, establish similar standards and step up production in the Small Scale sphere. The Union Government should take steps to look into the complaints and remedy the defects, wherever they are.

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informed the Committee that the Commerce and Industry Ministry were processing development of this capacity within the country and the need for accelerating the progress of this development was urgent.

RAILWAY PURCHASES FROM SMALL INDUSTRIES

Mr. Ramaswamy said that purchases of equipment by the Railways from the cottage and small-scale industries during 1960—61 were of the order of Rs. 188 lakhs. This was an improvement of Rs. 15 lakhs over the figures for 1959—60. There was great scope for the small industries taking a bigger share of the total railway purchases. The Government attached great importance to the development of small-scale industries and special organisations had been set up to encourage small-scale entre-preneurs and to afford them assistance in the shape of quality control, testing and other procedures. He welcomed the setting up in Madras State of a mobile testing laboratory to aid the small-scale industrialists and commended it to other States.

This was the last meeting of the Committee, which had completed its two-year tenure.

ROLLING STOCK FOR RAILWAYS

SELF-SUFFICIENCY BEING ENSURED

MR. S. V. RAMASWAMY, Union Deputy Minister for Railways, said that considerable progress had been made in attaining self-sufficiency in respect of railway rolling stock. "With greater co-ordination among the Railways, the private industry and the public sector undertakings, our country will be self-sufficient in all types of rolling stock by the end of the Third Five-Year Plan."

The Union Deputy Minister was addressing the tenth meeting of the Indian Railways Equipment Advisory Committee, at the Committee Room of the Southern Railway Headquarters Office. Mr. H. D. Singh, General Manager, Southern Railway, presided.

Mr. Singh, in his opening remarks, said that the members of the Committee, who would visit the Industrial Estate at Guindy, would be agreeably surprised to see the vast industrial development that was taking place in South India. He said, "Industrial development in Madras City and Bangalore was progressing at a fast rate."

Mr. Ramaswamy, referring to the development of indigenous capacity for railway rolling stock, said that they had now achieved self-sufficiency in many items. He had no doubt that in the not too distant future they would achieve complete self-sufficiency in regard to all types of railway equipment and also be able to export and assist in the development of the neighbouring countries.

Turning to the purchase of railway equipment the Union Deputy Minister said "In 1960—61 out of a total purchase of about Rs. 176 crores, imports were only to the extent of about Rs. 25 crores. Last year, the imports accounted for Rs. 34 crores. There has been a progressive decrease in the imports, which in 1958-59 were of the order of Rs. 86 crores. A large part of the imports has been on account of electric and diesel locomotives, steel rails, etc. The percentage of imports to the total purchases has come down from 9.1 per cent to 1.3 per cent in 1960—61, there has been a steady progress and there is no reason why by the end of the Third Plan period imports should not be reduced to a negligible minimum."

STOCK POSITION

Adverting to the stock position of railway rolling stock, Mr. Ramaswamy said that they were self-sufficient in respect of steam locomotives, passenger coaches and conventional rivetted type wagons. New designs of wagons were being undertaken at the different workshops in the private sector. The development of the design and production in a comparatively short time was indeed creditable. "The Ministry of Railways depends upon the wagon-building industry in the private sector for meeting the country's plans. It is hoped that with the full development of the capacity of the existing units, not only the needs of the Plan will be met, but also there will be a surplus for export," the Deputy Minister added.

Detailing the progress made in the public sector, Mr. Ramaswamy said that the Integral Coach Factory and the Hindusthan Aircraft Factory had been geared for meeting the demand for the latest type of integral coaches. Steps had already been taken in the I. C. F. to manufacture, during the Third Plan period, over 1,600 metre gauge coaches, the bulk of which would be third class coaches, including sleepers. This would be in addition to the metre gauge coaches produced in the private sector. The total of such coaches planned in the private sector was 1,500. The I. C. F. had also undertaken the manufacture of electric multiple unit coaches for use in Calcutta area, the electrical equipment for which would be supplied by the heavy electrical unit at Bhopal. The Government had also decided to undertake the manufacture of diesel rail cars, the motor for which would be supplied by the private sector.

Mr. Ramaswamy said that it was gratifying to note that the Railways were now self-sufficient in train lighting equipment, with the exception of certain raw and basic materials which were not yet available in the country. The Railways were introducing up-to-date electric signalling on a number of heavily worked sections and important trunk lines. The capacity to develop this item indigenously to meet the transport needs of the country was vital.

The Union Deputy Minister said that the Railways were in need of steel castings also and capacity for producing this item should also be given priority. He

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A BUSY YEAR AT ROLLS-ROYCE

DEVELOPMENT OF ENGINE WITH FOUR-VALVE CYLINDER HEAD

IN November 1960, Rolls-Royce exhibited a 'Mark IV' version of the well-known 'C' range of diesel engines. The new engine is now commercially available in the turbocharged form for operators and builders to whom an especially high power-to-weight ratio is important. The extra power has been obtained by the introduction of four valves per cylinder, an arrangement permitting a freer gas flow. Individual cylinder heads and gaskets are fitted in the Mark IV engine.

Fifty Mark IV eight cylinder turbocharged engines are now in course of delivery to the Swedish builders, Kalmar Verkstads A. B. for new shunting locomotives for the State Railways. A further twenty six-cylinder horizontal turbocharged units are being delivered to power Jamaican Railway Corporation railcars built in England by the Metropolitan-Cammell Carriage and Wagon Company Limited.

Although the Mark IV engines are now more in the limelight, Rolls-Royce are still supplying substantial numbers of the well-tried two-valve-head engines, in both horizontal and vertical types. Early in 1961, British Railways placed a repeat order through Drewry Car Company for forty 180 hp horizontal engines for railcars. Engines of this type were first delivered to British Railways in 1957, and on the busy suburban services of the North East Region, they are running for a period of 200,000 miles between overhauls.

The first diesel-hydraulic shunting locomotives commissioned by British Railways are also at present entering service. They are compact Rolls-Royce powered Yorkshire Engine Company locomotives of 176 hp. with the power equipment installed at an inclined angle.

OVERSEAS ACTIVITY

A temporary pause in the modernization programme of British Railways has enabled British manufacturers to concentrate on the growing markets overseas where industrialization calls for an efficient transport system. The tradition linking British locomotives with early railway developments in many continents is being maintained—maintained with great effort in face of fierce international competition.

Rolls-Royce recognize that some countries who formerly bought all their machinery abroad are now in a position to manufacture for themselves and prefer to do so when large quantities are involved. In such cases they often find a readiness to consider local manufacture under licence. This has happened in the case of the company's Dart turbo-prop aero engine which is entering production with Hindustan Aircraft Limited.

NEW LOCOMOTIVES

Two new Rolls-Royce powered locomotives, both diesel-hydraulic types, which have appeared since this time last year are worthy of mention. Last October the new Sentinel 0—6—0 48 ton industrial shunting locomotive entered service. Externally the locomotive is very similar to the popular 0—4—0 type with its low bonnet line and all-round visibility over the buffers. The standard 0—6—0 unit has a maximum tractive effort of 29,300 lb. and a maximum continuous speed of 18 m. p. h.

In April of this year, Yorkshire Engine Company's long-awaited 600 hp. Taurus locomotive was shown for the first time and handed over to British Railways for trial working. Its transmission principle, now known as 'Type S', was illustrated. An unusual feature of the locomotive is its ability to give an initial tractive effort of 45000 lb. from only one of its two 300 hp. engines. Apart from heavy shunting duties, however, the Taurus was also designed for trip working on main lines, and has a top speed of 36 m. p. h. with both engines driving. Further technical details of these locomotives may be obtained from the manufacturers concerned or from the Railway Traction Department of Rolls-Royce Limited in Shrewsbury, England.

LIAISON

The Railway Traction Department of the company is willing to investigate and engineer complete power installations for customer's individual needs. It deals in virtually all railway power requirements for railcars, surface and underground locomotives, cranes, and generating equipment. A Newsletter describing the department's activities is published from time to time and is circulated free-of-charge to interested railway parties throughout the world. Copies may be obtained direct from the Railway Traction Department in England or through the company's distributors Messrs. William Jacks and Company Limited, who have offices in Calcutta, Madras, and Bombay.

Railway engineers travelling in Britain are welcome to visit the Rolls-Royce diesel engine plant in Shrewsbury, and may make arrangements to do so either before or after leaving India.

CLEAN AIR FROM POWER STATIONS

Forty Flue Dust Monitors Ordered from AEI

Two orders covering the supply and commissioning of forty flue dust monitors have been placed with the Electronic Apparatus Division of Associated Electrical Industries Limited by Babcock & Wilcox Ltd. The equipments are to be installed at C.E.G.B. generating stations at West Thurrock and Rugeley—twenty at each site. They are required for the main boiler construction programme.

A dust monitor head will be installed in each induced-draft inlet duct and will without change in velocity measure the dust emission from the dust arresting plant before it enters the main duct and chimney stack. When the dust emitted exceeds the accepted level as determined by the Alkali Inspectorate, a warning device fitted to the equipment will operate a flashing light on the boiler control desk so that the operator can take the necessary action.

A continuous recording of the dust emission will be provided during the operational period of each boiler. The time between cleaning can be as long as or even longer than 15 months.

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An Important Announcement

WE have great pleasure in announcing to all our readers and advertisers that we are incorporating a special supplement entitled INDIAN RAILWAYS CHITTARANJAN LOCOMOTIVE WORKS SUPPLEMENT along with our May—July 1962 edition. We need not very much overemphasize the international importance of this gigantic locomotive building unit of the Indian Railways, in the whole of Asia. The Supplement will contain interesting articles specially contributed by eminent engineers about this largest engineering works in the public sector.

We take this opportunity of appealing to such of those engineering firms who have had the privilege of contributing their mite to this great State undertaking to subscribe by way of technical articles on various aspects of railroad engineering to our above Supplement.

The last date for receiving technical contributions is 10th July 1962. Advertisers desirous of buying advertising space in the above Supplement should intimate the fact to the Technical Editor on or before 10th July 1962 as there is very limited advertising space available.

Technical Editor

POST BOX NO. 21
MANOJIAPPA STREET,
TANJORE (South India)