

Journal of Industrial

Engineering



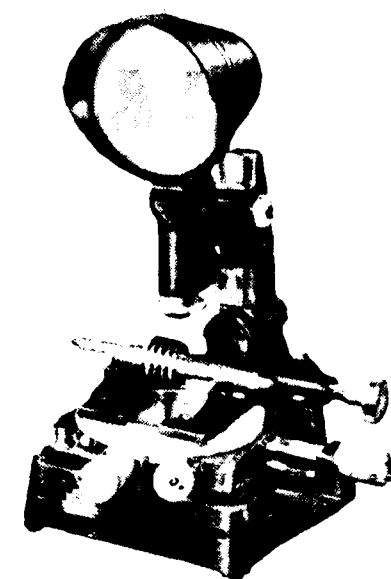
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Mining Industries Annual Supplement



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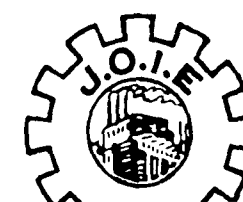


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BRITISH DIESEL LOCOS FOR INDIAN COLLIERIES

Four Diesel locomotives, three of 21 hp. and one of 38 hp., have left the Leeds (Yorkshire) works of the Hunslet Engine Co. Ltd. for India. These locomotives have been specially developed for low mine workings and narrow-gauge track, and will be employed in collieries in different parts of India on underground duties. The 21 hp. engines are capable of a speed of 7 mph., and in first gear will haul a load of 102 tons on the level. In first gear, the 38 hp. locomotive will pull 170 tons on the level. The two types of locomotive differ only slightly in appearance and have a track width of 2 ft. All major working parts in this design of locomotive are easily accessible, to facilitate on-the-spot maintenance checks or rapid repairs.

SAFETY IN INDUSTRY

THE safety of those engaged in industry calls for special attention in these days of stress. An industrial worker is the main factor in building up ultimate cost and operates at every step in production from the coal and ironstone in the earth up to the finished article.

The appreciation of the above need has led to the development of a whole range of safety devices that are personal or collective or incorporated in the equipment in use. The ideas of machinery design as well as the plant layout have been largely influenced by it. Nevertheless, there remains the need for an intensive propaganda and training on the subject. The idea that "it can't happen to me" is still very prevalent among the workers. In fact this attitude of complacency militates against any rapid progress towards reducing industrial casualties.

In the good work of preventing accidents, which lower morale—and production—much quicker than anything else, employers and workers alike must take their share of responsibility, and it is only by whole-hearted collaboration that the great improvement, which is still necessary, can be attained.

To anticipate and remedy causes of accidents is the best way to reduce them. The old cliché "Accidents will happen" assumes an acceptance of the inevitable which is disproved, after an accident, by the realisation of the ease with which it could have been prevented.

Modern factory regulations demand that machines should be made as safe as possible by the provision of guards and protective devices. There are, however, certain parts, which cannot be guarded without interfering with efficient operation but these are rendered harmless if ordinary precautions are taken.

Although both builders and users of machine tools are constantly striving to exceed legal requirements in their efforts to protect their workers, the normal tendency is likely to be in the direction of observing only the letter of law. There is also a tendency on the part of labour associations to make issues of isolated instances arising out of the inadequate safety provisions by the management rather than laying stress on education of the various categories of staff in matters of safety.

"He that is stricken blind cannot forget the precious treasure of his eyesight lost". All life is based on impressions, which are recorded in various ways. Taste records about 1 per cent, touch 1½ per cent, hearing 7 per cent and sight 87 per cent. These figures show that sight is one of our most precious gifts, one that should obviously be well worth protecting. Yet the appalling fact remains that many eye injuries, sometimes resulting in loss of vision, occur every year, many of which would never have happened if the correct eye protection equipment had been worn.

Eye safety should not be regarded as being adequately catered for if goggles or visors are issued to all who need them. There will always be the man who will take the risk; he will not wear goggles because he thinks he does not need them—he feels that he is too experienced. There will be others who complain that they look funny or effeminate or that the goggles are uncomfortable. None of these excuses will prevent an eye accident.

The right course will be to subject the man, who wilfully disobeys factory safety rules and refuses to use equipment provided for his benefit, to severe disciplinary action and for that purpose watchers are to be posted to detect such men. This may sound like life behind the Iron Curtain, but it is an effective way of making the worker more safety conscious.

One of the first essentials to safety is to dress properly. Man, from Adam onwards, has always been in need of protective clothing. There are, in many industries, certain circumstances where there are definite legal requirements concerning the provision of protective clothing. Nothing should be exposed to the danger of revolving or moving machinery. Loose clothings, apron strings and such like might get caught and pull the wearer into the machinery.

By far the most common article of protective clothing is the overall. The earliest of all protective clothing, the apron, is usually employed in place of, or combined with, an overall. The latter combination is usual if the work is especially dirty, or wet or is such that it would create undue wear on the overall. Taken as a loose term, "gloves" can mean the whole range of hand and arm protective clothing, covering everything from one finger to the whole hand and arm.

Foot accidents are far too common in workshops. Napoleon said that an army marches on its stomach. Despite what the mechanical handling enthusiasts would have us believe, industry still makes most of its progress on its feet. Hence it is but common-sense to see that the proper type of footwear is worn.

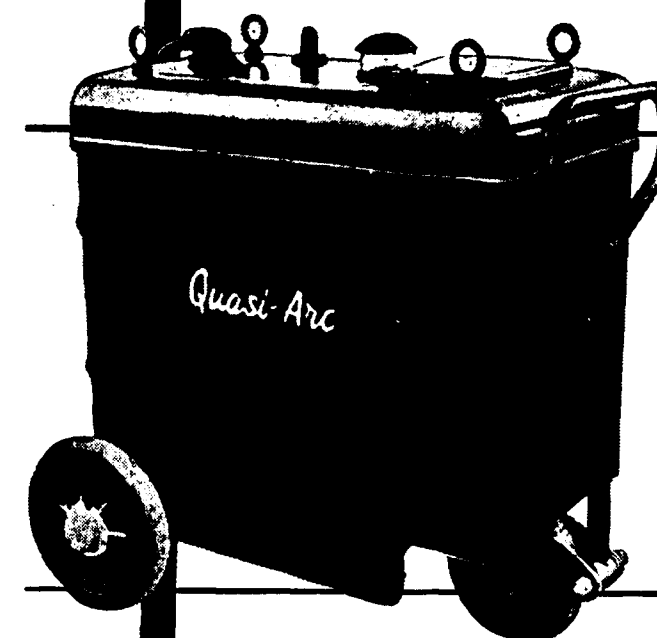
The fire-raising potentialities of welding are very great. In the two operations of cutting and welding, oxy-acetylene cutting is more dangerous owing to the considerable carrying properties of the sparks. These sparks, which are really small globules of molten metal, may be projected to a distance of 25 to 30 feet. They retain heat for some time and will readily ignite any combustible material on which they fall.

Sheet metal guards to keep the sparks confined to the centre of operation, should always be used. The operators should be drilled into following the procedure outlined by the manufacturer of the apparatus in use in so far as it deals with the sequence of operations in lighting, adjusting and extinguishing blow-pipe flames and connecting apparatus to the sources of gas supply. The individual who sought a gas leak with a lighted match gained immortality at the expense of his life. Yet the lesson is still unlearned by many welding operators.

Accident prevention is largely a matter of education, the aim of which should be to get the worker "safety conscious" rather than "accident conscious", for a worker, who is afraid of his machine, will never get the best from it.

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Safety films can be of outstanding value in safety training. There is no better way of infusing enthusiasm for a subject than to depict it, as is borne out by the old adage that "one picture is worth a thousand words". The subject matter is far more readily assimilated when it is "put over" in film form.

Similarly good posters and safety slogans form a strong appeal. The ~~pg~~ approach to the safety problem can be a humorous appeal or a "fear approach". The latter is very effective, but it will not be conducive to high productivity as it will breed fear of machinery. Safety must be married to production, not divorced. Similarly, humour should not obscure the seriousness of the lesson to be driven home. Frequent observance of "safety week" and declaration of prizes for safety suggestions by the workers during that week, will boost safety consciousness enormously throughout the works. As every safety officer knows too well, "safety" is just another word until the interest has been kindled. Once the interest is caught with the right type of information, it will be maintained of its own accord.

Productivity and safety both depend on the human element. It is impossible to get them from any man unless he has right conditions. It is very necessary for the employer, therefore to create conditions which are conducive to willing, accurate work with a reduction in fatigue, the two conditions essential for high productivity with low accident potential.

LOW-COST NUCLEAR SHIPS BY 1961 PREDICTED

Nuclear-powered ships with operating costs not more than 5 per cent. higher than those of conventional vessels will be in service by 1961. This was predicted on April 22 by an official of the United Kingdom Atomic Energy Authority, Mr. H. W. Bowker, who is head of the marine propulsion group at the Harwell research establishment. He was speaking at Utrecht, Netherlands, at a special international meeting on marine nuclear propulsion organized as part of Utrecht's technical trade fair.

Mr. Bowker pointed out that it had still to be determined "whether there is, or is likely to be, a reactor system that can produce power at a price comparable to that of conventional fuel when built in sizes that are required for (commercial) ships and when operated under marine conditions".

Nevertheless, if the progress made recently could be maintained, it was likely that nuclear-powered ships could be operating at competitive costs within five to 10 years.

Mr. Bowker said the results of a study made by British engineering firms of the comparative qualities of various kinds of reactor which might be suitable

for marine propulsion were being reported today (April 23) to the Admiralty, and their findings would be awaited with great interest.

He said Britain's General Electric Co. had evolved a reactor incorporating a "radically new approach to fuel element design", while a marine propulsion reactor was at an "advanced stage of design". The research group of the Nuclear Power Plant Co. and Swan, Hunter & Wigham Richardson was studying a nuclear power plant suitable for a tanker requiring 22,000 h. p.

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TISCO OUTPUT

The production of saleable steel by the Tata Iron and Steel Co., Ltd., in April has amounted to 93,300 tons against 100,700 tons in March 1959 and 63,000 tons in the corresponding month last year. The output of semi and finished steel has dropped from 43,000 tons and 57,700 tons in March to 39,400 tons and 53,900 tons respectively in April. The production of pig iron and steel ingots has, however, increased from 127,400 tons and 123,600 tons in March to 130,600 tons and 124,200 tons respectively in April.

Historical Development of Science and the Methodology of Scientific Research

By Dr. Indra Sanghi, M.Sc., Ph.D.(Dunelm), A.R.I.C., F.I.C., Dip.Admn.(Lond.)
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WHAT IS SCIENCE ?

SCIENCE is search for knowledge—research and not mere discovery, but the creation and the cultivation of the spirit of discovery. Thus, the search after knowledge is the most vital and yet the most contentious part of science. Science should not only inculcate method, mental retentiveness, quickness of apprehension and skill in argument, but more important, it should inculcate selflessness, nobility, sincerity and balance of judgment which imparts honesty, generosity and the supreme love of truth in all the servants of science. We should come to science not as to a mere knowledge shop where to acquire fragments of dull information but as to a factory of ideas where new thoughts and modes of life can be understood. For the evolution of these new ideas and modes of life, science and research are the supreme means. Sir William Dampier defined science as "ordered knowledge of natural phenomena and rational study of the relations between concepts in which those phenomena are expressed". Bertrend Russel gives a wider definition, "knowledge which seeks general laws connecting a number of particular facts." Gradually, however, the aspect of science as knowledge is being thrust into the background by the aspect of science as the power. But the most important attribute of science is not knowledge, but its capacity for acquisition of knowledge. Knowledge which science contains at any particular time is limited, frequently fragmentary and inaccurate, always liable to revision. The capacity of science to acquire knowledge is infinite. Thus, we see that science has two aspects, the static and the dynamic. The static view emphasises the present state of interconnected principles laws and theories together with the vast amount of information, while the dynamic view regards science as an ever-continuous activity and a process of further investigation in which the present state of knowledge serves only as a basis. Thus, science is science only when it is fruitful of further experimentation and observations.

RESEARCH VS. REVIEW

To-day, while embarking on scientific education and research, we may congratulate and console ourselves that this is not an age when scientific discovery might be rewarded by death at the stake. To-day, one has nothing worse to fear than poverty, obscurity, ridicule and frustration for which almost all research workers should be prepared. The history of scientific research is inter-woven with the history of society and at any moment in history it has been conditioned by the degree of development of arts and crafts, industry and commerce, and means of communication and social relationships of that period. Scientific research is essentially compounded of two elements, (a) observation by which knowledge of certain facts is obtained through sense perceptions, and (b) reasoning, by which the meaning of these, their significance and relationship to the existing knowledge are ascertained. Thus, we see that research presupposes to some extent a knowledge of the existing information and thus a research worker ever remains a student for he has to keep abreast with the growth of knowledge. To-day, about 50,000 scientific journals and periodicals are published and about 50,000 articles appear in print every week. This reveals the utter impossibility of keeping abreast of more than a very small fraction of specialized knowledge of any branch. It is this vast material which confounds a young worker so that often he loses his bearings and originality of thought. Bernard Shaw was perhaps pointing out this dilemma when he quipped "reading rots the mind". In fact some scientists and educationists have contended that detailed and extensive reading of others' ideas and inferences sometimes so conditions the mind as to lose originality and direction for a fresh and fruitful approach. As Byron wrote, "to be perfectly original, one should think much and read little, but this is impossible, for one must have read before one has learnt to think". The best way of meeting this dilemma is to read critically and maintain a healthy

scepticism. Too much reading is a handicap mainly to people who do not have the correct attitude of mind. Freshness of outlook and originality need not suffer much if reading is used as a stimulus to think and not to take for granted. As Francis Bacon has aptly remarked "read not to direct and confute nor to believe and take for granted but to weigh and consider". Furthermore, variety in reading is essential and stimulates freshness of outlook whereas too constant study of a narrow field predisposes to dullness. It is more important to have a clear understanding of general principles than to load the mind with a mass of detailed technical information. There is much truth in the saying that "in science the mind of the adult can build only as high as the foundations constructed in the early college days will support". The young scientist will find his life enriched and his understanding deepened by reading the lives and works of some of the great men of science.

HISTORICAL DEVELOPMENT OF METHODOLOGY OF RESEARCH

The scientific method of research consists essentially of the following 4 steps. (i) observation, (ii) hypothesis, (iii) experimentation and (iv) induction.

Ancient science originated in observations and grew out of their accumulation. At the early stages, science consisted merely of recorded observations, of their co-ordination and of evolution of certain arbitrary ideas. It was by this method that about 2500 years ago elementary anatomy, mathematics and astronomy were developed in India, Egypt or Babylon. It was not till the 6th century B. C. that Greek science added hypothesis to observation. But the amount of scientific knowledge available at the time was too small to impose a degree of limitation on a hypothesis and permit it a degree of precision customary to-day. The modern conceptions of hypothesis as a provisional interpretation, leading to and verified by the experiment, and of the planned experiment as the decisive test of the validity of the theory, first emerged in the works of Archimedes, one of the greatest physicists.

The economy of ancient Greece was based on slavery, and while it gave Greek gentlemen leisure and material security which enabled the more intellectual of them to engage in contemplation and reasoning, it made them despise the efforts and skill of a man's hands. Knowledge was prized but the acquisition of new knowledge through scientific experimentation was

rejected in favour of philosophic discussion. It was this social attitude due to which the great intellectuals after Pythagoras and before Archimedes—Socrates, Plato and Aristotle—were not experimentalists but philosophers. When the Romans became the dominant world power and Greek science had to shelter under the Roman wing, matters became worse as Romans recognised and encouraged science only as far as it was practical and useful. Although this resulted in successful applications of known facts, it quickly proved fatal to further progress. Thus, gradually the ancient civilisation decayed and disintegrated and the world entered the long period of the dark ages in which theology took the place of science and philosophy. That science did not perish entirely during this period was due to the Arabs who have much to their credit. The Arab scientific school gave us the most revolutionary advance in the methods of scientific research when Averroes in the 12th century fought for the emancipation of science and scientific research from the yoke of religion and mythology. Copernicus and Galileo in astronomy and Darwin and Huxley in biology continued this struggle and slowly Europe emerged from the dark ages into the light of a new civilisation in which all reasoning, all conclusions, however convincing they may appear, could not be regarded as valid unless and until they had been tested and confirmed by experiment. This conception of science and scientific research in which experimental evidence won over unsupported theory, speculation, calculation or interpretation was a tremendous advance in scientific thought and method. Society which has honoured scientists whose discoveries have been acceptable to it, has been harsh to those whose discoveries have been too far in advance of its stage of development. It is the practice of society to honour the rediscoverer more than the premature discoverer and there may be some justice in this as there is some justice in students' preference for a good teacher who is not a great scientist as against a great scientist who is a bad teacher.

INSTRUMENTATION

Galileo contributed greatly to the development of scientific research in this period. His invention of the thermometer and his application of the telescope to Astronomy were events of the highest importance to science and to the establishment of the principles of instrumentation and new devices in scientific study of natural phenomena. Thus history of science from the 17th century upto the end of the 19th shows an increasing tempo of development through discoveries

each of which has paved the way to more discoveries in a chain reaction manner. This was mainly due to the changed attitude of society towards science. The amazing developments during this period have been due almost entirely to the success achieved in scientific research and to the great contributions to the methodology of science by every prominent scientist. Newton stands as a select group in himself as he introduced mathematics into the methodology of scientific research. He had far greater mastery over mathematics than on experimentation and this is borne out by his apparently greater success in the fields of physics than in the fields of chemistry. In contrast to him, Faraday relied exclusively on experimentation and his work and contributions are brilliant proofs that greatest discoveries are possible through the use of experimentation even without much mathematical aid, elaborate apparatus and endless observations, provided the scientist has daring imagination, acuteness of observation, clarity of thought and a power of simplification. A different kind of contribution to the methods of research was made by Cavendish who demonstrated that highest discoveries could be made through experiment, not because of ingenuity in planning, brilliance in execution or imagination and profundity in interpretation, but entirely through care and accuracy. He established the composition of air when he proved that 1/120th part of the air which refused to combine with alkali on sparking was not an experimental error, but a new gas of unknown properties. This brilliantly demonstrates that even though we may not be as brilliant as Newton or Einstein yet, we each can outshine them through experimenting, discovering and interpreting new phenomena of which they were not aware and which were not brought to their notice. We have this advantage of better instrumentation and better experimentation over all the other stalwarts and geniuses of the past and this is the only hope of a large number of scientific workers.

CRUCIAL EXPERIMENTS AND THEIR LIMITATIONS

The success of experiments largely depends on the care taken with preliminary preparation and the thought given to the problem before-hand, in resolving it into crucial questions and then designing experiments to give categorical answers. A crucial experiment is one which gives a result consistent with one hypothesis and inconsistent with another. However, it is not always possible to design such experiments and this is beautifully illustrated in the

case of light which was earlier envisaged as a wave motion based on the results of certain experiments. This overthrew the older corpuscular theory near about and after 1800, when certain phenomena were discovered which could not be explained on the basis of corpuscular theory. By the middle of 19th century, wave theory was established; but about 1912 certain other phenomena connected with the absorption and emission of light were discovered which could not be accounted for on the basis of corpuscular theory. Here was a dilemma; but the scientists in those days thought that the difficulty could be resolved by suitable experimentation and that light could not be both corpuscular and undulatory. But to-day, it appears that no experiments can ever be devised that will resolve this dilemma and that after all light can both be corpuscular for certain purposes and undulatory for others.

MODERN DEVELOPMENTS AND RECONCILIATION OF SCIENCE WITH PHILOSOPHY

The close of the 19th century almost ushered in a veritable revolution in science which was initiated by Rontgen's discovery of X-rays, Thomson's determination of the mass and charge of the electron, Wilson's Cloud Chamber, Becquerel's discovery of radioactivity of uranium and the discovery and isolation of radium by Madam Curie. During all the previous centuries, science was based upon certain fundamental conceptions, the most important one of which was the indestructibility and indivisibility of atoms. Suddenly, all this was changed and the old conceptions were shattered. But this increase of knowledge did not produce a decrease of the understanding of the universe. Later on, the greatest scientific achievement of the 20th century was perhaps Planck's quantum theory and the work of Einstein, both of which increasingly used mathematics as an instrument of investigation. Their work and ideas also reunited science and philosophy in a most marvellous and miraculous way. Planck writes "all the ideas employed in physics are derived from the world of sense-perception The laws of physics ultimately refer to events in the world of the senses Many scientists and philosophers tend to the belief that at bottom Physics is concerned exclusively with this particular world. What they have in mind, of course, is the world of man's senses. On this view, for example, what is called an 'object' in ordinary parlance is, when regarded from the standpoint of physics, simply a combination of different sense-data localised in one place. It is worth pointing out that this view cannot be refuted by logic,

since logic itself is unable to lead us beyond the confines of our own senses Reason tells us further that both the individual man and mankind as a whole, together with the entire world which we apprehend through our senses are not more than a tiny fragment in the vastness of Nature whose laws are in no way affected by any human brain It is considerations of this kind and not any logical argument that compel us to assume the existence of another world of reality behind the world of senses; a world which has existence independent of men and which can only be perceived indirectly through the medium of the world of senses". Thus, we see, that he strongly points out to the limitations of physics in which all successful theorising has been done on the assumption of a real world independent of our senses which is actually not true.

OBJECTIVE VS SUBJECTIVE CONCEPTS

Einstein on the other hand, in his 'Evolution of Physics' writes "physical concepts are free creations of the human mind and are not, however it may seem, uniquely determined by the external world With the help of physical theories, we try to find our way through the maze of observed facts, to order and understand the world of our sense perception. We want the observed facts to follow logically from our concept of reality. Without the belief that it is possible to grasp the reality with our theoretical constructions, without the belief of inner harmony of our world, there could be no science."

Thus, the modern concepts point out that no brilliancy in mathematics or skill in experiments can give us the right answers unless we ask the right questions and this means that we may be on the verge of a breakdown of the scientific method. Since, if the choice of a hypothesis is the only true key to knowledge and understanding and one's personal beliefs and desires are the determinants of such choice, scientific research must ultimately be enmeshed in the subjective element. Einstein's theory of relativity reveals this inner world harmony in two ways. Firstly, by demonstrating the essential unity of apparently opposed entities such as mass and energy, space and time; and the other by showing that qualitative differences may ultimately be merely quantitative differences as in the case of matter and field.

CONCEPTS OF DIALECTICAL MATERIALISM

Another most important concept in the methodology

of science has been that of dialectical materialism which unfortunately has been too much submerged and hidden by the political controversy of communism. Out of its four fundamental principles, the first one enunciates that in a world where nothing is eternal and immutable the laws of nature themselves change with time. The second principle, according to Marx and Engels, is necessary for forming a correct hypothesis and enunciates the unity of opposites. This is beautifully illustrated by the example of the nature of light which ultimately shows both corpuscular and undulatory behaviour. Its third principle propounds the change of quantity into quality which was the basic concept of Einstein's equation, later leading to the atomic bomb. Finally, the fourth principle of negation and negation of negation is perhaps most impressively illustrated in astro-physics by the supernova phenomena. According to the modern theory of stellar bodies, increase of mass beyond a certain point produces a decrease of volume which continues until a star about 1.4 times heavier than sun would tend to zero volume. Increase of mass thus negates the volume that mass may occupy. However, according to the principle of negation of negation such a state of affairs cannot exist without creating an opposite tendency to negate the negation and it is this new force which comes into play to stop the contraction of the stellar body to a mathematical point. This has actually been observed when the phenomenon of supernova was discovered. Although it is by no means easy to apply these 4 principles for formulation of correct hypothesis yet, they are invaluable guides for the purpose.

ORGANIC MECHANISM

We may now pass to Whitehead's philosophy of Organic Mechanism, according to which, the universe is only knowable and understandable when regarded as a succession of organizational levels in which each level of organisation has structural features and laws of behaviour, characteristic of itself, and not reducible to mere statistical expressions of behaviour of the simpler organisms of which it is composed. The correct interpretation is that while constituents of an organism do determine its structure and mode of behaviour, the organism in its turn imposes modifications upon the characteristics of its constituents. Thus, Whitehead argues that among all the primary elements of nature as experienced by us, there is no example which possesses "simple location" i. e., whose existence and location does not interfere with its surroundings and neighbours. This brings us right to the door of some of the older philosophies, and we

begin to see a new correlation between science and some of the abstruse ideas of philosophy preached by religions.

CONCLUSIONS

Briefly recapitulating, the scientific method consists of speculative thinking, deductive reasoning, cut and dry or empirical experimentation. Much of the advancement in science has been due to inspired guesses, intuitive hunches or brilliant flashes of imagination in the minds of pioneers and imaginative scientists. Chance, thus, plays an important part in the life of a research worker. The importance of this factor should be fully appreciated and deliberately exploited. Opportunities come more frequently to active bench workers and people who dabble in novel procedures. Thus, chance also favours only those who know how to court her.

The most common sequence followed in an investigation is (a) a problem recognised and an objective formulated, (b) all the relevant literature is critically reviewed and information collected, (c) the information available is marshalled and correlated and specific questions are formed, (d) working hypothesis is formulated or intelligent guesses are made to answer the questions, (f) deductions from the hypothesis are drawn, (g) actual experimental tests are devised and carried out to test the working hypothesis or the deductions therefrom bearing on most crucial questions. Finally, depending on the outcome, the working hypothesis is accepted, modified or discarded.

RECIPROCAL MOTORING SERVICES THROUGHOUT COMMONWEALTH

Indians will be among delegates representing 6,000,000 motorists from all parts of the Commonwealth who will attend a conference in London from June 7 to 13 to discuss mutual problems and aims.

The primary object of the conference, which has been convened jointly by Britain's Royal Automobile Club and the Automobile Association, will be to consider the formation of a projected Federation of Commonwealth Motoring Associations and Clubs, which will ensure reciprocal motoring services throughout the whole of the Commonwealth. Invitations to the conference have been extended to 57 overseas motoring organizations.

Topics under discussion will include trends in

The history, traditions and methodology of science, like ethics of the medical profession, are the products of a social organisation, international in scope and independent of any state. Science and technocracy are quite two different things. The technocrats believe that, without the patience and submission involved in observing nature, by a form of arrogant self-assertion they can contrive and control nature. This is megalomania. Man is neither impotent nor omnipotent; similarly science has powers which are surprisingly great but not infinite. In scientific search one must not lose the aim and meaning of human life and existence. The ends must sanctify the means. Science and its methodology should be used and developed for the benefit of mankind, for freeing man from want and ignorance and not for enslaving or annihilating him. The politician and the research worker can no longer ignore each other. The future of science as well as that of mankind depends on the interaction and the relationship between scientist and the statesman. And in a democracy this means, needs and demands an enlightened and scientific public opinion. Science can never be true or universal unless it can be freed from the dictates or dogmas of politics or religion. Where science ends, religion begins, not a blind fanatical religion but an enlightened ethical religion of the soul.

So, this is the path before the mankind to follow. At this juncture, in the history of human race, we are standing at the cross roads. We must wisely choose our way, know the rules of the road and finally plan and prepare for the glorious journey, bearing in mind Bacon's words that "even the lame in the path outstrip the swift who wander from it".

international touring, road safety, technical and engineering services, the development of traffic engineering Commonwealth countries, and the role of motoring organizations in national road development plans. Delegates will also discuss ways and means of assisting the expansion of small motoring organizations in the Commonwealth, and the creation of such bodies in territories where none exists at present.

Both the Automobile Association and the Royal Automobile Club already operate reciprocal service arrangements throughout the Commonwealth, and a member of either body is now entitled to the free service of allied organizations. The projected federation would integrate and extend both these schemes and create the largest corporate motoring organization in the world.

General Electric achieves "Highest Pitch Sound" ever reported

From A Technical Correspondent

THE "highest-pitch sound" ever reported has been achieved by scientists who believe their accomplishment will open the way for new discoveries in solid-state research.

"Sound" waves with a frequency of 10,000 megacycles (10 billion cycles per second) have been produced by Dr. Edward H. Jacobsen of the General Electric Company. This frequency is almost one million times greater than the highest-pitch sound the human ear can hear.

Lower pitched ultrasonics have been used widely in recent years for such special industrial jobs as cleaning metal parts and inspecting huge castings. The new ultrasonic frequencies will find their first applications in the laboratory, according to Dr. Guy Suits, General Electric vice president and director of research. "One of the powerful techniques of solid-state research is to study materials by poking them, probing them, and shaking them—and observing how they react. Now we have one of the most effective methods yet for 'shaking-up' the atoms in solids," Dr. Suits said.

It is expected that the extremely high frequency vibrations will be used initially to investigate phenomena such as the energy levels of atoms and the interactions of electron spins in a crystal lattice.

In the past, new research tools of this sort have always opened new vistas for exploration and discovery beyond those seen at the moment. Many important uses in the study of solids are seen, but science and technology will probably feel the greatest impact of this achievement through discoveries yet to be made with it.

Dr. Jacobsen created the 10,000 megacycle sound waves by combining techniques used in the propagation of microwave electromagnetic radiation with those of conventional ultrasonics. He applies microwave pulses to a quartz crystal in a specially designed cavity-resonator device.

The crystal is kept at temperatures as low as 2 degrees K. (minus 456 degrees Fahrenheit). The low temperatures assist in keeping the ultrasonic vibrations

from "degenerating" into vibrations associated with the heat content of the material.

This unusual type of "heat barrier" is one of the biggest problems in achieving higher and higher frequencies, according to Jacobsen, a 33-year-old scientist who has been with General Electric since 1955.

Any explanation of the new ultrasonics requires an understanding of the differences between "sound" waves and "electromagnetic" waves.

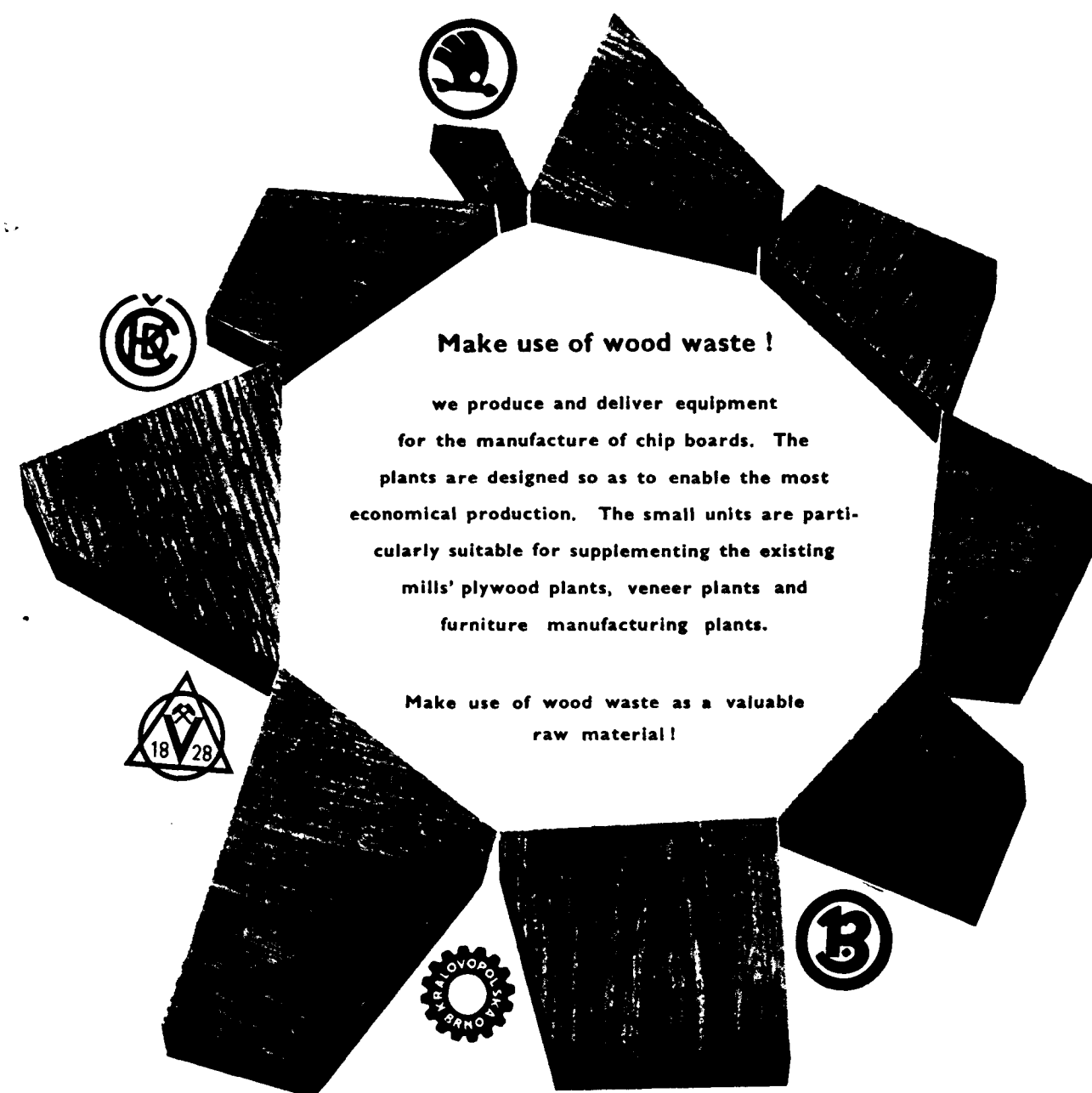
"Sound" waves involves the mechanical motion of atoms. (A strict definition of "sound" limits it to the low frequencies—30 to 15,000 cycles per second—that can be heard by the human ear. However, ultrasonics is, physically if not physiologically, the same phenomenon.)

"Electromagnetic" waves are travelling disturbances in space (cosmic rays, gamma rays, x-rays, ultraviolet, visible light, infrared, radar-television-radio waves, etc.).

Sound waves of all frequencies can be transmitted into solids: many of these same solids resist penetration by waves in certain parts of the electromagnetic spectrum. Thus, the new ultrasonics will help fill the gap in solid-state investigative techniques caused by the fact that many metals and other solids reflect electromagnetic microwave radiation much as a mirror reflects light.

Electromagnetic frequencies in the 10,000 megacycle range are used for microwave radar (wavelengths in the centimeter range). An ultrasonic frequency of 10,000 megacycles will be of varying wavelength because the speed of sound is different in different materials. Since even the highest speeds of sound are far below the 186,000 miles per second of electromagnetic radiation, the ultrasonic wavelengths are extremely short. The waves Jacobsen has produced in low-temperature quartz are approximately a ten-thousandth of a centimeter.

Because the new ultrasonic waves are far above audible limits, "musical" descriptions are hardly appropriate. Nevertheless, the new sound—if you could hear it—would be 20 octaves above high C.



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Economic utilisation of existing steam plant by generating electricity as a by-product

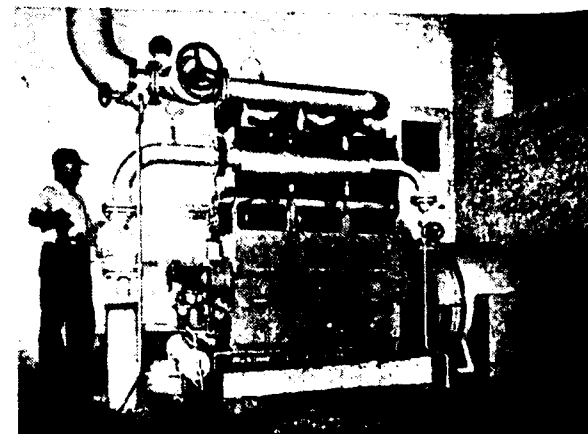
By Fritz Hummel
GERMANY

MESSRS. SPILLINGWERK OF HAMBURG, from 1919 onwards, when designers generally became more and more interested in steam turbines and diesel engines, concentrated exclusively on the construction of vertical piston steam engines and developed the novel design of a high-speed, compact steam engine, which can be extended as required, thus creating an up-to-date and economic prime mover for steam plants generating their own electricity.

The Spilling steam engine has been developed as an entirely new type of machine, built on the unit construction principle, by the skillful and well thought out adaptation of the known structural elements of safe, modern, high-speed diesel engines and electric motors to the design of a vertical reciprocating steam engine. Experience has shown that the inlet and outlet valves of internal combustion engines are particularly liable to cause trouble, and therefore it has been decided to retain piston slide valve control on the Spilling steam engine, which has proved extremely successful for steam engines in continuous operation. The high piston speeds usual with internal combustion engines, cause piston rings and cylinder liners to wear out in too short a time to be acceptable for steam engines in continuous operation. For this reason the Spilling steam engine runs at an exceptionally low piston speed and is therefore particularly resistant to wear and tear, even under the arduous conditions of continuous operation.

The Spilling steam engine has avoided the disadvantages of the reciprocating movement of rods and intermediate levers by incorporating the revolving camshaft, well known in the construction of engines, and thus ensuring an accurate and hard wearing control system.

The special balancing of masses permits installation of the engine on anti-vibration mountings, so that it can be operated in premises above cellars and on floors above ground level, as well as in blocks of flats, offices and in other places susceptible to vibrations.

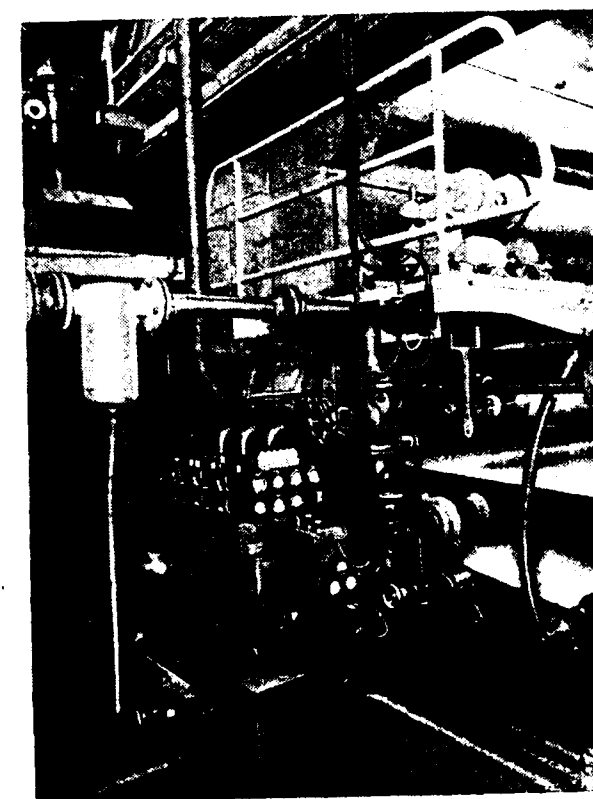


The steam piston engines of the old type are even to-day manufactured one at a time and their mechanical qualities therefore depend ultimately on the often varying abilities of the men who build them. In order to avoid these disadvantages it has long been accepted in modern engine design and construction—and this applies also to the Spilling steam engine—to machine the crank case unit from all sides simultaneously in a single operation and in one setting. The

position and alignment of all parts of the crank case unit are mechanically fixed, so that one unit is exactly like the next. This mechanically controlled fixing of centre lines, constitutes the invisible but none the less important backbone of the machine. The unit construction system of the Spilling steam engine enables the capacity of the machine to be increased on the site by grouping together several independent engine blocks or "power units", or by adding to them. If the output of the steam engine installed should prove to be no longer sufficient after having been in operation for some time, then it can be raised and adapted to the increased demand by subsequent incorporation of one or several engine blocks or power units. Therefore it is not necessary to allow for higher machine output with reserve capacity requiring a greater capital outlay, than is actually necessary for the immediate demand.

The unit construction assembly of multi-cylinder engines from identical engine blocks enables the Spilling steam engine to cover the whole range from 10 H. P. to 1200 H. P. output with only two types of engine blocks.

Wherever steam is required for a production process, the Spilling steam engine will prove eminently suitable



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The Spilling steam engine virtually replaces the uneconomical reducing valve, which, though providing steam of a certain temperature and pressure for the manufacturing processes, dissipates the existing pressure gradient without utilizing it.

The running production costs for energy generated by back pressure operation are very low. An average heat consumption of only 5500 BTU/kWh can be expected, and this corresponds to a consumption of

0.44 lb. of coal per kWh, or

0.31 lb. of fuel oil per kWh.

Spilling steam engines prove particularly economical where cheap fuel or combustible waste products are available for burning in boilers, which can be utilized for steam generation and consequently electricity generation.

The saving in cost of electric power obtainable by the generation of electricity by means of a Spilling steam engine and a generator, make it possible to write off the capital cost of steam engine and generator in 6 to 24 months, depending on the individual operating conditions.

BIG TELESCOPE IS PROBING AGE OF UNIVERSE

Studies made with the 200-inch Hale telescope on Mount Palomar in California have made possible "a more realistic concept of the size and age of the universe", states a recent report of the California Institute of Technology.

The latest estimate of the age of the universe now ranges from 7,000,000,000 to 13,000,000,000 years, according to Dr. Allan R. Sandage of the staff of the Palomar observatory. Geologists of today base their estimates on the decay of radioactive elements in rocks and meteorites. In doing this, they use a method made possible by development of peaceful uses of atomic energy.



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TEXTILES SECTION

RESINS FOR WASH-WEAR FINISHES

By Hector C. Borghetty

Manager of International Operations
General Aniline & Film Corp. (U. S. A.)

THE demand for new textile finishes continues in the direction of fabrics that can be made into garments that require minimum of care. Some fabrics are actually designated as wash-wear, but this term should be interpreted as an indication that while the subsequent garments can be worn by the casual wearer without ironing, it is recommended that a touch up or "cool iron" be used. The rapid and very favourable acceptance of such garments indicates the success of the very first types and points the way to large untapped potentials.

The term wash-wear was coined, promoted and substantiated by the synthetic fiber producer who manufactured the first hydrophobic fibers that have intrinsic wrinkle resistance and wash-wear qualities.

HYDROPHOBIC FIBERS

Dacron, a polyester type, stands at the head of this list as a fiber that renders satisfactory performance when made into minimum care garments. Orlon, Acrilan and other acrylics stand high, while nylon has by comparison confined itself to uses that meet other, but certainly not less important requirements. Acetate, in the form of its triacetate, Arnel, has entered the picture, while many new acrylics are beginning to appear and others will soon attain large volume production.

The hydrophobic type fabrics can be finished by utilizing the inherent thermoplastic properties of fibers during the heat setting operation. This permits some internal flow and a readjustment of the fiber stresses so that the fabric acquires "a memory" that induces it to shed wrinkles and to dry smoothly.

Chemical finishes are not usually required, nor often added, to fabrics made from Dacron, the acrylics, or Arnel. Surface or syrup resins are however

frequently used on nylon to impart, for instance, firm crinoline type finishes.

COTTON FINISHING WITH RESINS

The sudden and certainly surprising entrance a few years ago of cotton into wash-wear dress goods and more recently into the difficult white wash-wear shirting field, has so successfully allowed this fiber to compete with the synthetic hydrophobics that it now surpasses, in volume, the entire balance of all other wash-wear fabrics.

This success can be attributed not to the inherent fiber qualities of cotton but to a chemical modification of its character during the finishing operation. More surprisingly still, this chemical modification was a logical adaptation, mainly since the introduction of ethylene urea resins, of principles reduced to practice of Foulds, Marsh and Wood of Tootal, Broadhurst and Lee Co., Ltd., England.

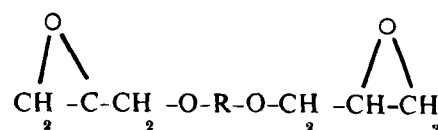
The large scale use of cotton crease resistant treatments did not reach its full commercial exploitation however until consumer acceptance of the hydrophobic synthetic fibers had been won. This stimulated cotton finishers and chemical manufacturers to increase the crease resistance of cotton until the degree of wash-wear was attained. Wash-wear on cotton is thus a crease resistant treatment of high quality embodying also good durability to repeated washings.

The resins used for imparting wrinkle resistance and wash-wear to cotton dress goods are all of the thermosetting type requiring a catalyst, a high temperature cure and preferably an after wash. The most important initial contribution to resin finishing was given by the introduction of chemico-mechanical techniques such as embossing and Everglaze. The

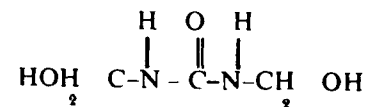
resins used for these fabrics were either urea or melamine formaldehydes, and later ethylene urea derivatives.

The latter quickly found acceptance for straight crease resistant finishes and because of their good resistance to household chlorination quickly supplanted the former types. Urea formaldehydes have high retention of chlorine with subsequent damage to the fiber during the drying. Melamine derived resins, although much more resistant to chlorine damage, retain the chlorine in the form of a yellow complex which mars the appearance of fabrics that contain even small percentages of white backgrounds. The ethylene urea resins, often called by their chemical terminology dimethylol ethylene urea DMEU, neither yellow nor damage under chlorination as practiced in the home according to instructions as given by the manufacturers of chlorine solutions.

The need for finishes that could withstand the rigors of commercial laundering led to the introduction of completely non-nitrogen epoxy resins not long ago. They were later modified and adapted for use in conjunction with ethylene urea resins. The epoxy resins react through an entirely new mechanism which links the cellulose chains together through treatment; e. g., with a diepoxide such as:



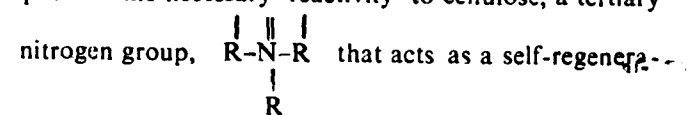
This new reaction represents a milestone in the textile industry and reveals a chemical means of achieving what heretofore was possible only with the methylolated urea or melamine group: e. g., with derivatives of dimethylol urea:



The disclosure of this invention has furthermore led to greatly increased activity in the finishing of cellulose fabrics so that there are now on the market many grades of crease resistance and wash-wear effects.

Combinations of epoxy resins with dimethylol ethylene ureas possess the good crease recovery of the

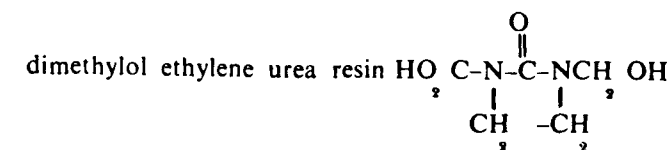
nitrogen resins with the outstanding chlorine resistance of the epoxides. Nitrogenous resins of the triazonone type, although discovered many years ago, have finally been perfected and can be processed without objectionable amine odor. Triazonones contain, in addition to the ureido groups that make possible the necessary reactivity to cellulose, a tertiary



acid protective group, able to resist the severe chlorination during commercial laundering.

RAYON

The success of wash-wear fabrics made from hydrophobic synthetics and from chemically modified cotton has hurt the sales of rayon fabrics, because so far no wash-wear finish has been possible on viscose rayon. The vast amount of finishing research directed towards a wash-wear rayon may eventually lead to the solution of this difficult problem. The fact remains that the inroads made by the wash-wear fibers will otherwise continue to relegate rayon to uses that are not on the uptrend in our industry. Indications point to a partial solution of the problem since the introduction of soft durable thermoplastic resins that can be added in high amounts without reducing the springiness of or harshen the hand of the fabrics. It is well-known that thermoplastic acrylic resins will improve the abrasion resistance of rayon that has been rendered crease resistant by treatment with synthetic resin. It is also established that if a



is employed a high wash-wear rating is achieved but at enormous sacrifice of abrasion resistance. By a peculiar behaviour rayon does not lose tear or tensile in proportion to this drop in abrasion. The abrasion can be controlled by added thermoplastic acrylic resins that form continuous films able to protect the fiber during wear. The problem does become one of developing a thermoplast that is of great softness and high abrasion so that it can be added to the thermosetting resin and allow the latter to be used in the high amounts required to impart the wash-wear character. Usually doubling of the normal thermosetting resin content will move the rayon finish from crease resistant to the "minimum care"

category. The soft thermoplast will control the abrasion so that the fabric is merchandiseable.

The principles as outlined can be utilized to give improved finishes, at somewhat high cost, to many fabrics of spun rayon and to its blends with acetate. Selection of fabrics of good initial abrasion and of ready adaptability to crease resistant treatment coupled with sound merchandising techniques will finally place rayon finishers in competition with some minimum care garments. It is, furthermore, not inconceivable that the application of the above principles could lead to the introduction of improved thermosets that may eventually make possible that much sought for goal of wash-wear rayon.

NON-WOVEN FABRICS

The introduction of improved thermoplastic resins into the textile industry has had far reaching effects in the bonding of non-woven fabrics. These fabrics were developed some years ago and have been utilized for tissues, disposable cloths and interlinings. They represent a radical departure in any industry that was mechanically dependent for many decades on carding, drawing, roving and spinning operations, followed by the rather slow process of weaving. Non-woven fabrics are made by applying a bond of an adhesive to a web or veil that has been merely carded. A web can also be produced by floating the fibers by means of an air stream and depositing them in a web or interlaced form as a skeleton structure of a fabric that is then bonded with a rubber latex, a thermoplastic acrylic binder, or even by fusing the fibers together under heat and pressure. Intermixture of fusible powder together with the fibers is another means of procuring satisfactory bonding of the fabrics. The non-woven fabric industry is expanding rapidly and is limited only by improved binders, bonding techniques and streamlined method of depositing the fibers into a web-like structure.

Softer binders impart greater wrinkle resistance and better drape, while appropriate selectivity of the type of fiber used determines the ultimate strength, wrinkle resistance and durability of the fabric. The insolubilization of the rubber latex binding can take place by vulcanisation, while in the case of the acrylic a drying at high temperature is often sufficient to impart a tenacious bond that is resistant to multiple washings.

Cellulosic fibers are used extensively because of their low cost and they can be rendered crease resistant by incorporating thermosetting resins of the

urea or melamine formaldehyde type. Application of soluble or dispersible thermoplastic binders to the non-woven webs can be carried out by spraying, printing, dipping, padding or backing. Pigment colors can be incorporated simultaneously with many of the resin binders which usually possess the property of pigment bonding as well as fiber sealing. The use of pigment colors permits the production of highly styled fabrics for use in outer garments. Dyed fibers of many different shades can be used in the blends before forming the web to give cross-dyed and fancy effects.

This technique further demonstrates the flexibility of the non-woven fabric operations and the possibilities afforded to those willing to pioneer, modify and develop textiles that are not conventionally manufactured.

Pigment dyes possess outstanding lightfastness and compatibility with thermosetting resins, thermoplasts, catalysts, as well as with binder systems. They therefore greatly facilitate the dyeing operation, making possible dyeing simultaneously during finishing to permit elimination of extra drying, washing and finishing operations.

RESINS FOR STABILIZATION OF FABRICS BY BACKFILLING TECHNIQUES

Many fabrics can be rendered dimensionally stable by applying a backing that does not mark through or in any way affect the appearance, hand, pile or structure of the face. Such fabrics are used extensively in automobile and furniture upholstery and draperies. They are characterized by rather luxurious appearance and by novelty designs. Often they are woven, for reasons of economy, with as few threads as possible so that the resultant fabrics shift or slip when pressure or tension is exerted along warp or filling. This is readily controlled by finishing on a backing machine which uses a knife or a kiss roll technique to deposit thermoplastic resin on one surface only while the fabric moves towards a drying unit.

The resins employed are based on synthetic lattices that dry or cure to deposit a flexible film to the back and thus lock the warp and filling threads together to render the fabric durably stabilized without changing the appearance of the face. Control of the penetration of the film so that the fabric face is not clogged is accomplished by using solutions of high viscosity. Additional control is carried out by mechanical means such as speed of cloth, tension, arc of contact of cloth with finishing roll and time contact with the thickened

solution. Combinations of resins can be used to give greater durability to washing and drycleaning.

Synthetic fibers and blends are now used extensively in upholstery fabrics, while blends that contain 10% of nylon show markedly improved tensile and wear strength.

WOOL

The use of thermosetting resins to impart stabilization to wool fabrics was disclosed many years ago and alkylated methylol melamine resins have since been successfully applied to some fabrics. Chlorination methods of controlling the shrinkage of wool yarns and knitted materials are practiced more extensively; however, wool finishers have not been eager to adopt the chemical finishing techniques that have so radically and beneficially been exploited by the finishers of rayon and cotton.

Present methods of rendering wool non-felting or anti-shrinkable are based either on a locking or spot welding effect or on the principle of fiber attrition. The former utilizes thermosetting resins to immobilize the fibers and yarns, while the latter (chlorine method) consumes part of the fiber to expose the wool cuticle and attack the base of the

scales. Chlorine shrinkage control is efficient and imparts soft hand, but the wool character is modified so that the dye qualities are modified and the subsequent wash-fastness of dyestuffs is reduced.

The present technology indicates that a satisfactory mechanism can be based on clogging the scales of the fiber to reduce friction and to prevent the scales from opening and swelling in water. The difficulty of achieving this effect lies in the danger of gumming the fiber surfaces with a large, though effective, amount of harsh resinous polymer that detracts from the natural hand of the fiber. Soft thermoplastic resins have recently been developed that perform this function with a minimum loss of hand.

The property of good adhesion to the wool fiber after repeated washes can be conserved by utilizing the acrylic thermoplasts in conjunction with a thermosetting resist that act by insolubilizing the thermoplast on the fiber surface. Wool fabrics of good shrinkage stability cannot qualify in the wash-wear field because the fiber, due to a protein nature, is inclined to assume and maintain the position in which it is held during washing in warm solutions.

Wool garments that are shrinkproofed should be handled carefully, preferably by hand washing followed by straightening of the wrinkle before drying.

British Nuclear Plants can help raise World living standards

OVERSEA MARKET FORECAST FOR REACTORS

British nuclear power reactors could, in future, help raise living standards throughout the world. This forecast is made in a review of the prospects for the industry published in London by Political & Economic Planning, an organization which concerns itself with studies of modern problems.

The review says that it is clear there is, or will be, an overseas market for reactors. At the moment the market will be for relatively large reactors developing over 100MW of electricity. But there is a potential market for small reactors similar to that for modestly powered gas-turbine and Diesel-powered generating sets.

"A small reactor", the review points out, "has the advantage that it can be sited where the power is needed, and its fuel requirements are small, thus doing

away with transmission lines and high fuel transport costs. If cheap, it could transform areas which are now undeveloped or unexploited, and help to raise the standard of living of millions of people throughout the world who are now forced to do with little or no power and to rely on inefficient fuel burning, on human labour or on animals".

To feed the reactor, the United Kingdom has adopted a fuel supply service. Fuel could be sent, for example, from Britain to Italy, and when it had been used, shipped back to the United Kingdom and re-processed.

The review adds that in industrial countries, particularly in Europe, atomic power is the best answer to the long-term problem. "Expansion is running ahead of fuel supplies, and fuel will be more and more expensive as time goes on, so that nuclear power costs will be more and more competitive".

Textile Machinery and Accessories

3rd International Exhibition in Milan (Italy)

September 12-21, 1959

THE 1959 International Exhibition of Textile Machinery & Accessories will be staged in the halls of the world-famous Milan Fair under the auspices of the Committee of European Manufacturers of Materials for Textiles.

The principal manufactures of the following countries will take part: Belgium—France—Germany—Great Britain—Holland—Italy—Switzerland—Austria—Denmark—Spain—Sweden—U. S. A.

There will be exhibited textile machinery and accessories for every section of the textile industry including cotton, wool, silk, hemp, flax, jute, and the man-made fibres.

In 35,000 square metres of stand space will be displayed by over 500 exhibitors machinery, accessories and equipments for every phase of textile production including preparatory to spinning; spinning; preparatory to weaving; weaving; bleaching; dyeing; printing; and finishing.

There will also be on view a comprehensive display

of machinery for knitwear and hosiery manufacture; braiding; sewing; and making-up; together with a complete range of ancillary equipment and products, accessories, and laboratory testing apparatus.

The machineries exhibited will be in operation; thus, the visitors connected with the textile industry will have an opportunity to see the machines in actual production.

Visitors will be able to see the very latest developments in textile machinery from all over the world, and the exhibition should be of particular interest amongst those countries which are in the process of developing their own domestic textile production.

The organization of the exhibition is entrusted with "A. C. I. M. I. T." (Association of Italian Manufacturers of Machinery for Textile Industries) and further information may be obtained direct from:

Segreteria Generale "E. I. A. T. 59"
via Baracchini-10, Milano, Italy.
Cables: "EIAT—Milano"

ORDINARY TRACTOR PULLS TRAILER WITH TEN-TON LOAD

It is claimed that a ten-ton load can be pulled up a one-in-four gradient by an ordinary farm tractor in a new two-wheel trailer now being sold by Steel Fabricators (Cardiff) Ltd., of Wales.

The tractor can do this by means of a "swan neck" coupling in the form of an inverted "U", which is attached at the forward end, to a forked drawbar fitted to the tractor beneath the rear axle. This arrangement ensures that traction takes place below, and at each end, of the back axle. The fact that the trailer's two wheels are at the rear also means that part of the weight of the trailer and load is passed through the coupling to the rear of the tractor, thus giving the back wheels a better grip. The coupling is so attached to the drawbar that tractor and trailer are able to turn round in a circle so small that the tractor can come back on its own ground without risk of overturning.

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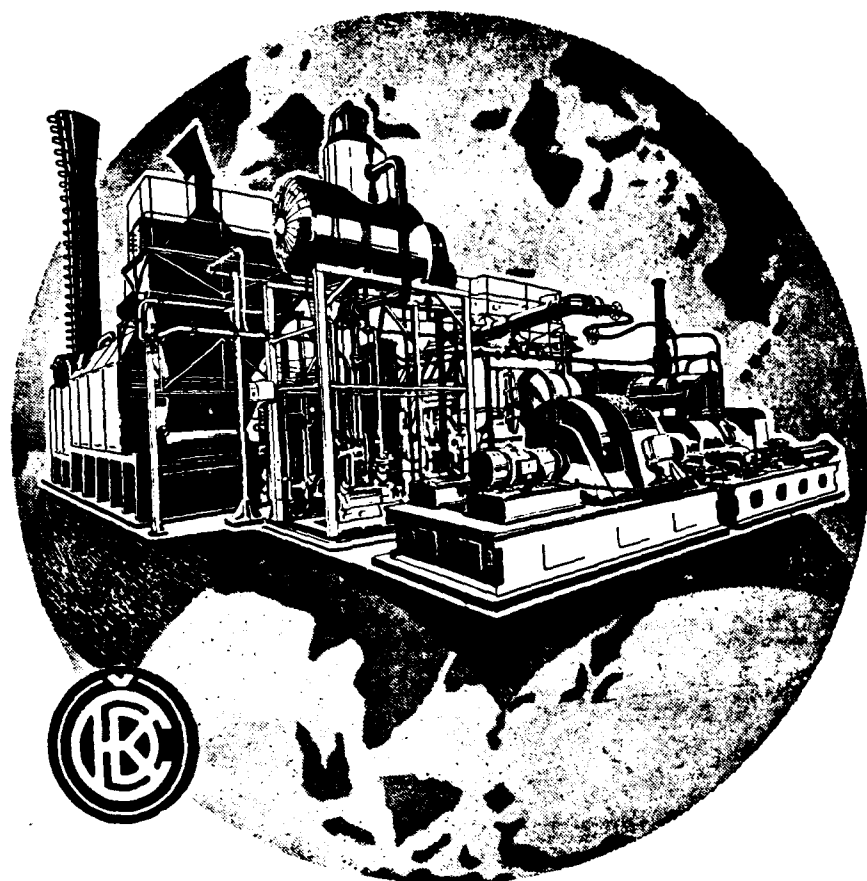
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U.K. METALLURGICAL EXPERT TO VISIT INDIA AGAIN

Mr. S. Barraclough, a metallurgical expert now back in Britain after spending three months with the Indian Standards Institution, will soon return to India for another period to complete his work. He was assigned to the Indian Standards Institution under the Colombo Plan for assisting in the formulation of standards for alloy and special steels.

Mr. Barraclough sees the setting up of standards for steels and steel products as vital both for ensuring the necessary standard of quality and for helping economic production and utilization. He believes that it is important that the maximum use should be made of indigenous raw materials, such as manganese and chromium, and that imported materials like nickel and molybdenum should be used sparingly.

Mr. Barraclough is a member of the research department of the United Steel Companies Ltd., of Sheffield.



PACKAGED POWER PLANT

The Czechoslovak Industry has developed a new type of steam power plant of an output 1,500 and 750 kW.—called "Packaged Power Plant".

The characteristic feature of the equipment is that it is delivered in blocks, ready assembled by the manufacturing works, the weight of the heaviest block being 18 tons. The Packaged Power Plant can be therefore transported by any means of transportation to the places where it is necessary to make the electric power available.

These Packaged Power Plants require minimum building investments,—a simple building with concrete slab, without vaulting. The erection on site requires minimum time, as only the interconnection of separate units is necessary.

The Packaged Power Plants can be used with advantage for large construction projects, for small factories and communities.

The good results achieved in operation and the experiences gained with these Packaged Power Plants present a good evidence of the high standards of the Czechoslovak steam power plants.

TECHNOEXPORT Praha, Czechoslovakia

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June 1959

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P.1

PAINTS, PLASTICS AND CHEMICALS SECTION

New Vinyl Wrinkle Finishes made known by Union Carbide International Company

THE development of the first wrinkle finishes based on vinyl plastisols, organosols and solutions was recently made known by the Plastics Department, Union Carbide International Company, Division of Union Carbide Corporation. The new finishes provide unique decorative effects as well as the resistance and durability characteristics of coatings based on Union Carbide vinyl resins.

An important ingredient in the new finish is Monomer MG-1, another Union Carbide product. In addition to a select combination of driers and polymerization catalysts, Monomer MG-1 is largely responsible for the development of the wrinkle pattern. The polymerizable plasticizer is also familiar as a plastisol modifier used to produce extremely rigid type plastisols.

PLASTISOLS

For maximum thickness wrinkle coatings, plastisols are preferred. The particular advantages of plastisols for wrinkle finishes are :

1. Freedom from objectionable volatiles.
2. Application of 100% solids content for maximum film build.
3. Excellent flexibility of films.
4. Film toughness.
5. Ease of preparation.
6. Films are non-critical as to wrinkle uniformity.

Generally these plastisols may be sprayed to a film thickness of five to ten mils per wet coat.

ORGANOSOLS

Where the use of volatiles is not objectionable and lower viscosity coatings are desired, organosols may be

used instead of plastisols for wrinkle finishes. The main advantages of organosols are :

1. Greater range of film hardness.
2. Easier handling with spray equipment because of lower viscosity.
3. Lower viscosities give higher pigmentation and greater range of modifiers.
4. Thinner film.
5. Greater range of film flexibility and hardness.

Conventional enamel or lacquer guns may be used to spray organosol wrinkle finish. Except for the difference in advantages listed above, wrinkle finishes made from organosols are similar in properties to those made from plastisols because the same Union Carbide vinyl resins are used.

SOLUTION COATINGS

The major advantage of solution coatings is the finish may be prepared using lower temperatures in the baking schedule than is possible with either plastisols or organosols. In formulation, solution vinyl wrinkle coatings are quite different from plastisols and organosols. The solution coating closely follows the principles of general solution vinyl coating formulation.

TRAYS COATED WITH UNION CARBIDE VINYL OFFER DURABILITY, VIVID COLORING

This colorful new serving tray, featuring durability and practicability, is protected by a tough coating based on Union Carbide vinyl resins. Designed as a household serving aid, the tray must withstand kitchen abuse and resist food or drink stains. The clear vinyl coating is inherently durable and resistant to moisture, alcohol, food and beverages.



Moreover, the plastic surface is odorless, imparts no taste and may be easily cleaned.

The trays are made for use in Coca-Cola Company, U. S. A., promotional activities. A multi-color picture of fruit and beverage decorates the tray face.

Roller-coated over the decorative tray, the glossy overprint coating is flexible, flame-resistant and possesses excellent adhesion properties.

NEW PLASTIC TYPEWRITER COVER PROVIDES PROTECTION AND STRENGTH

Tough, clear and inexpensive plastic covers made of Union Carbide polyethylene are now being used to protect new portable typewriters and the linings of their leather carrying cases from abuse during shipment, storage and display.

Protecting both the leather carrying satchel and the enclosed typewriter, a covering of plastic film has substantially decreased dealer complaints of marred merchandise, prevalent before the polyethylene film was employed. Without the film, machines were often scratched and interiors of the leather carrying cases marked in transit or during unpacking.

As an additional advantage of the new plastic lining, typewriters are kept dirt-free yet may be prominently displayed through the transparent plastic material. The new package appeals to customers by imparting a quality of newness.

Measuring eleven by three by ten inches (28 by 8 by 25 cm.) the bag is made in a four-mil (0.1 mm.) thickness from Union Carbide Polyethylene. Polyethylene film packaging is inexpensive and has the



advantages of being waterproof, strong, tough, non-absorbent and impervious to most chemicals.

ACCOUNTING MACHINES SHIPPED AND STORED IN BAGS MADE OF UNION CARBIDE POLYETHYLENE FILM

By dramatically wrapping large accounting machines in film made of Union Carbide polyethylene, a manufacturer has been able to reduce shipping costs 50 per cent. Previous to the use of polyethylene film wrapping, the manufacturer used a tongue and groove box for shipping these machines. The film bags,



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however, have permitted a switch to lighter, wirebound boxes which cut packaging costs in half and also markedly reduce shipping weight.

Another major advantage of the polyethylene covers is protection against dust. With their thousands of intricate parts, the complex machines are extremely vulnerable to dust, and must be protected. The bags also keep out moisture, an important factor during shipping when a box is sometimes exposed to bad weather.

Union Carbide polyethylene film was chosen specifically because of its flexibility, good aging and water-proof qualities, toughness and high tear resistance.

FOAMED POLYETHYLENE CORE NOW USED IN COAXIAL CABLE FOR COMMUNITY TELEVISION

To meet the specific requirements of community television systems, radio frequency coaxial cables now embody a specially compounded foam insulation made of Union Carbide polyethylene and jacketed with black polyethylene.

The foamed core is made up of millions of polyethylene bubbles, filled with an inert gas, each of which is completely sealed from the other. This foamed cable core provides much lower attenuation for a given cable size, and therefore reduces the number of costly amplifiers previously used.



The non-contaminating cable jacket of Union Carbide polyethylene provides chemical resistance, superior weathering and excellent abrasion properties, all of which contribute to extended cable life. These properties are all made available with a reduction in cable weight due to the foamed polyethylene core.

New Scheme for Small Industry

The Government of India has evolved a new scheme to accelerate the development of ancillary industries in the country. The scheme, which is now being considered by the various trade and industrial organisations, aims at the establishment of small industrial estates and industrial co-operative estates in comparatively backward areas where there are only a few or no industries at present.

According to the scheme, each trade organisation will choose 10 to 20 acres of land in a particular region where it would provide basic facilities and construct simple types of sheds for small industries. These sheds will be allotted to different entrepreneurs on a hire-purchase system. The machinery needed by the small industries in these estates will also be made available on similar terms.

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METAL CORP. TO EXPAND

The shares of the Metal Corporation of India, Ltd., have improved to Rs. 15.12 in Calcutta as a sequel to reports of the company's expansion programme. The company proposes to establish a zinc smelter in collaboration with a foreign firm. It also proposes to issue 13 lakh new ordinary shares of Rs. 10 each and one lakh six per cent., tax-free redeemable cumulative preference shares of Rs. 100 each. Both the issues are to be made at par.

The foreign firm will take six lakh equity shares and the Indian Steel and Wire Products, Ltd., will also subscribe for six lakh ordinary shares. The balance of one lakh ordinary shares and the preference shares are to be offered to the existing share holders of the company or to the public, according to the discretion of the directors.

PRESS COATED AND MULTI-LAYER TABLETS

By Theodore J. Tsevdos

Manager, Pharmaceutical Division, F. J. Stokes Machine Company, Philadelphia, PA.

RECENTLY, two special tablet forms have excited many pharmaceutical manufacturers with their many possible applications. They are the press-coated tablet, or tablet-within-a-tablet, and the multi-layer tablet.

We will first consider the tablet-within-a-tablet: What it is, how it is made, and some of its typical applications. Then we will discuss several types of multi-layer tablets, how they are made, and their possibilities and uses.

Let us first define what a tablet-within-a-tablet is and what it looks like. A simple tablet-within-a-tablet, which is also frequently called a press-coated tablet or a dry-coated tablet, consists of a central core tablet made on any conventional tablet press and a press-coating, or outer tablet, made around this core tablet, by the press-coating machinery that will be more fully discussed later. Some typical applications of these press-coated tablets should help to illustrate their great potential and wide range of uses:

1. Press-coating can be applied where water cannot be used in the coating pan operation; for example, with compounds containing aspirin, penicillin, and so on. This type of application explains why the nickname of "dry-coating" has been given to the press-coating process.
2. Press-coating permits the combination of two incompatible materials in a single tablet by placing one of them in the core tablet and the other in the press-coating.
3. Press-coating enables the manufacturer to apply a heavy time-delay or enteric coating on the core tablets, with accurate control over the thickness of this coating and the amount of dosage to be placed in it. This is especially important when a heavy coating is desired, because it requires considerable time and expense to build up a thick coat by means of a coating pan process.

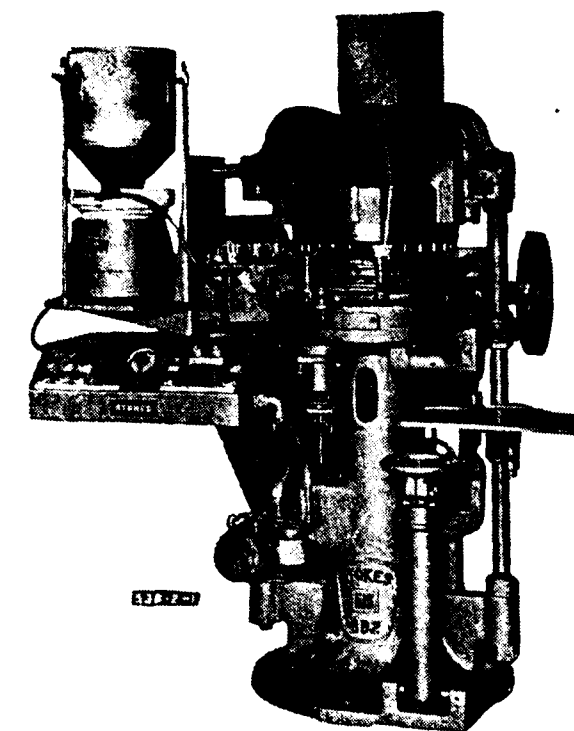


Illustration 1.

A tablet-within-a-tablet press with single rotary head and automatic hopper.

4. In like manner, press-coating may also permit the making of tablets with quicker, more accurate time-disintegration properties.
5. Press-coating can make tablets with double and even triple dosages. Vitamin tablets, for example, can be press-coated with granulations containing desirable mineral combinations. Multiple dosages can be made by first press-coating core tablets with a small sub-coating and then re-running these tablets through the press to apply a second or heavier final press-coating.
6. Press-coating also permits better product identification than pan-coating because

the punches of the tablet-within-a-tablet press can mark the press-coated tablets with the desired embossed, engraved or other identifying trade mark.

7. And finally, since the tablet-within-a-tablet press can produce tablets at the rate of about 500 tablets per minute and higher, press-coating becomes very attractive as a means of reducing or eliminating the time and labor cost involved in standard coating pan operations. However, the actual extent to which press-coating can reduce or eliminate pan-coating processes will depend on the pharmaceutical products and the economics of each pharmaceutical manufacturer.

There are two basic types of tablet-within-a-tablet presses. The first basic type consists of two rotary tablet presses coupled together so that the first rotary head produces the core tablet and transfers it to the second rotary head which presses the coating granulation on it. This type of tablet-within-a-tablet press is useful in making some press-coated tablets where it is desirable to produce the core tablet and then immediately press the coating granulation on it. The second basic type of tablet-within-a-tablet press consists of only one rotary press which takes previously compressed core tablets which are fed to it from an automatic hopper and presses the coating granulation on them. The second type of tablet-within-a-tablet press is usually more flexible than the first for several reasons: Core tablets can be easily made and with good speed on any standard tablet press and then later transferred to this tablet-within-a-tablet press for the press-coating operation. This offers better flexibility in scheduling production. In addition, the necessary quality control checks can be made on the core tablets before the addition of the press-coatings.

Now let us examine a typical tablet-within-a-tablet press to see how it makes press-coated tablets and to determine its desirable features and its limitations. Illustration No. 1 shows the general arrangement of this second type of tablet-within-a-tablet press which has a single rotary head and an automatic hopper to feed the core tablets.

The core tablets are loaded into an automatic

* Delivered before American Pharmaceutical Manufacturers' Association, December 13, 1955.

hopper which orients them and positions them into a feeder with an escapement that places each core tablet into the transfer mechanism which is located on the table of the machine. Illustration No. 2. The die is first volumetrically filled with a small amount of the coating granulation, and then the transfer mechanism takes a core tablet and inserts it and centers it in this die cavity and on top of this bottom layer of granulation. The die with the centered core tablet in it is now volumetrically filled with the remaining amount of the coating granulation, and as the die passes under the machine's pressure rolls, the punch presses the coating granulation firmly and completely around the core tablet at the proper pressure and density.

Any finished tablets that do not contain a core tablet are automatically rejected by this tablet-within-a-tablet press. The properly press-coated tablets are



Illustration 2.

Loading core tablets into automatic hopper.

automatically ejected from the machine in the same way that tablets are ejected from standard tableting presses. Illustration No. 3. This tablet-within-a-tablet press also has a convenient control panel to aid in setting up, adjusting and operating this equipment. Illustration No. 4.

Various pharmaceutical manufacturers have told us that a practical tablet-within-a-tablet press must have the following general features:

1. It must accurately center the core tablet in the finished tablet and hold variations of concentricity to within several thousandths of an inch where necessary.
2. It must be easy to set up and operate, with relatively easy changeover from one size of core tablet to another and from one type of coating granulation to another.
3. It should also be able to press-coat special shaped tablets, such as ovals, capsules, squares and so on.
4. It should be able to accurately control the thickness of the press-coating on all sides of the core tablet while pressing it to the desired pressures and densities.
5. It must be able to deliver up to 500 press-coated tablets per minute or higher, and to feed and transfer core tablets at these speeds without damaging them.
6. It must have a simple but workable inspection system that will automatically reject tablets that do not have a good core tablet in them.
7. And finally, it should be possible to operate

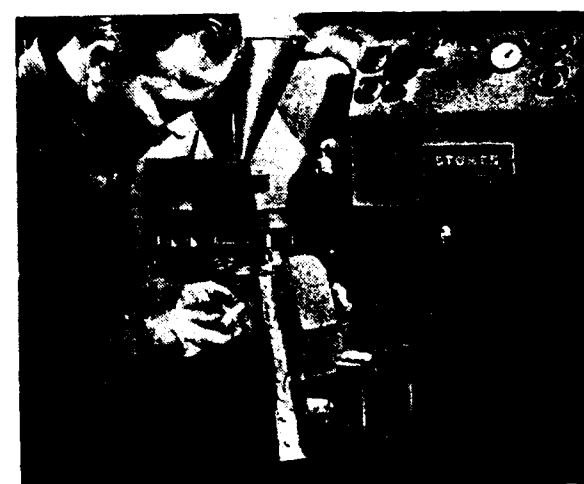


Illustration 3.

Properly press-coated tablets being ejected from machine.

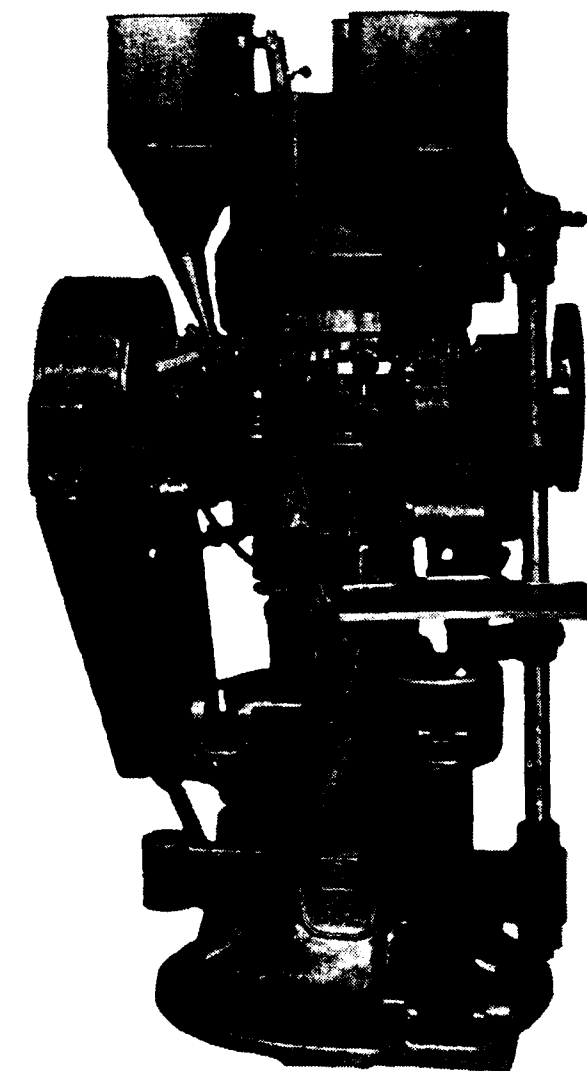


Illustration 4.

Control panel which aids in setting up, adjusting and operating the equipment.

this tablet-within-a-tablet press as a standard tablet press by simple modification when production requirements so demand.

Now, let us look at another new tableting process with a number of useful applications, namely, the multi-layer tablet.

Multi-layer tablets are usually made with either two or three layers of material. The making of multi-layer tablets is actually a well-established industrial tableting process. Bi-metallic contacts (which are two-layer tablets) were made by the electrical industry about 15 or 20 years ago, and three-layer pyrotechnic tablets with a red flash on top, a white illuminating charge in the center, and a green flash on

the bottom were made by the Ordnance Corps over 10 years ago. But it is only recently that new developments in multi-layer tablet presses have made this process suitable for a variety of pharmaceutical applications.

As a result, pharmaceutical firms are now developing a number of new products utilizing the special capabilities of the new multi-layer tablet presses. Typical applications being considered are:

1. Multi-layer tablets are useful when two active materials must be separated by a middle layer of inert or inactive materials.
2. Multi-layer tablets may be made of two or three incompatible materials by keeping these compounds in their own individual layers in the tablet.
3. Multi-layer tablets can provide product identification by the use of different colors in the tablet layers.

Many other applications for multi-layer tablets are now being investigated by pharmaceutical manufac-

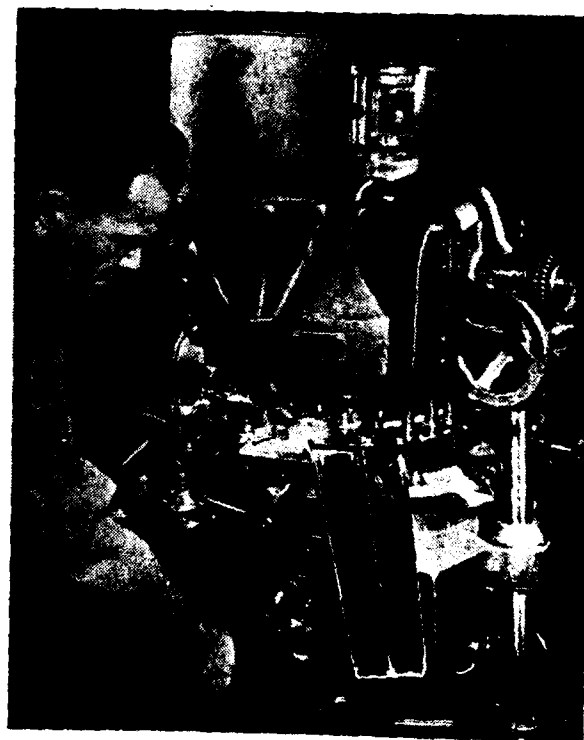


Illustration 5.

Multi-layer tablet press making accurate, two-layer tablets by individual layer-compression method.

turers who are interested in marketing new tablet products.

Multi-layer tablets can be made by two basic methods. The older method is called the single-

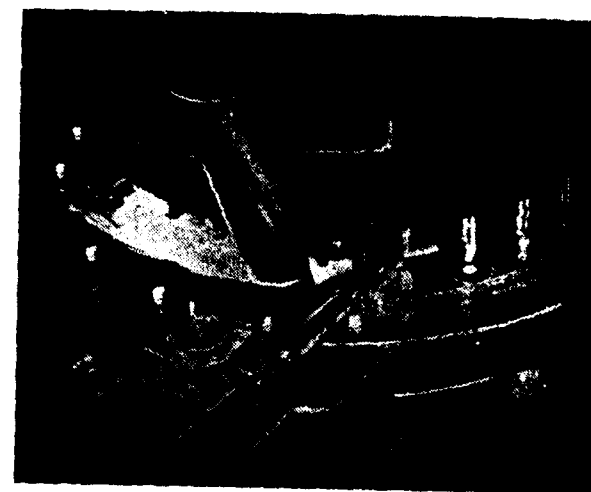


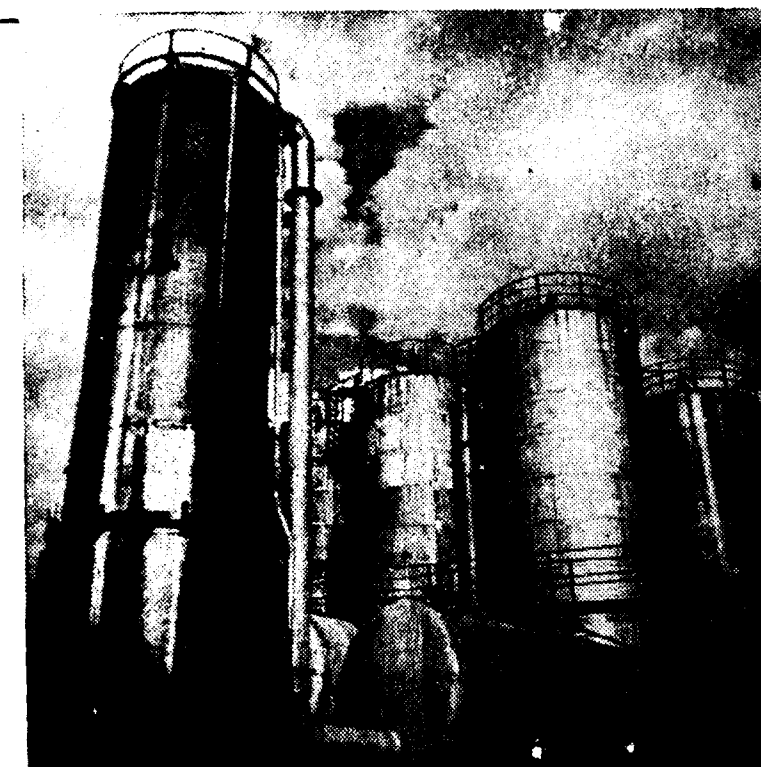
Illustration 6.

Showing the finished two-layer tablet.

compression method. In this method, the die of the rotary press is filled with the different materials in successive layers, one on top of the other, and the multi-layer tablet is formed by pressing all the layers together with a single compression. With this method, the weights of each layer can be held to a variation of about two per cent or better and the separation lines between the layers sometimes tend to be a little irregular. However, this method is satisfactory for multi-layer tablet applications where very accurate weight control and clean layer-separation are not too essential.

The newer method of making multi-layer tablets is called the individual layer-compression method. In this method, each layer of material is filled and pressed separately to provide multi-layer tablets with the following advantages: First, clean straight-line separation of each layer of material; second, more accurate weight control of each layer down to a variation of about one per cent or less; and third, a quality control check can be performed on each individual layer. The individual layer-compression method is, therefore, very useful for multi-layer tablet applications where extreme accuracy and good quality control are required.

Illustration No. 5 shows a multi-layer tablet press arranged to make accurate two-layer tablets by the



(Tradition + Experience) · (Carefulness + Accuracy)
+ (Modern Production + High Working Qualifications)
 + Control +  = Quality
 Quality = 

Products of organic and inorganic Chemistry

Tar Dyestuffs

Ceramic Glazes and Frittes

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Textile Chemicals

Dental Products

Pharmaceutical Intermediates and Specialities

PRAHA
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CHEMAPOL 

individual layer-compression method. On this machine, two-layer tablets are made by filling the die with the first material and pressing it to make the first layer, then filling the die with the compressed first layer in it with the second material, and then pressing it again to form the finished two-layer tablet. Illustration No. 6. By adding an additional hopper, feed frame, and compression stage, a three-layer tablet machine would be obtained.

Quality control checks can be easily made while this machine is in operation. By pressing a lever, a sample first layer in the die can be automatically ejected while the machine is running so that the weight of this layer of material can be checked. If a three-layer tablet were being made by this method, a sample containing the pressed-together first and second layers could also be automatically ejected for a similar weight check. The weight of the final layer of material can be easily obtained by subtracting the weight of the first layer or the first two layers from the weight of the finished multi-layer tablet.

A practical multi-layer tablet press should have the following features:

1. Clean separation between the various layers.

Aero-Engine as Electrical Power Producer

A new use of turbine aero-engines—to produce electrical power from remote-controlled robot power stations in sparsely populated areas—has been announced in London. As an experimental development, two completely automatic "pocket power plants" are to be built in Western England by the South-Western Electricity Board. The first station is likely to be at Princetown, Devon.

A model of the robot power station was on view for the first time at an engineering exhibition in London recently. A spokesman of the Electricity Board explained that the new generators, which are modified land versions of the Bristol Proteus engine which powers the Britannia airliner, can be started and stopped from control rooms 100 miles away. The generating set can work, without excessive noise, in a building the size of a small house, and should require only routine visits four times a year and overhaul once every 10 years.

Each of the new 3,000-kilowatt generating sets is capable of supplying electricity to a town of 10,000 people. Although unsuitable for continuous running,

2. Accurate control of the weight and thickness of each layer.
3. Ability to sample check each individual layer as described above.
4. Ease of set-up and operation, with only one set of cams being required to produce a variety of multi-layer tablets. A press that requires special cams for each multi-layer tablet being produced is obviously limited in flexibility.
5. A three-layer press should also be able to make two-layer tablets and single-layer standard tablets when desired. In like manner, a two-layer press should also be able to make standard tablets when necessary.

To sum up, the new presses and techniques for making press-coated tablets and multi-layer tablets offer the pharmaceutical manufacturer additional tools to prepare and market new pharmaceutical products, or to modify and improve existing ones. One thing seems fairly certain at this time: Probably no two pharmaceutical manufacturers will use these two new types of special tabletting presses in exactly the same way.

they are regarded as an excellent stand-by should the mains supply fail.

WHAT'S HOLDING BACK TITANIUM SANDWICH STRUCTURES?

It's lack of a suitable titanium alloy foil and a satisfactory process for fabricating the panels. So says the latest report from the Titanium Metallurgical Laboratory at Battelle Memorial Institute. Commercially pure titanium is available in foil thicknesses, but it lacks the required strength. In fabrication, the biggest problem seems to be brazing the metal. Battelle believes "the brazing operation will have to be performed at aging temperatures" so brazing alloys that flow at these temperatures (in the 900 to 1180-F range) may have to be developed. Battelle gets good results brazing commercially pure titanium and the 6% aluminum-4% vanadium alloy with a 97% silver-3% lithium brazing material. But says Battelle "the amount of lithium in this alloy is rather high; therefore the corrosion resistance of this alloy should be carefully investigated". There is, obviously, work till to be done.

Gas Turbines Up Process Efficiency

By J. E. Parker

Utilities Engineering Supervisor, Union Carbide Chemicals Co., Texas City, Tex.

Process applications for gas turbines are few and far between. However, industrial recognition of the worth of turbine-exhaust oxygen may soon change this picture.

TO KEEP in line with our rapidly expanding plant capacities, we recently found ourselves facing the need for more adequate compressed-air facilities. The air shortage had been developing for some time, but at a rate that didn't warrant any major installations—some 30-odd portable compressors had partially absorbed the increasing load. Since we felt that more portable units couldn't economically and reliably keep pace with the ever-rising air demands, we decided in favor of some more permanent solution.

EXPLORING THE PROBLEM

An engineering study of the air situation revealed that either a gas-turbine-driven centrifugal compressor or a gas-engine-drive reciprocating compressor would afford a satisfactory solution to the problem. In the course of the study, we had to rule out electrical motors and steam turbines as possible drive units for the centrifugal compressor because of their adverse effect on the plant's steam and power balance.

The most serious disadvantage of the gas turbine is low thermal efficiency. For a single-shaft, simple cycle machine, the thermal efficiency figures to about 17.2%. Even with a regenerator, this efficiency would only rise to about 28%. In comparison, gas-engine thermal efficiencies range from 24.0 to 33%. Therefore, to make the turbine competitive on the basis of efficiency, effective utilization of its exhaust heat would be necessary.

At about the same time that we started our air-compressor studies, it began to appear that a newly ordered 200,000-lb./hr., 1,000-psi. boiler would be inadequate to meet the expansion's additional power demands. We therefore turned our attention to the possibility of utilizing the gas-turbine exhaust heat for steam generation.

Since the plant needed 1,070-psi. steam at 850 F., we bypassed the idea of a waste heat boiler—calculations showed such a unit to be economically feasible only for our lower-pressure steam needs. Likewise,

the prospect of using the turbine exhaust as a heat source in a boiler feedwater economizer met defeat because the amount of heat in the 840 F. turbine exhaust was well in excess of the amount that could be utilized for feedwater heating.

We would like to make a point here of calling attention to the fact that these two possible solutions, which were not justified in our situation, might be attractive to other plants. Successful utilization of gas turbines in process applications depends almost entirely upon prevailing conditions under which they must be applied.

EXHAUST SUPPORTS COMBUSTION

Then an unexpected solution presented itself because of one of the basic features of gas turbines that is generally considered to be a handicap, and which causes its low thermal efficiency—high excess air in the exhaust. Since power developed by the turbine is dependent, among other things, upon mass gas flow, and also since temperatures through the machine have to be controlled in line with the capabilities of its materials of construction, the gas turbine has to operate with about 500% excess air. Heat content of this large quantity of air accounts for most of the heat loss in the turbine exhaust.

Due to this over abundance of air, however, the turbine exhaust contains a relatively high percentage of oxygen. Available oxygen amounts to about 18-18.5% of the total flow. This is only slightly lower than that in normal air. The exhaust stream of gas turbines then, is merely highly heated air. It can be more correctly referred to, therefore, as exhaust air flow rather than exhaust gas flow. It's quite possible that this misnomer has caused attractive applications of gas turbines to be inadvertently neglected.

We should thus consider the exhaust as a secondary heat source for support of primary combustion, rather than as a primary heat source. Realizing this, we changed our thinking, and reviewed the general

problem from the standpoint of indirect heat recovery.

Our approach was to calculate how much heat was available if we fired enough fuel to utilize the available oxygen in the turbine exhaust, and reduced the final flue-gas temperature to normal boiler exit conditions. On this basis, we determined that between 250,000 and 300,000 lb./hr. of 1,000-psi. steam and at 850 F. could be generated.

Much to our satisfaction, we also found that our newly ordered boiler could be converted to fit these new conditions for about a 10% increase in cost. The primary change required was enlargement of the gas passages to accommodate the larger flue-gas flow. Secondly, boiler design originally called for an air preheater; since this was no longer necessary, the preheater was replaced by an economizer section. With the economizer conversion, de-aeration pressure was dropped to 10 psi. to give the economizer a lower-temperature water, thus permitting even greater heat recovery and a lower flue-gas exhaust temperature.

With these changes, the boiler was re-rated for 50,000 lb./hr. when operating on gas-turbine exhaust. Note that only a 10% increase in cost effected a 25% increase in capacity. Of utmost importance was the fact that the resultant increase in steam, obtained indirectly through waste heat recovery, could be applied at our highest primary pressure, thus providing a most efficient and flexible steam supply to meet the plant requirements.

HIGH EFFICIENCIES, LOW COST

We found that the over-all thermal efficiency of the combined gas-turbine-boiler unit would run about 77.0%. Breaking this down, the apparent turbine efficiency would rise to 74.8%, as compared to 71.2% when operating independently. The apparent boiler efficiency under the combination conditions jumps to 81.6%, as compared to 80.6% when operating independently. Therefore, the most serious drawback of the gas turbine—low thermal efficiency—has been eliminated; and as a matter of fact, the cause for this disadvantage now becomes one of the most important assets. This can be even more readily seen when we compare the new apparent turbine thermal efficiency of 74.8% with the best efficiency (33%) that can be expected of a gas engine.

The exhaust of a 7,000-hp. gas turbine will normally contain sufficient oxygen to support a boiler load of 300,000 lb./hr. While our converted boiler is nominally rated at 250,000 lb./hr., it is felt that because of the conservative design of the gas passes, it will be possible, at least for intervals, to operate at 275,000 to 300,000 lb./hr. Operation at these higher capacities shows combined efficiency increases to 77.4% and 77.9%, respectively. This even further increases the attractiveness of the installation. It also points out the necessity of matching the boiler with the turbine to fully realize the potential gains of this type of combined installation.

AIRCRAFT AND AUTOMOTIVE INDUSTRIES SECTION

1958 A Year of Jet Engine Progress for General Electric

By an Aviation Correspondent

A General Electric Company executive today hailed 1958 as a year of progress and important milestones in the jet engine business.

In a year-end statement, J. B. Montgomery, General Manager of the Company's Aircraft Gas Turbine Division, described substantial progress in commercial jet engine activity and important milestones in military areas.

A General Electric contribution to commercial jet flight was the unveiling of the first successful U. S. turbofan engine. Mr. Montgomery also cited development of a thrust reverser and noise suppressor as an integral part of General Electric jet engine design.

He emphasized that of this date, seven airlines—both foreign and domestic—have ordered jet aircraft powered by General Electric engines.

In the military area he noted that more than 95 per cent of the country's total turbojet experience at Mach 2 has been acquired with General Electric engines.

Aircraft powered by General Electric turbojet engines established many records, and a number of significant "firsts". The achievements of the Lockheed F-104 Starfighters were saluted by Mr. Montgomery. Starfighters, powered by General Electric's J79 engine, this year captured the world's speed record of 1404 miles per hour, altitude record of 91,243 feet, and seven time-to-climb records. This airplane became the first to hold world's records in all three categories.

Starfighters were the first Mach 2 aircraft to become operational in USAF squadrons and to be assigned to Formosa during the Quemoy crisis. The J79-powered North American A3J Vigilante and the McDonnell F4H both made first flights during 1958.

Other aircraft equipped with the J79 are the Grumman F11F-1F Super Tiger and the Convair B-58 Hustler.

Performance of the J79, Mr. Montgomery said, played an important part in selection of the General Electric J93 engine as the power-plant for the nation's first Mach 3 fighter and bomber aircraft. Contracts were received leading to a large-scale program for development of the J93—announced to power North American's 2000-mile-per-hour B-70 and F-108 long-range interceptor.

The engine also is designed to power other aircraft and missiles of the future, according to Mr. Montgomery.

A commercial aviation highlight was the unveiling of the Company's CJ-805-21 aft-fan turbojet engine. Scheduled for use by American Airlines on their Convair 600 luxury liners, the new engine is the first successful U. S. turbofan type. It will perform at ideal efficiency in the Mach .80 to Mach .95 speed range with a decrease of 8 to 12 per cent in fuel consumption over conventional turbojet engines.

The General Electric CJ-805-3 commercial jet engine received CAA certification and the first production engine was shipped. This engine will power Convair 880 jetliners. The 880 has been ordered by TWA, Delta Air Lines, Transcontinental S. A. of Argentina and REAL of Brazil. Of particular significance was the recent SAS/Swissair decision to buy G. E.-powered 880's—first medium range commercial jet airliner in the European market.

High in commercial developments are a thrust reverser rated at 5000 pounds reverse thrust and noise suppressor that will reduce the noise level of the four-engine Convair 880 jetliner. This equipment is undergoing tests at the Company's outdoor test site, Peebles, Ohio, and in a specially adapted test cell here.

MODI PAINTS

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More than 1000 hours of test time has been accumulated on the CJ-805 using kerosene as fuel. Kerosene affords a 10 per cent saving over conventional JP-4 jet fuel.

Significant progress was made, Mr. Montgomery said, in the small aircraft gas turbine field resulting in successful first flights of the new 2000-pound-thrust-class J85 engine in both the McDonnell Green Quail decoy missile and North American T-39 jet trainer. It is also scheduled to power the Northrop supersonic T-38 jet trainer.

The J85 is produced by the division's Small Aircraft Engine Department, which is also producing the T58 turboshaft engine for the Sikorsky S-62, Vertol H-21D and Sikorsky HSS-1F helicopters. The T58 has been announced for several new applications and pre-production testing has passed more than 10,000 hours. Development continued on the new 2600-horsepower class T64.

The division's Aircraft Accessory Turbine Department completed, and delivered to the Air Force design and development of self-contained auxiliary power units for supplying electric and hydraulic power for North American's X-15.

In 1958, General Electric established another record when it rebuilt its 10,000th flight-used jet engine. To date more than 38,000 engines have been built to General Electric design and have accumulated more than 20 million flight hours, Mr. Montgomery said.

At the General Electric Flight Test Center, Edwards Air Force Base, California, the Company continued its policy of advance flight testing developmental engines before delivery to the aircraft manufacturers. A new multi-million dollar ram-jet facility is under construction at Evendale, Ohio, to test the J93 and future high-Mach turbojet powerplants. Two new aerodynamic research facilities also were activated here.

Intensive research in the division's Jet Engine Department and Flight Propulsion Laboratory Department produced a new high-temperature alloy, Rene 41, during 1958. This nickel-base alloy, because of its high 1800 degree F. temperature capability, will make possible higher jet engine and airframe Mach numbers at lower specific weights. "Low-cost production of high temperature alloys has extreme significance," Mr. Montgomery said.

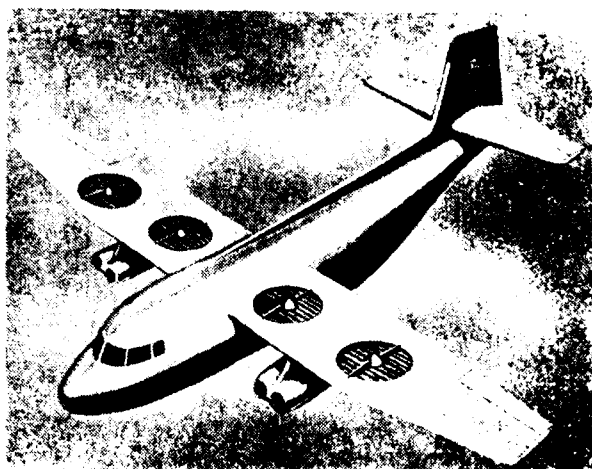
The performance record of the General Electric X-405 rocket engine, first stage engine for the Vanguard rocket, was cited as "outstanding in the rocketry field," and he noted that the Flight Propulsion Laboratory Department had made advancements in establishing the application of high energy fuels both for afterburners and combustors.

The division was responsible for the largest purchase of real property in General Electric's history. It acquired 135 acres and 14 buildings—three million square feet of floor space—formerly owned by the Auto-Lite Company at Evendale.

GENERAL ELECTRIC ANNOUNCES CONVERTIBLE AIRCRAFT ENGINE DESIGNED FOR VERTICAL TAKE OFF AND LANDING

A new engine design which could speed the development of vertical take off and landing aircraft (VTOL) was described to the Institute of Aeronautical Sciences recently by Morris Zipkin of the General Electric Company.

Mr. Zipkin, described the new system as a "convertible VTOL powerplant." It has two basic



Powerful lift fans mounted in the wings of this transport aircraft would enable it to take off and land vertically. This vertical take off and landing (VTOL) transport could carry a 4000-lb. payload for 600 nautical miles at speeds up to 320 knots. The lift fans are powered by hot gas generated by four turbojet engines. In level flight the lift fans could be "closed off" and the system would operate as a straight turbojet. The aerodynamically "clean" installation of General Electric's convertible VTOL system would permit high flight speeds.

components—a conventional turbojet engine and a turbine-powered lift fan. "The system could use existing turbojet engines," Mr. Zipkin explained, "which would reduce development time and cost."

During vertical flight, hot gas from the turbojet would be ducted to a turbine which would drive the lift fan. For level flight, the system would be "converted" to operate as a straight turbojet. Valves located in the duct and in the engine's tailpipe would control the flow of hot gas.

"One of the problems in designing VTOL engines," explained Mr. Zipkin, "is that vertical flight takes more than twice as much thrust as that needed to obtain maximum speed in level flight. Conventional engines sized to develop enough thrust for vertical take off are much too large and powerful for economical operation at cruise. They must be throttled back during level flight. This means poor fuel economy and excess weight, and results in smaller payloads and shorter range."

Mr. Zipkin said the convertible VTOL powerplant was designed to obtain good operating characteristics from the turbojet engine at cruise. To augment the thrust for vertical take off, G-E's VTOL system would take advantage of the lift fan's ability to increase the thrust of the basic turbojet engine.

Another feature of the convertible system is that the turbojet engine and the fan facilitate an aerodynamically "clean" installation that would reduce drag and permit high flight speed in VTOL aircraft.

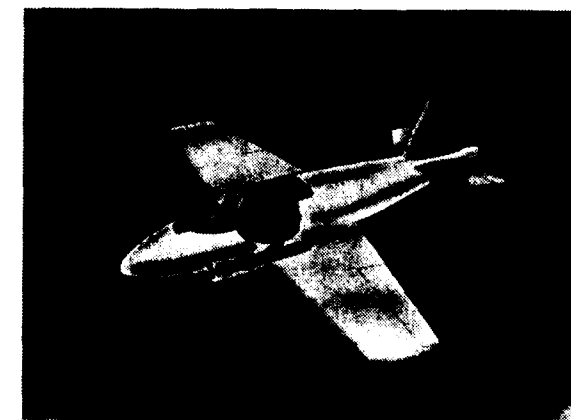
Among the potential uses for these new engines

NEW NYLON SEALING WASHERS

A range of new nylon sealing washers was shown by Dowty Seals Ltd., at the Engineering, Marine, Welding and Nuclear Energy Exhibition held recently at Olympia, London. Known as "Selons", they are captive and self-centralising and are an economic replacement for copper, copper asbestos and fibre washers. The "Selon" is particularly suitable as a sump-sealing washer and for use with gearbox and rear-axle drain plugs. Its benefits will be readily recognized by the motor industry.

Another new Dowty product is the "Topat", a protective cap used in conjunction with the Dowty "Spat" roof fixing and sealing washer, millions of

would be transport and observation aircraft. A VTOL transport powered with four of these units could carry a 4,000 lb. payload for 600 nautical miles at speeds up to 320 knots.



Convertible vertical take off and landing (VTOL) powerplants, shown in a potential installation, would enable aircraft to take off and land vertically. The system visualized here shows two major components—a conventional turbojet engine and a lift fan. The lift fan would operate during vertical flight only, taking its power from the turbojet. For level flight, the General Electric—designed system would be "converted" to operate as a straight turbojet. Valves in the ducting and in the engine's tailpipe would control the flow of hot gas from the turbojet.

A VTOL observation aircraft, using a different engine arrangement, could carry a two-man crew and a 600 pound payload of electronic observation equipment over a radius of 200 miles. In addition, it could hover or loiter over a given location for two hours to carry out observation activities.

which are now in use.

This is the first time that Dowty Seals has had a stand at this Exhibition. Special items included all-metal seals, flange seals, and a variety of precision mouldings in natural, synthetic and silicone rubbers, and P. T. F. E. components. Examples of the wide application of these products in general and nuclear engineering were featured.

Also included in this display of engineering sealing components were "O" rings, "U" rings, Bonded Seals, "Selocs" and "Struds", all of which are available in the usual range of commercial sizes.

Diesel Locomotive Final Drive Reversing Gears

By V. Lehel

Chief Engineer, Alfred Wiseman & Co. Ltd., U. K.

ALTHOUGH not much in evidence, the final drive reversing gears of diesel mechanical and diesel hydraulic locomotives are one of the most vital parts in the transmission of power from the engine to the driving wheels. Considering that they have to reduce the output speed of the hydraulic converter or mechanical gear box by a ratio of 5:1 to 15:1, and the input torque itself which they receive is 4 to 6 times the engine torque at the lower speeds of the locomotive, they have to be appreciably more robust than a change speed gear box or a converter.

The type of final drive to be used to best advantage depends to a large extent on the design of the locomotive. If the locomotive is of the bogie type, an individual bevel gear final drive on each axle is the more suitable solution. Two of these are connected to a combined reversing-distribution gear by means of cardan shafts; in the case of four driven axles further distribution gear boxes may be necessary, and an example of such arrangement is shown diagrammatically in fig. 1.

A complete final drive system of such type consists, in the case of 4 driven axles, and including the reversing gear portion of the converter, altogether of at least 5 individual gear boxes and 4 cardan shafts.

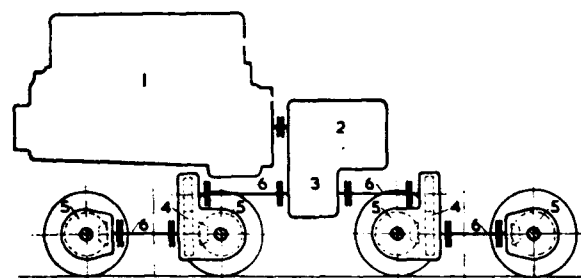


Fig. 1. Axle drives of bogie type locomotive.

1. Engine.
2. Change-speed gear box or converter.
3. Reversing gear.
4. Distribution gear
5. Bevel gear final drive.
6. Cardan shafts.

This complication is compensated to some extent by the fact that each of the final drives has to transmit only the amount of power sufficient for the drive of a single axle and 2 of the 3 distribution drives have to transmit power for the drive of 2

axles only. Even so, this system of axle drive is rather expensive and is naturally also more costly in maintenance. Its use is, therefore, generally restricted to bogie-type locomotives in which its higher first cost and maintenance expenses can be measured up by the advantages of the bogie-type running gear.

A cheaper, simpler and very widely used system of final drives is the single unit reversing reduction gear, which drives the traction wheels through a jack shaft and side-rods, similar to those employed in steam locomotives. This type of drive enjoys great popularity in the field of industrial and shunting locomotives and is also well represented in main line passenger and freight locomotives. A typical layout of a gear box of this type is shown in fig. 2.

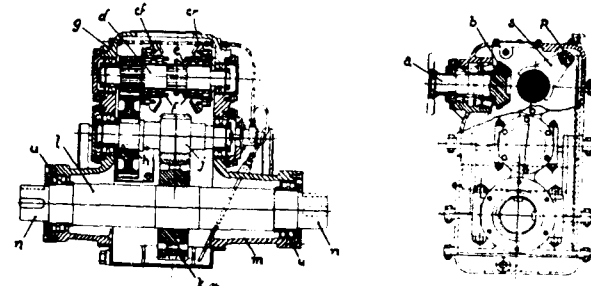


Fig. 2. Reversing reduction jack shaft drive.

The input shaft (a) carries the bevel pinion (b), which is in constant engagement with the bevel wheels of (cf) or (cr). These are mounted loose on the bevel wheel shaft (d) and rotate in opposite directions. The gear tooth clutch (e) can engage with the clutch teeth (f) of either of the two bevel wheels and in this way, it imparts a rotation in the forward or reverse direction to the bevel wheel shaft and the spur pinion (g). This pinion engages with the spur wheel (h), which is on the same shaft with the final spur pinion (j) driving the final spur wheel (k) fitted on the jack shaft (l). This jack shaft is supported in the casing (m) in bearings (u) and has two projecting shaft ends (n) for the crank webs. The gear tooth clutch can be moved on the splines of the shaft (d) by the well known type of yoke (s) by means of a shifter rod (p) which latter has an air cylinder at both ends, by means of which it can be operated from the driver's position through a control valve. An emergency

manual operation is also provided, by means of which the direction can be reversed if the air supply should fail. The manual operation can also be used to get the clutch into neutral position if the locomotive has to be towed.

To keep the gear tooth clutch safely in neutral during the towing, a special neutral lock can be provided.

Naturally the gears of such drives are all made of high quality alloy steels with ground teeth, with ball and roller bearings all over. Lubrication is sometimes only of the splash type, but by using a lubricating pump the oil supply begins more readily after starting. The type of pump most advantageous for this purpose is the reversing type positive displacement (plunger) pump, which works in both directions of rotation and picks up very readily at starting.

The casing (m) has cheeks (r) by means of which the final drive can be bolted to the locomotive frame

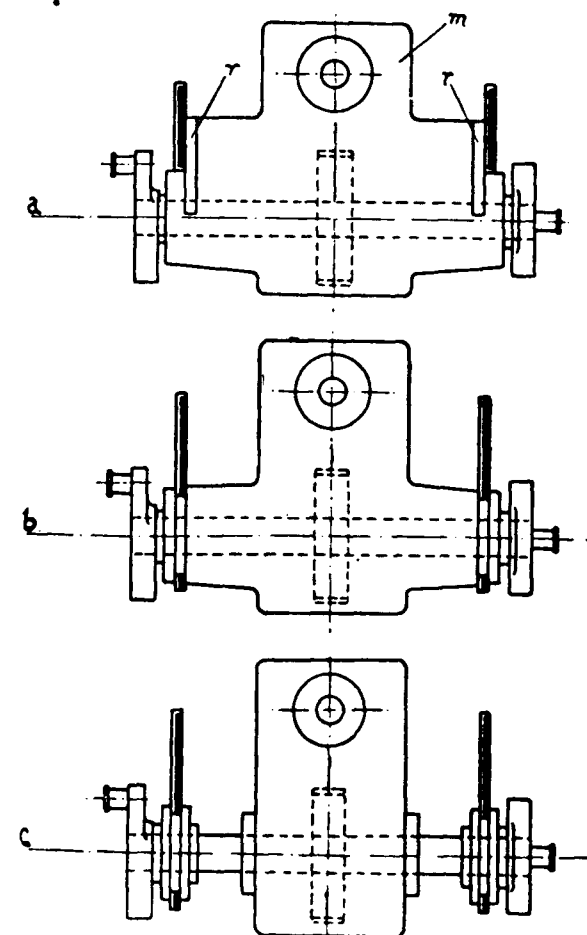


Fig. 3. Types of mounting of jack shaft drives.

plates and the rigidly built casing forms a stiffening cross beam of the underframe (fig. 3a). A good support in the frame must be provided for the housing of the jack shaft bearings since this is the point where the crank reactions are transmitted to the locomotive underframe.

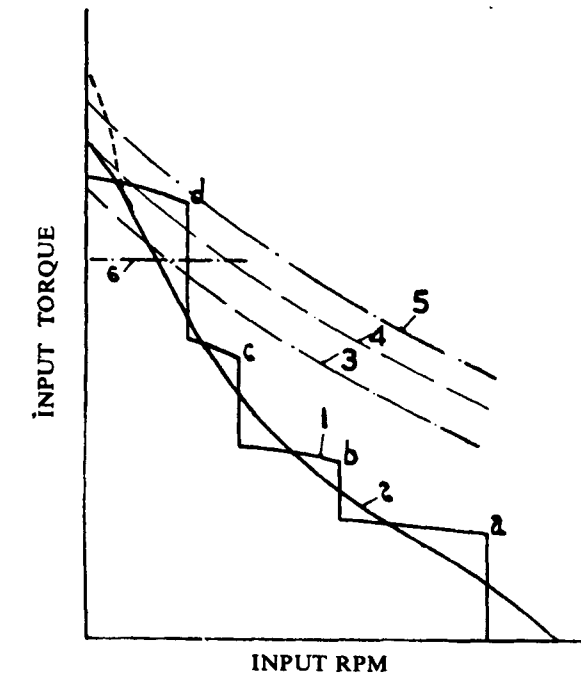


Fig. 4. Torque diagram.

The most highly stressed part of the jack shaft is at the neck of the crank journals and to avoid stress concentrations here, the corners of the keyways should be well filleted. Although the final gear (k) is in the middle of a fairly long span between the bearings (u), sufficient rigidity of the jack shaft is generally assured by the diameter which is sufficient to sustain the forces acting on the crank journals. On broad gauge locomotives generally and in standard or narrow gauge locomotives which have the frame plates outside the wheels, sometimes the middle part of the jack shaft must be given an increased diameter to keep shaft deflection within permissible limits.

It is also quite usual to support the reversing gear unit in the frame plates at the jack shaft bearing housings only and not to bolt the casing to the plates (fig. 3b). In this case the final drive must be held against rotation by a torque suspension member, and it becomes in fact three-point suspended. With such mounting the final drive casing does not contribute to the rigidity of the locomotive frame, but against this deformations of the locomotive frame are not

transmitted to the gear casing, and the gear casing can be of a lighter design.

Another form of accepted practice is to carry the final drive casing on the jack shaft, and have separate bearings supporting the jack shaft directly on the frame (fig. 3c). This arrangement gives also a 3-point suspension to the gear casing, 2 points being the bearings by which the gear box rests on the jack shaft and the torque suspension the third. In consequence the casing remains here also unaffected by frame deformations and therefore this method is particularly suitable for locomotives of a comparatively light design. It is true, that the weight of the complete reversing final drive unit rests on the jack shaft, but this weight is negligible as compared to the crank forces and an ordinary jack shaft is well able to carry it. In addition, with this type of arrangement no stronger jack shaft is necessary with a greater distance between the frames and in many cases even a lighter jack shaft is sufficient than with the other two types.

The selection of the suitable size of reversing-reduction final drive may be done as follows. A chart of the torque loads is prepared, plotting the input or output (jack shaft) torques against the input or output rpm. Since a tractive effort diagram is usually available, it is practicable to convert this into a torque load diagram by suitably modifying the abscissa and ordinate scales. It is obvious, that the new scales will differ only by constant factors and the same curves can be used without distortion.

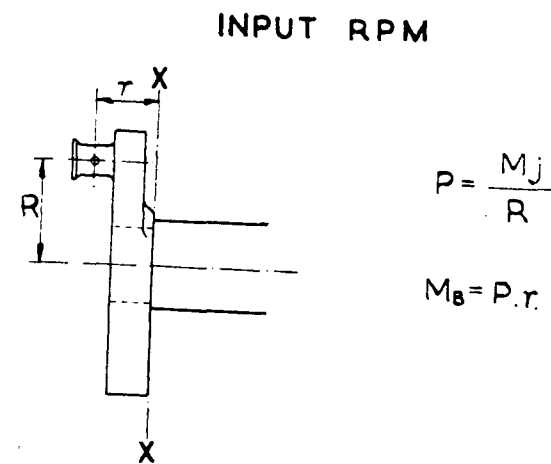


Fig. 5. Loads acting on the jack shaft.

M_j = jack shaft torque.
 M_b = bending moment.
 P = crank force.

On this diagram the torque capacity curves of the available types of reversing-reduction final drives are superimposed. Since the torque capacity varies with the reduction ratio, the curves belonging to the specified gear ratio must be selected. Naturally these must be shown in the same scale as the load-diagram and must refer to the same torques and speeds (i.e. input or output).

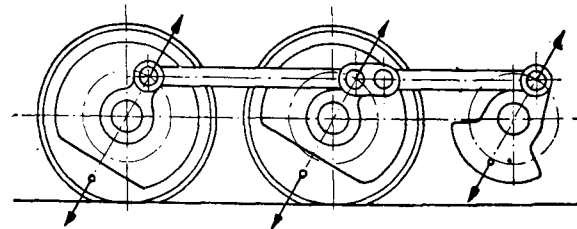


Fig. 6. Centrifugal forces in the driving gear.

Obviously, the curves of the output torque of the speed-converting transmission, plotted against its output speed (which are the input torque and input speed of the final drive) can be used directly. These are, in fact, identical with the tractive effort curves, drawn up on a different scale.

Fig. 4. represents a diagram of the input torques, plotted against input speeds. Curve 1 represents the input torque given by a typical 4-speed mechanical gear box, curve 2 that of a modern type of hydraulic torque converter. Curves 3, 4, and 5 represent the input torque capacities of final drives of different sizes having the required gear ratio. As may be seen, the torque capacity curves of the gear boxes are much flatter, than the torque load curves, and evidently the critical range of the loads will be at the low speeds.

The diagram shows, that the capacity of the gear box represented by curve 3 is inadequate for either of the two types of transmission. Curve 4 is just sufficient for the hydraulic converter, but falls short at the top of the first speed torque of the mechanical gear box, while curve 5 satisfies both transmissions comfortably. In this case, therefore, the choice would be the gear box of curve 5 for the mechanical gear box and that of curve 4 for the hydraulic converter. It may happen, however, just as easily, that the hydraulic transmission requires the larger size gear box, if its torque curve runs as shown by dotted line, and it may be safely said, that it comes very seldom to such knife-edge decisions and in the overwhelming majority of cases the nearest available size of final drive covers either type of transmission with a margin as much as 20-30%.

The torque characteristic of a hydraulic converter is always supplied by the makers whereas the locomotive engineer often has to construct the output torque curve of the mechanical gear box himself. The corner-points a, b, c, d, are obtained by dividing the input speed by the gear ratio in the respective gear and by multiplying the input torque by the same gear ratio. It should be remembered, that in case there is a fluid coupling between the engine and the gear box, the input speed of the gear box will be the engine speed less the slip of the coupling, whereas the input torque is the same as the engine torque, without any loss.

It should be mentioned that the torque capacity curves of the final drive gear boxes already take account of the fact that the locomotive works in the lowest gears only a comparatively short time and a great deal of work is done at partial loads.

Another factor which may be taken into consideration, is the adhesion of the wheels on the rails. If the tractive effort exceeds the adhesion, the wheels begin to slip. The limit where this occurs is shown by the line 6 in fig. 4.

The adhesion limit is determined by the weight carried by the driving wheels, multiplied by the coefficient of adhesion. This latter may be assumed within fairly wide limits, in practice generally between 1/6 and 1/3. For safe starting we generally calculate with the lower figure 1/6, while for the purpose of checking the maximum load on transmission parts, 1/3 is taken into consideration. Theoretically the load on the final drive gear could not exceed the adhesion limit, although there is a possibility, that the driver forgets to release his brake and may try to start with the brakes full on. In this case the full input torques shown by curves 1 and 2 may be applied

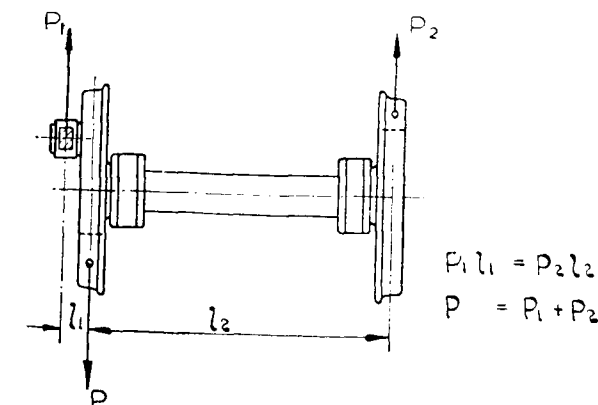


Fig. 7. Balancing of the centrifugal forces on the two sides of the locomotive.

and certainly the gear box must not break even under such exceptional load. Nevertheless, somewhat higher stresses may be permissible in such exceptional cases, which are not likely to occur very frequently

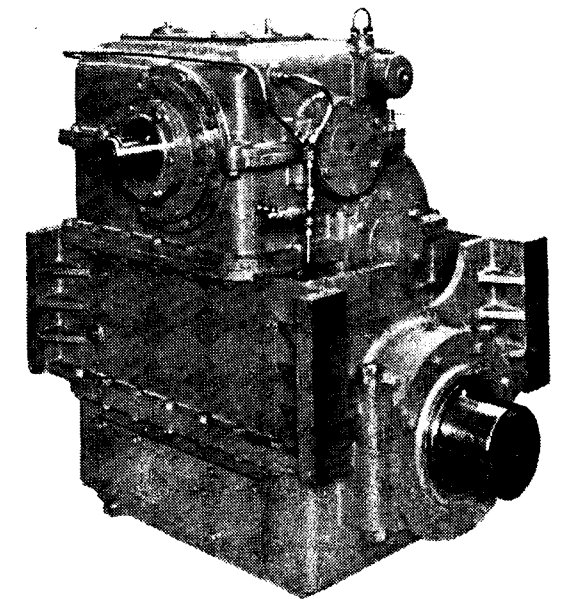


Fig. 8. 600 h.p. locomotive reversing gear and jack shaft drive (Alfred Wiseman & Co. Ltd., Birmingham)

and whereas no firm limit could be laid down, 5 per cent, may be considered a safe figure for the maximum excess load above adhesion.

In cases where the hydraulic converter is also designed to work as a brake and there is a possibility of using it for sustained braking on long declines, this type of loading must also be taken into consideration. The critical load in this case will probably be in the higher speed range and the power put through the gear box may even be in excess of the engine power. In any case, it is advisable to make special mention of this point when ordering the final drive gear, because with the reversed direction of rotation the spiral bevel gears carry the load on the opposite side of their teeth and give a greater thrust on some of the bearings in the "back drive", than in the positive drive, which must be checked.

One other point, to be checked, is the shaft end of the jack shaft. The most stressed part is at the neck of the crank journal, in the section X-X fig. 5, where besides the full jack shaft torque the bending moment from the crank force also acts. The crank force should be calculated from the maximum jack shaft torque, assuming, that all the torque is transmitted at one side, there being no guide to

what extent the other side may participate. There are certainly positions—around the dead centre of one crank when almost all load is carried by the other side.

The necessary gear ratio is defined by the specification of the traction characteristics of the locomotive, so that the maximum service speed of the locomotive should be achieved at the maximum service speed of the engine, in top gear, in the case of a mechanical change speed gear box, and in the case of a hydraulic transmission from the condition, that there should be a certain specified tractive effort available at the maximum specified service speed, which can be read off the torque diagram of the converter.

When defining specified speeds, or tractive effort, the wear of the tires of the driving wheels should be taken into consideration. The maximum allowable tire wear is given in most cases by the rules of the railways for the use of which the locomotive is intended and it is usual to relate speeds and tractive efforts to wheel diameters which have been reduced by one half the maximum permissible wear.

The efficiency of a double-reduction final drive, in which the drive passes through one pair of bevels and one pair of spur gears, may be assumed as about 96-97%, while a double-reduction final drive may have approximately 95-96%, at full load, although these figures can not be regarded as exact values and they depend to a large extent on load and speed.

It is possible to make the reversing gear unit with two different overall ratios, by providing two pairs of spur gears between the bevel wheel shaft and the final pinion shaft, of which the one or other may be engaged. This engagement may also be done by air pressure or manually. By having two different gear ratios, the locomotive has two different top speeds and in this way combines the characteristics of a passenger—and of a freight locomotive. The gear change from high to low or vice versa is done by gear tooth clutches and must therefore happen with the locomotive at rest, but this is perfectly in accordance with the requirements of railway service as it can be decided by the composition of the train before leaving station which character of a locomotive is better suited for the particular traction job.

Since reversing is also done by gear tooth clutches, it is obvious that the locomotive must stop before reversing, which is compatible with commonsense and the general requirements. In exceptional cases,

where very quick and frequent reversing is required, friction clutches may be used instead of gear tooth clutches. The first cost of the gear box with friction clutch reversing will be, of course, considerably higher, the overall dimension will also be greater, and the circumstances must therefore be given a very careful consideration before deciding on the acceptance of this refinement. It may be safely said that well designed gear tooth clutches engage very readily, are reliable in service, cheap in first cost and maintenance and have therefore every justification to be used in the overwhelming majority of cases.

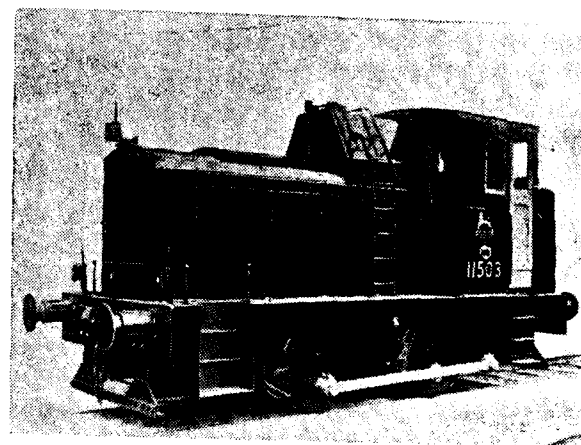


Fig 9. 153 h.p. diesel locomotive with side rod drive (A. Barclay & Co., Kilmarnock and jack shaft drive by Alfred Wiseman & Co. Ltd.) Birmingham.

A word may be said about balancing. The view is sometimes held, that side rod driven locomotives are apt to hunt in running and transmit hammerblows to the rails due to the moving masses of the side rods. This is not so. Every part of a jack shaft drive rotates in a circular path and the centrifugal forces can therefore, be perfectly compensated by counterweights in the driving wheels and on the jack shaft crank web. (fig. 6). A brief consideration will convince that accurate balancing is possible also in the other plane, at right angles to the longitudinal axis of the locomotive, by dynamical balancing i. e. by putting a secondary counterweight on the wheel on the other side (fig. 7.)

The power range of reversing reduction final drives is very wide. From about 100 to 600 h. p. exceptionally 800 h. p., they cover all practical needs, e. g. two 800 h. p. gear boxes in an articulated unit give a 1,600 h. p. locomotive which should be sufficient also for most main line duties, while even the heaviest shunting or industrial locomotives seldom reach 500—600 h. p.

Naturally the rating of a gear box depends to a large extent on the reduction ratio and input speed. The same gear box can transmit considerably higher power at a small overall reduction ratio e. g. of 7:1 or 8:1, than at a large ratio of 14:1 or 15:1. With increasing input speed the horsepower capacity increases almost in direct proportion, although this increase is largely destroyed by the effect of the larger gear ratio which becomes necessary with higher input speeds.

Firms specialising in the manufacture of locomotive final drives and reversing gears generally have a suitable range of standard sizes, covering most practical needs, and as in every field, also here the rule applies, that it is always the most economical proposition to choose a suitable size from an existing range, although for a large number of identical gear boxes for some special application it may be economical to have a gear box "made to measure".

Why Special Advertising for Engineers?

An executive of a large advertising agency recently said to me "I don't see why engineers are any different than other people in their buying habits—they are people—and I don't see why they shouldn't be influenced by the same sales appeals we use in our consumer advertising. Why should we prepare special advertising copy for them? Our product advertising is most successful, and it should work as well in a technical paper like "Product Engineer" as it does in general or business news magazines like "Time" "Business Week" etc. etc."

in his field, his abilities his reputation, the efficiency of his department. He can't afford to gamble—there's too much at stake. The consumer buys a product—usually one or a few for his own purposes—the engineer may specify for thousands or millions."

All of which reflects the importance of facts and useful information in advertising directed toward engineers. The advertising pages of an engineering magazine can be just as informative or helpful as the editorial content. And many advertisers recognize this important fact.

My reply went something like this: "Consumer advertising would work as well in a technical publication for a product the engineer bought for his personal use. He is largely influenced by the same appeals—the same personal benefits—as is the average consumer. May be he is a bit more analytical—but on the whole the engineer enjoys the same pleasures, has the same emotional reactions, sees the same shows, drives the same automobiles, smokes the same cigarettes or tobacco as other folks. If he buys a new or unknown brand for his personal use, it is strictly his business. His decision is his own and he alone has to live with it. "But when this same engineer has to decide on a type or make of product to be used in his plant or product, he buys *professionally*. He wants all the facts, not only of one brand, but of all its recognized competitors as well. He wants performance data. He wants to be sure the manufacturer or supplier has the know-how, plus the facilities to back up his claims.

The Publisher can't control the content of his advertiser's sales messages, but you must admit more and more advertising pages have in them the kind of information you need and want. We are spending a lot of money to influence advertisers to put the kind of information you need into their advertisements. We want to make every advertising page useful to you and worth your reading time because the more you know about all the materials, parts, components and product finishes the less time you spend searching out information.

We are trying to improve the usefulness of the advertising pages to you just as we are constantly working to improve editorial content and methods of presentation. Your frank expressions on either editorial or advertising are always welcome. THIS IS YOUR MAGAZINE.

The Principal asset of the engineer is his standing

Courtesy "PRODUCT ENGINEERING".

MARINE ENGINEERING SECTION

m.v. "TEWKESBURY" takes the water at Burntisland

Launch of a Cargo Liner with special features

By A Special Correspondent

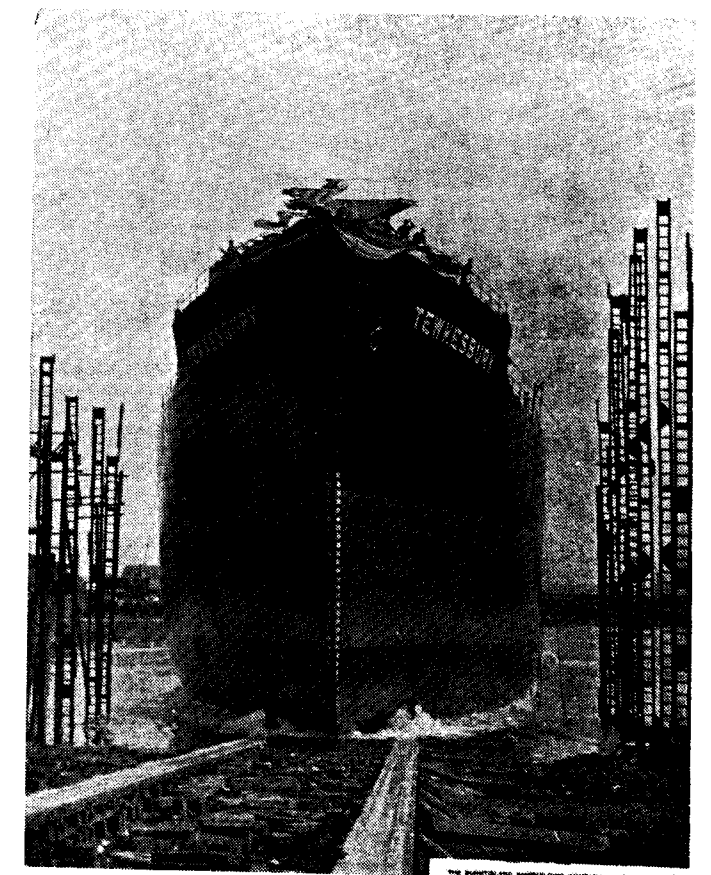
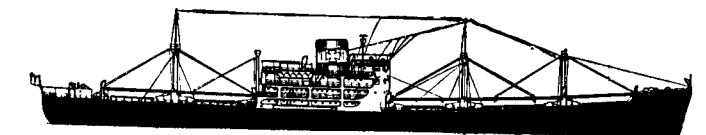
ON Wednesday, March 25th, the motor vessel "TEWKESBURY" entered the water from the Burntisland Shipyard, Burntisland, Fife. The sponsor on this occasion was Mrs. Jane Boulton, daughter of Sir Frank S. Alexander, Bt., Chairman of the Alexander Shipping Co. Ltd. The launch of this ship marks another link in the long chain of constructional activity which the Burntisland Shipyard has carried out for the Alexander Shipping Co. Ltd. over many years. It was not long ago, for example, that this shipyard delivered the motor vessel "SHAFTESBURY" to the same owners. The "SHAFTESBURY" was well described as "a cargo liner with special features", features which underline the big changes which have taken place in cargo ship design and construction in recent years. The outstanding features in the "SHAFTESBURY" will be repeated in the "TEWKESBURY", and consist of the following:

1. an electric galley on the starboard aft side of the superstructure on the bridge deck
2. two aluminium-alloy lifeboats
3. permanent plastic awnings on the bridge and boat decks
4. special fresh water generator capable of producing twelve tons of domestic water per 24 hours thereby eliminating the need for large tank storage spaces encroaching on cargo-carrying capacity.
5. ozone generating sets fitted in the galley and refrigerated handling room space as well as in the toilets, a factor making for greater hygiene and cleanliness
6. permanent lighting in the holds and cargo 'tweendecks.

There are five cargo holds and five 'tweendecks

(Continued on page M.E.2)

arranged three forward and two abaft the machinery space. In No. 1 hold there is also a large deep tank



Cargo Liner
m.v. "TEWKESBURY"

Owners: Alexander Shipping Company Limited, London.
(Managers: Houlder Brothers & Co. Ltd.)

Builders: The Burntisland Shipbuilding Company Limited,
Burntisland.

JUBILEE OF TECHNICAL SKILL

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Construction of Big Shipping Terminal at Los Angeles

CONSTRUCTION of Los Angeles Harbor's \$15,000,000 cargo-passenger terminal got under way recently when bulldozers rolled into a previously useless marsh area to build an earthen dike and clear and level the land.

The earth-moving machinery quickly established a dirt barrier between Main Channel and the terminal site which will become berths 90 through 93 in the San Pedro district of the harbor.

"Los Angeles Harbor's latest passenger-cargo facility will be ultra-modern in design", Bernard J. Caughlin, general manager of the port announced. "It will be preferentially assigned to American President Lines," he added.

Present construction will prepare the way for dredging a slip 300 feet wide by 1,200 feet long. The entire project, according to Caughlin, is scheduled for completion by late 1961.

The port official pointed out that the new APL

facilities is part of the Los Angeles Harbor Department's long-range \$101-million construction program.



Other major projects, under simultaneous construction, include the \$5,000,000 concrete wharf and shed development in the West Basin area and the nearly complete supertanker terminal at berths 45-47 in the Outer Harbor.

(Continued from page M.E.1)

for vegetable oil, water ballast or dry cargo, whilst the tunnel side tanks in No. 4 hold serve a similar purpose. For cargo handling there are eight 5-ton and six 12½-ton derricks on three masts and one pair of derrick posts. Heavy-lift derricks, one 25-ton and one 50-ton, are available for main and mizzen mast respectively when required. There are also two 2-ton derricks sited at the fore end of the main superstructure. The auxiliary load is supplied at 220 volts d. c. by three 200 kw. diesel generating sets operating at 570 r. p. m. There is also a domestic service generator of 75 kW. output for port use.

The main propelling machinery is a Hawthorn-Doxford direct coupled, direct reversing, opposed piston,

2-cycle, oil engine developing 5,500 b. h. p. at 115 r. p. m. The entire machinery installation is being carried out by the engineering department of the builders.

The "TEWKESBURY", like "SHAFTESBURY", is of about 11,900 tons deadweight. She measures 430 ft. in length between perpendiculars, has a beam moulded of 61 ft. 9 ins., a depth moulded to the upper deck of 38 ft. 3 ins. and to the second deck of 29 ft. 3 ins. The load draft is about 28 ft. 10 ins.

"TEWKESBURY" is a fine interpretation of the modern shelter deck, 'tweendeck cargo ship with machinery amidships.

Sun's Energy Flashes Experimental Light

By a Marine Engineering Correspondent

ANGEL'S Gate light house, known to seafaring men around the world as the entrance to Los Angeles Harbor, is the scene of an experiment that may lead to solar-powered warning lights, fog horns and other sound aids to navigators.

The heart of the experiment, which the Coast Guard has been operating without fanfare for the past year, is a silicon solar converter which changes heat from the sun into electrical energy, Globe Press Service reports.

Maurice Lostlen, a civilian engineer and specialist in navigational aids employed by the Coast Guard, is in charge of the project which he describes as "a small scale start with unlimited possibilities."

The converter is comprised of a bank of 320 wafer-thin cells of near-pure silicon, arranged on a flat surface 30 inches square. The cells are wired to two regular 100 ampere-hour, 6-volt wet cell storage batteries that are hooked up in series for a 12-volt output.

The batteries keep a 16-watt incandescent bulb flashing at a rate of about 2,500 blinks every night. During the experiment, the light is hooded to avoid confusing mariners.

Each dawn, the flashing bulb is automatically turned off when a sun ray relay switch cuts in the silicon cells and starts the electricity flowing into the batteries.

The Coast Guard unit of this area, on orders from Washington (D.C.) headquarters, purchased the silicon solar cell unit a year ago from Hoffman Electronics of Los Angeles for about \$5,000. A not excessive price, according to Lostlen, when the difficulties of producing the cells are considered.

First, pure silicon must be found. Today's price is \$100 a pound. Then comes a complicated process to convert the silicon into an ingot about 6 inches long and 1 inch in diameter. Next a diamond saw goes to work, cutting off slices only 16-1000th of an inch thick.



Finally, through an ingenious metal-working technique, positive and negative terminals are created on the incredibly thin wafers so that each may be hooked, in a chain-link fashion, to the storage batteries.

The silicon solar converter at Los Angeles Harbor is positioned so that the cells face the sun as it rises and moves from east to west. Curiously, the output of the cells diminishes on overcast days. But a dense fog seems to have little effect on the generation of power.

Lostlen, who heads the only experiment of its kind in the U.S., predicts that a larger unit some day will be mounted on a self-powered turntable which will keep cells facing directly at the sun as it moves across the sky, summer or winter.

"We plan to continue the experiments indefinitely, considering the possibility that one day a more efficient element than silicon will be discovered," he says.

"Today ten of these available units could flash a 160-watt bulb. So 100 units could flash a 1,600-watt light.

"The harbor light at Angel's Gate, known to mariners round the globe, requires 500 watts of electricity to flash it. And the round-the-clock attention of four Coast Guardsmen.

"If we can accomplish what we think we can," he says, "one day Coast Guard lights, horns, whistles and other navigational aids will be powered by that old celestial fireball—the sun—and no Guardsmen at all."

SPECIAL WATER PURIFICATION PLANT FOR UNDERWATER PHOTOGRAPHY

THE increasing use of underwater photography for industrial and scientific research has created a demand for water purification plant capable of maintaining large quantities of water permanently at optical clarity.

An interesting installation of this type is in operation at the Admiralty's research laboratories at Teddington, serving a water tunnel with glass panels through which water can be watched flowing past models at speeds of up to 50 knots, a glass sided tank for the study of the trajectories of bodies and a rotating beam channel containing more than a million gallons of water in which submerged bodies can be towed in a circular path at speeds up to 100 knots. The behaviour of many of the fast moving models is studied with the use of high speed photography and the water is so pure that a submerged object can be seen quite clearly 100 feet away.

The principle of operation of the filtration system is firstly by the continuous removal of the surface layer of water which is most likely to become contaminated and secondly, by the complete transfer of the entire mass of water through the filters without leaving any stagnant pockets. Twenty jets, individually valved deliver the water into a channel across which it flows passing over 40 weirs each two inches in diameter for



Pulsometer Water Treatment & Pumping Plant.

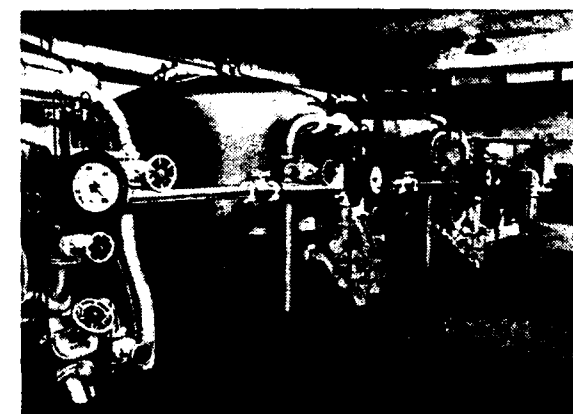
Chosen to clarify water for high speed underwater Research work.

The photograph shows frogman scientist making adjustment to a Torpedo in a million gallon water tank. The water is clear enough for photographs to be taken at one 40,000th of a second, of missile travelling at speeds up to and over 100 knots (115 m.p.h.)

eventual drainage into a large sump in the floor of the filtration plant room.

A second large sump is fed by a secondary circuit which draws water from three uniformly spaced sump points in the bottom of the channel and it is connected to the surface water pump by means of a penstock valve. The water is pumped from these sumps by three Pulsometer centrifugal pumps each with a capacity of 700 gallons per minute, which are so arranged that they work in perfect harmony with the filters irrespective of the rate of filtration of these.

The filtering unit consists of three Pulsometer eight-foot diameter pressure sand filters which have a maximum filtration rate of 250 gallons per hour per square foot. The internal surfaces of the welded steel plate shells are coated with special corrosion resisting material and the filter medium is supported upon steel grid plates. Fitted to these are alloy die cast adjustable nozzles designed to allow the passage of water only when filtering and the passage of air and water when washing in such proportions that the whole filtering area receives equal and adequate attention. There are no moving parts in the filter to rust or fracture.



Pulsometer Water Treatment & Pumping Plant.

Chosen to clarify water for high speed underwater Research work.

The photograph shows the three 8' 0" diameter Pulsometer A.S. type Vertical Pressure Filters (of this Water Purification Plant) treating one million gallons of water per day, when fed by three H.S.L. Pulsometer horizontal split-casing Centrifugal pumps.

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The necessary floc on the surface of the sand is formed by dosing with special chemicals, some of which are also used to maintain the pH value at approximately 7.4. A standard automatic vacuum chlorinating unit serves to prevent organic growth.

The equipment has sufficient pumping capacity to allow double the filtration flow, which gives it flexibility and an adequate margin. If desired a portion of the flow can be made to by-pass the filters thus increasing the general water movement without

raising the duty of the filters.

The filter vessels are washed by reversing the flow in the customary manner and the sand bed is gently agitated with compressed air. The contents of the water tunnel can be filtered independently by means of a separate flow and return main.

Full details may be obtained from the manufacturers The Pulsometer Engineering Company Ltd., Nine Elms Iron Works, Reading, England.

NEW LENS HELPS THE NEAR-BLIND TO SEE

With the aid of a new and unique kind of eyeglass, which has lenses similar to the ones used in light-houses, many thousands of partially blind persons may be able to see again. The lens has already been used successfully by 281 patients.

Dr. William Feinbloom of the Optometric Centre in New York City described the new lens recently to a meeting of optometrists, saying that it has a magnification range of from 300 to 2,000 percent. The lens is made of clear transparent plastic. Its upper sector is a multiple lens system of eight

optical surfaces that produce 300 percent magnification. The lower sector is a multiple lens system that produces up to 2,000 percent magnification for reading. The centre section provides a 120 degrees angle of vision for middle distance sight for use while walking or similar activity where intense magnification is not required.

By using the new glasses many persons with partial blindness associated with diabetes, cataracts and high myopia have been able to resume many of their normal activities.

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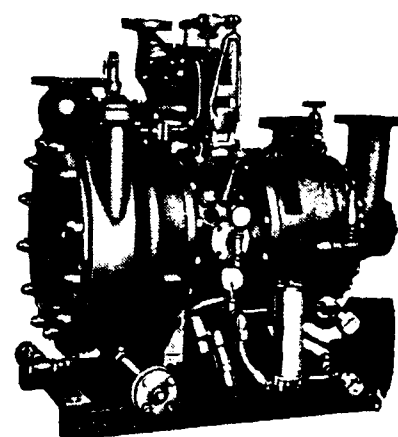


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Mining Industries Annual Supplement

COAL MINES MECHANISATION

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

WITHIN her womb the Good Earth holds coal, a marvellous gift to mankind, produced through aeons of time by the unbelievable alchemy of Nature. It has risen from the earth to make iron his slave and become the life blood of the Nation.

Like the human heart which pumps 246,175,000 quarts of blood in a lifetime, coal sustains India's industries by feeding the railways, generating electricity, producing gas and steam, meeting the growing community needs and exporting to many countries of the world.

Coal industry can well be regarded as the barometer of industrial progress. The production of steel is often taken, and for very good reasons, as the yardstick of a country's industrial stature. So the emphasis on expanding steel production in India's First and Second Five year Plans needs no justification. But the fact that every ton of steel produced still requires, under present day practice, some two tons of coal emphasizes the vital and basic importance of coal production as well.

The dependence of our industrial economy on coal in India can be partially judged by the fact that about 75 per cent of the country's total annual expenditure on fuel items is incurred on coal and coke only. With the industrial expansion envisaged in the Second Five Year Plan, coal will play an even more important role. It has been assessed that its production will have to be increased to about 60 million tons by 1960.

In the periphery of the above consideration, the need for the mechanisation of coal mines cannot be too strongly stressed.

METHODS OF MINING COAL

There are two main methods of working for the underground mining of coal, viz.: Room and Pillar, and Longwall. In the Room and Pillar method, square or rectangular pillars with roads about 15 ft.

wide all round it, are formed. The pillars may afterwards be extracted completely or partially as conditions permit or they may be left intact to provide support for the surface and/or the workings.

The Longwall on the other hand is a wall of coal generally about 100 to 150 yards long (for single units) lying along Dip and rise and advancing strikewise. The whole of the coal is extracted over this wall or face. In this case only two roads exist one at each end of the face. In the common application of this method, viz., Longwall Advancing, as the coal face advances the roadways for haulage, ventilation and other services are formed and maintained behind it in the adjacent strata.

There are numerous modifications and combinations of these methods. For example Longwall Retreating, which is a combination of the two methods, narrow roadways or headings are driven to form large pillars. These pillars are then extracted by bringing back a longwall face towards the origin of the headings.

The long wall is cut by coal cutting machine, holes drilled by electric drills and coal blasted down. Shovelling of coal is then done to a conveyor lying parallel to the face and only a few feet away from the coal face. Coal is conveyed down into tubs at the bottom level or to trunk conveyor brought nearer the pit and loaded into tubs there. With the advancement of the face to 15/18 ft. the space except about 5 ft. from the face is barricaded and filled with sand conveyed hydraulically by pipes from surface, thus filling up the void.

Elaborate sand getting machinery like sand pumps, drag scrapper, etc., is employed for the procurement of sand from river bed. Stowing ensures support of roof and facilitates in controlling roof weight and allows better ventilation with less danger of fire-dump which those seams give up profusely. In a few cases, coal loading into the conveyor is done by coal face mechanical loader. The advantage of the method lies in concentration of working face involving less use

of machine and man power with resultant higher output per manshift.

Room and Pillar, the older of the two methods, was evolved when thick and moderately thick seams were available at shallow depths. In such conditions, the roadways are supported by the pillars without undue crushing; the amount of ripping required to be done in stone to make and maintain roadways of adequate dimensions may be small and the production of unproductive labour is reduced to a minimum. Further the Room and Pillar method presents conditions which are favourable for full mechanisation.

APPLICATION OF MACHINERY

The application of machinery to the operations of breaking down, loading and transporting coal at the working face has engaged the attention of engineers for nearly two centuries, but it is only since the First World War that any sufficient advance has been made.

Mining in India is mostly restricted to shallow depths except in a few cases. Coal seams which are generally thick but of lower grade compared to those in U. K. and the continent, are opened up by quarries, drift or inclines, adit level or pits as found suitable.

In the 19th Century and towards the beginning of the 20th Century, Steam was used as the motive power to drive only a limited machinery such as winder and pumps. Ventilation was mostly natural, aided by exhaust of steam pumps and haulages, sometimes a steam jet and a few steam driven fans. Underground development was not possible as steam power could not be piped far inside with efficiency to pump water. As a result several openings were required to develop a small area.

In shallow small mines, steam-driven geared winding engine of incline haulages drew coal up to the surface in tube. Coal was hand cut and loaded manually into the tubes. Except a steam haulage and a steam pump or two, no other machinery existed.

Upto the First World War in the 20th Century, a few small Generating Stations came into existence and electricity was used for pumping only. Since about 1920 remarkable progress was made in mechanisation which has been chiefly in the application of electric winders and haulages and coal cutting Machines.

The Tata Iron and Steel Co. Ltd. and Kilburn &

Co. are the pioneers in introducing mechanisation in coal mines in India. In 1920, the coal cutting machines were first introduced in Jamadoba Colliery of the Tata Iron & Steel Co. Ltd. Shot holes were drilled by electric drills and coal was blasted down with the aid of explosives.

The employment of coal cutters and conveyors is regarded as normal mechanisation and the steady but substantial increase in their use has been made possible by the evolution in design of the machines themselves in methods of roof control, the development of conveyor transport on roadways and technical advances in other branches such as power transmission and coal preparation. More intensive mechanisation however includes the employment of power loading and mechanised room and pillar mining on the lines developed in the United States.

DIFFERENT EQUIPMENTS IN USE

In coal mines mechanisation, the pride of place goes to the evolution in design of the coal-cutter. Various types for application in a wide variety of seam conditions and to both the Room and Pillar and the Longwall methods of mining have been developed. They include machines as low as twelve inches in height for use in thin seams; machines for cutting at different horizons in the seam between the floor and the roof; machines which can make both horizontal and vertical cuts for use in narrow workings in addition to special types such as those which make two parallel cuts simultaneously for cutting out thick dirt bands.

With the old system, the undercutting of the seam, so that it could be blown down, was the hardest and most disagreeable work which the miner had to do. This meant lying on his side, to use his pick, and



The early miner, picking his stint of COAL would marvel at today's mass production brought about by mechanisation of coal mines.

continually inhale coal dust. Besides the work being hard, the system was not economical as a great deal of coal was wasted.

The present system is to place the machine at one end of the coal seam. With the switching on the current, the cutter arm—a revolving chain—fitted with readily changeable pick points, swings round and cuts its way into the seam, requiring no bed but travelling along on its own “shoes”. The only attention required is to shovel away coal which may fall on the revolving chain and tend to clog the wheel.

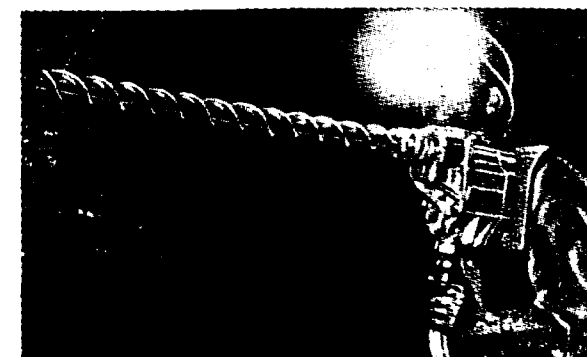
After the coal is undercut, holes are drilled in the face of the seam by electric drills when the coal is blown down ready for the miner to pick it up in small lumps and load it into trucks.

The advantages of coal cutter mining are :—

- Improvement of mining efficiency and concentration of working field.
- Economy in the consumption of explosives, and increase in the production of lump coal.
- Decrease in accidents and simplification of coal mining work.

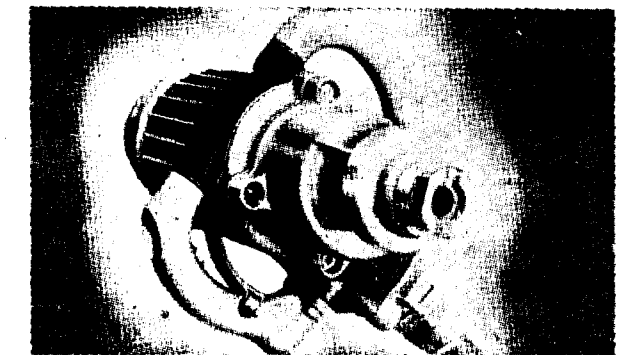
Selection of the particular type of coal cutter required, depends upon the following factors. (i) quality of coal, (ii) dip, (iii) thickness of coal seam, (iv) existence and locality of parting, and (v) quality of hanging wall and floor.

In general, if the coal cutter is used according to a proper mining method and with appropriate management, practically all of the requirements governing the rationalisation of coal mining will be accomplished.



Pneumatic Coal Drill.

Mining coal with pneumatic picks is especially well adapted for use in mines where the structure of coal is well developed. This method yields a higher percentage of lump coal output and is a great help in promoting efficiency.



Electric Coal Drill.

Electric coal drills have come into increasing use with the mechanisation of coal mines. The drill is used to bore holes in the coal wall to charge explosives, using a screw drill known as the auger.



Coal released from its primordial prison by drilling and then applying explosives.

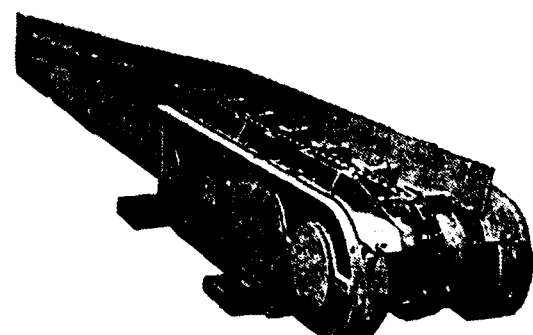
With the mechanisation of the coal mining processes, the advance in extending the coal face has become more rapid and regular. In order to make the disposal of coal output from the coal face surer and easier, therefore, the heading must always proceed ahead of the coal face. In this sphere, the heading machine comes into play in mechanising the process of driving heading work and facilitates the work accomplished by explosives, operating with the same effect as a coal cutter working on a coal face. This machine may also be employed for purposes other than driving heading work; when applied to the face cutting in shortwall coal mining, it may show better results than coal cutters.

POWER CONVEYANCE SYSTEM

The fundamentals of mechanised coal mining are the operation of coal cutters for mining and the

utilisation of a power conveyance system at the coal face.

The application of mechanical conveyors was first introduced at the face in the Longwall system to increase the length of face between roadways and thus reduce the amount of unproductive work required in their making and maintenance; to concentrate producing operations into smaller areas of workings and to reduce the manual labour involved in loading.



Scraper Chain Conveyor.

The chain type of conveyor was among the first to be introduced, followed by the shaker and later the rubber belt conveyor. These are still the principal types used.

All coalface machinery is powered either by electricity or compressed air. In pits where electricity cannot be safely utilised because of the presence of explosive gas, compressed air has to be used. As a power source, compressed air is inferior to electricity as the efficiency of the air compressor which is driven by electricity, is not very high to begin with, and there are large losses from leakage and resistance in the course of transmission over the long distance between the location of the air compressor and the place where compressed air is used. Because of this fact the trend is towards the increased use of electricity although compressed air will have to be retained where necessary for reasons of safety.

MACHINES FOR LOADING

The development of mechanical cutting and conveying and concurrent improvement in machines and techniques for blasting or otherwise breaking down the coal to loadable sizes, naturally focussed attention on the application of machines for loading.

There are several types of loaders. Face loaders,

for example, which are rope-drawn and can therefore be used for working coal faces on steep gradients, are used in the Longwall mining method. The Gate end loader can be used for loading coal from the chain coal-face conveyor to the coal tub, but its main use is for hand coal-face loading. In other words, instead of hand-shovelling, this machine scrapes up the coal into the tub.

Interest in loading machines has been diverted by the comparatively recent development of machines which both break the coal away from the solid face and load it on to conveyors or other forms of mine transport. These machines perform simultaneously the four operations represented in conventional methods by cutting, drilling, blasting and loading.

The most successful machine of this type developed is the "Cutter-Loader", which is essentially a high-powered coal-cutter fitted with three cutting jibs, in which a loader unit is coupled to the cutter unit. Horizontal cuts in the seam, one at floor level and one at some other horizon, are made by two of the jibs, while the third jib, which is attached to the loader unit, makes a shear cut at the back of the horizontal cuts. Where the natural cleavage planes in the seam are favourable these multiple cuts are sufficient to break up the coal to loadable sizes. The broken coal falls on to the loading unit, consisting of a short conveyor which, in turn delivers it on to the face conveyor.

"Stripper" is another type of cutter-loaders, recently developed. This machine employs the principle of wedge for breaking down the coal instead of depending upon cutting jibs.

MINE TRANSPORT

Every step taken to increase production efficiency at the coal face must be accompanied by the establishment of an adequate system of transport for prompt clearance of the coal.

Originally the haulage of colliery tubs or trucks was done by means of pit ponies. The system was gradually replaced by cable or main and tail rope haulage. Steam locomotives and compressed air locomotives are also occasionally used. At present the use of electric and diesel locomotives is on the increase.

The diesel locomotive has the advantage of being

an independent unit requiring no external source of power, and no overhead wires and the present trend is therefore towards the increased use of the diesel locomotives in preference to others.

In India mechanisation of mines has not come up to the extent so as to be compared favourably with other foreign countries where mechanisation has been introduced extensively. This is mainly due to its

dependence on import for getting the required machinery and to the heavy capital cost involved in their installation.

In the context of the heavy demand on the supply of coal to meet the expanding need of the country, it is high time for the coal industry to keep pace with the changing systems of mining and introduce mechanisation in the mines to the maximum possible extent.

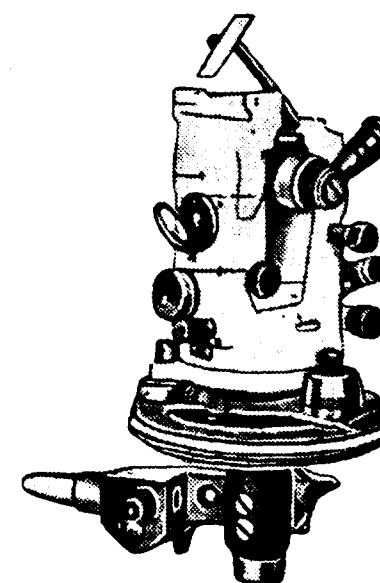
CEAT TYRES

The directors of Ceat Tyres of India Ltd., report satisfactory progress in the construction of the factory and expect the company to go into production by the beginning of 1960. The company intends to manufacture tyres and tubes of the same quality and standard as the well-known Ceat tyres. A licence of the value of Rs. 10 lakhs for giant tyres was obtained to test them on Indian roads. The market has reacted favourably to the performance of these tyres. In order to complete the appraisal, the company has applied for a further licence.

The company's issue of 1.15 lakh ordinary shares of Rs. 100 each was fully subscribed. Out of this, 68,850 ordinary shares were subscribed by CEAT S. p. A. of Turin, Italy, to finance the cost of capital goods to be imported. The site for the proposed factory initially suggested by the Government at Kalyan was subsequently selected, with Government's approval in Bhandup. The land was obtained under the Land Acquisition Act through the Government of Bombay and possession entered into in December 1958.



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COKE FOR CUPOLA USE

By *N. N. Das Gupta and A. Ghosal*

Central Fuel Research Institute,
Jealgora, Dhanbad, Bihar

ABSTRACT

THE paper gives a comprehensive review of the position of the Foundry, chemical and other industries (excluding Steel Plants) of the country as regards the requirement and availability of hard coke, both in respect of quantity and quality, in near future. At present idle capacities of the existing foundries cannot be exploited due to non-availability of coke of proper quality. By the end of the Second Five Year Plan, with the availability of more pig iron, the requirement of coke will increase many times, but if forward planning is not done right now for meeting the requirement, industrial progress of the country will receive a severe set back. The cokes as are now available for cupola use are of inconsistent quality and leave much room for improvement.

INTRODUCTION

Coke holds a key position in the industrial development of a country. It is one of the most important raw materials for the production of iron. It is equally indispensable to various chemical industries e. g. soda ash, lime, cement, sugar textile, water and producer gas generation etc.

Hard coke as produced from high temperature carbonisation of good grades of coking coals or their blends are primarily used in blast furnaces and foundry cupolas, a smaller quantity being used for chemical and other industries. The coke may either be made in the so-called beehive or country oven (as in India) with loss of the valuable liquid and gaseous by-products or in coke ovens of various designs with complete or partial recovery of the by-products. Hard coke is an indispensable material for use in many of the industries envisaged in the Indian five year plans. It can also be utilized as a good foreign exchange earner since a sizeable export market exists in the South East Asian countries suffering from great dearth of this material.

In this paper it is proposed to discuss the position of demand and supply of hard coke for various industries

along with the quality of this material as now produced in the country in so far as its use in foundry cupolas is concerned and to suggest ways and means for improvement.

A. PRODUCTION AND REQUIREMENT OF HARD COKE

The target of production in 1960-61 for various industries is considerably higher than the production in earlier years. This would naturally mean a corresponding increase in the consumption of hard coke.

PRODUCTION OF HARD COKE

The production of by-product and beehive coke in India since 1951 is shown in Table 1.

TABLE 1.

Production of coke.

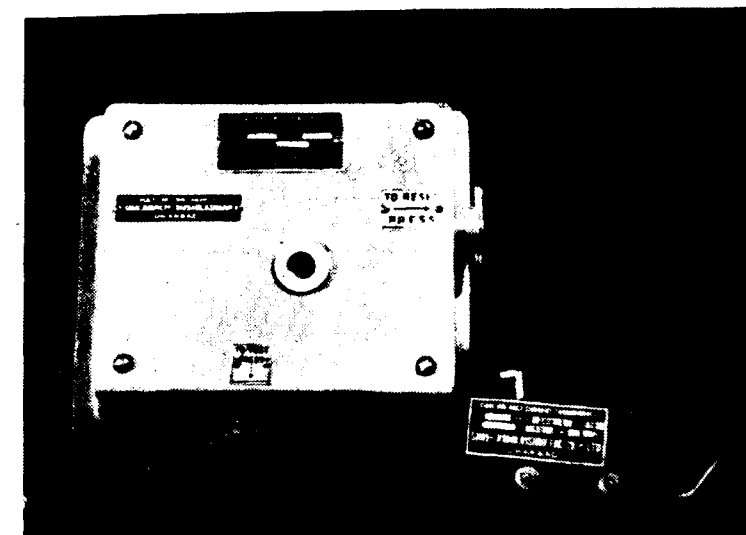
Year.	Steel Plants m. tons (2)	Merchant coke Plants (4) tons	Beehive Ovens tons
1951	1.763	280,734	106,625
1952	1.655	276,711	111,396
1953	1.608	275,102	128,510
1954	1.948	218,644	157,606
1955	1.889	249,515	257,180
1956	1.759	255,311	265,654
1957	1.759	—	—
	(estimate from average of first 6 months.)		

The steel plants produce coke mostly for their own consumption and have little to spare for consumption in other industries. The figures for production of coke in the coke-plants other than those owned by the steel companies shows a fall in production since 1951.

The three steel plants at Durgapur, Rourkela, and Bhilai in the public sector and the coke ovens set up by the West Bengal Government at Durgapur are expected to go into production during 1958-59. The

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isting steel plants in the private sector are also expected to double the production of hard coke during the Second Five Year Plan Period. It is certain, however, that no portion of the increased production from steel plants will be available to foundry cupolas.

SURVEY OF HARD COKE REQUIREMENT

In the year 1954 the Central Fuel Research Institute conducted a statistical survey of hard coke (excluding blast furnace coke) requirement in India. The salient features of this survey are given in Table 2.

TABLE 2

Size Range	Monthly Requirements size-wise.	Monthly production size-wise			Production of sized coke to demand of sized coke.	
		B. F.	B. H.	Total	$\frac{97}{100} (3) / (2)$	$\% (5) / (2)$
< 2"	7,480 (17)	2,700 (15)	2,100 (15)	4,800 (15)	36	64
2" — 4"	13,200 (30)	4,500 (25)	3,500 (25)	8,000 (25)	34	61
Above 4"	23,320 (53)	10,800 (60)	8,400 (60)	19,200 (6)	46	82
Total	44,000	18,000	14,000	32,000	41	73

Since the condition of the hard coke industry has not materially changed since 1953-54, these findings still hold good. It is apparent from the Table 2 that the present production of hard coke of above 2" covers 74% of the demand of sized coke above 2" and in the case of sized coke above 4" the production covers 82% of the demand. But in terms of by-

product coke alone the production of coke meets only 37% of the demand of 4" size coke.

Table 3 shows the future demand of hard coke by taking into consideration the factors of size and production.

TABLE 3

Year	% Production to demand (from F. R. I. Survey)	% Production of sized coke above 2" to demand (col. 2 $\times$ 0.85)	Consumers demand per month on the basis of (2)	Production (Monthly) required on the basis of (3), assumption; the demand of > 2"
1953-54	82	70	39,024	45,714
1957-58	58	49	55,172	65,306
1960-61	55	47	58,536	68,085

During 1957-58, the demand of hard coke will increase 41% over 1953-54 and by 1960-61 the demand will be more than 50% higher than that in 1953-54. If the production remains at the 1953-54 level, it will meet only 58% of the total demand in 1957-58 and only 55% of the total demand in 1960-61. If we further assess on the basis that only 85% of the production conforms to the standard laid down, the rate of production will be only 31% of the overall coke requirement and supplies of by-product coke only 17%. Thus, the total required monthly production of coke in 1960-61, to meet the demand

may be computed at approximately 68,000 per month or about 0.8 m. tons per annum. Substantially the same figure was obtained by the Indian Foundry Association, through a survey conducted independently by them.

The Planning Commission also arrived at a figure of 0.8 m. tons of coke requirement by 1960-61. They assessed that 0.7 m. tons out of this will be met from the sources of production in the country after meeting the requirements of the steel plants. The estimate was as follows :—

TABLE 4

(Production of Hard coke for Foundries, Chemical Industries, etc.—Planning Commission)

(a) 4 Merchant plants in the private sector—	269,000 ton/Yr.
(b) Giridih coke plant (without renovation)—	28,000 ton/ „
(c) Indian Iron & Steel Co. (Surplus)—	44,000 ton/ „
(d) Durgapur Coke Oven Plant (West Bengal)—	285,000 ton/ „
(e) Beehive coke—	105,000 ton/ „
Total	731,000 ton/ „

In critically examining the above estimate the following further facts have to be taken into consideration.

Merchant coke ovens: The Planning Commission's estimate presupposes increased throughput from the merchant coke plants to achieve the target. Most of the plants, however, are 25—30 years old and have outlived the period of their useful lives. The condition of some of the plants is so unsatisfactory that it is not considered worthwhile to recondition the ovens. Two of the plants have, however, carried out repairs and rebuildings to some extent. It is thus doubtful whether all the merchant plants together will even be able to maintain the current output leave alone increase their production.

Surplus coke from steel plants: The coke released for the market by the steel plants for sale will hardly conform to the rigid size requirement of foundry coke, and as such the assumed figure of 44,000 tons may well be neglected in the estimate.

Preference for by-product Coke: 90% of the consumers insist on by-product hard coke in preference to beehive coke which is at present of poor and inconsistent quality. With the general adoption of the practice of using washed coal in by-product ovens the quality of the coke available in the beehive ovens is expected to be still worse than at present because coal available to beehive ovens will be poorer in quality. In considering future availability of hard coke to meet the demand, therefore, the production from beehive may be ruled out of consideration.

AVAILABILITY OF EXTRA PIG IRON

The estimate of demand made earlier was based on

the availability of 0.7 m. tons of pig iron which, it is now known, will be increased by another 0.3 m. tons. This fact and the price equalisation of iron and steel all over the country will mean an increase in the demand which may be assumed to be of the order of 100,000 tons per year. It being also known that about 60% of the present capacity of foundries remain idle due to want of pig iron, the additional requirement of sized coke may be assessed at 150,000 tons per year.

Export of coke: India has a potential export market for hard coke in South east Asian countries. The export of hard coke rose approximately 59,000 tons in 1952-53. On a conservative estimate it can be, therefore, assumed that there exists a market for 75,000 tons of good quality hard coke per annum.

Thus the final balance sheet of requirement and availability of hard coke for foundries and other industries may be summarised as below :

TABLE 5

(Requirement by Industries other than Steel Plants and corresponding availability).

Requirement	Tons/per annum
C. F. R. I. Estimate	827,000
Availability of Extra Pig-iron (3 steel plants) and Engineering Development (2nd Five Year Plan) (Sized—150,000 Tons)	180,000
Provision for Export Trade (Sized—75,000 tons)	90,000
Total	1,097,000

Availability	Tons/per annum
Total By-product coke (Planning Commission)	626,000
Deficit	471,000
Allowance	9,000
Total Deficit	480,000

(Total deficit of sized—coke—425,000 Tons/P. A.)

To meet this total deficit of 480,000 tons of hard coke an extra amount of about 700,000 tons of coal will have to be carbonised per year. Thus the gap between the requirement of coke and its possible

production is indeed considerable and this cannot be filled by enhancing the present capacity of the existing merchant coke ovens.

The full production of the Durgapur Coke Oven has been taken into consideration in arriving at the above estimate. Thus it is clear that there is a case for setting up two more plants of the same capacity as the Durgapur Coke Oven to meet the demand of industries in the immediate future.

B. PROPERTIES OF CUPOLA COKE

The precise quality of coke for metallurgical use is still controversial. It is even more so for cupola coke due to wide variation in the design and operation of the cupola. Foundry coke is required to supply the necessary heat for melting the iron in the cupola so that it may be tapped satisfactorily. This is ensured by the exothermic reaction between carbon in the coke and the oxygen in the air blast to form carbon dioxide; the production of carbon monoxide by reaction of the carbon dioxide with coke should be as low as possible as this reaction takes up heat.

The more important properties of cupola coke are as follows:

Table 6 shows the average properties of cupola coke used in different countries.

1. *Chemical properties:* Certain amount of moisture is unavoidable in coke. It is a diluent in the coke and may lead to loss of coke by water-gas reaction.

Ash is an incombustible constituent derived from the mineral matter invariably associated with coal. It reduces the calorific value of the coke, needs more fluxing materials, produces more slag and ultimately leads to the use of more fuel. Its chemical constitution affects the fusion range which should be neither too low nor too high. While 6-10% of ash is common in most countries, in South Africa & Australia it is higher. In India, however, it is possibly the highest, ranging generally between 18-24% and higher: especially in beehive coke which is made mostly from inferior coals.

The amount of volatile matter in the coke is often considered a yard stick for the quality of coke. It generally varies from 1-2 per cent. Higher values are often viewed with some concern as they are believed to indicate coke of bad quality. The laboratory

TABLE 6
AVERAGE PROPERTIES OF FOUNDRY COKE IN DIFFERENT COUNTRIES

	British	South African	Australian	American	German	French	INDIAN		I.S. 439-1953 Sp. Gr. & Gr. 1
							Special Coke From washed coal	By-product From blends	
Ash %	6.5-9.7 (a)	11.4-17.3	20.0 (a)	8.5-12.0	8.0 (a)	9.0 (a)	9.8-10.4	16.7-17.2	20-24
Volatile matter %	1.5	0.9	1.2	1.3-3.0	—	—	0.4-1.0	1.3-1.5	2.0 (a)
Sulphur %	0.65	1.4	—	0.65-1.25 (a)	1.0 (a)	1.0 (a)	0.39	0.4-0.6	0.7 (a)
Phosphorus %	0.04	—	—	0.30 (a)	—	0.018 (a)	0.031	0.045-0.054	0.3 (a)
Shatter Index:									
on 2"	73-92.0	89.0	—	70-80.0 (b)	85.0 (b)	—	47.0	72-87.6 (b)	
on 1½"	88-95.0	—	—	—	—	—	78.6	88.9-94.5	85.0 (b)

(a) The figures give the allowable upper limit. (b) The figures give the allowable lower limit. (c) For beehive cokes the values are invariably much higher.

determined values of volatile matter are often affected by external conditions (e. g. quenching and storage). It is, therefore, to be accepted with some reserve. Instances are known of coking having volatile matter higher than 2% and still being strong and hard.

Both sulphur and phosphorus in foundry coke should be low. The upper limits are fixed by local conditions. The stipulated limits for sulphur is higher and for phosphorus lower in other countries than in India. High phosphorus in Indian coals is an impediment in their use in special castings.

PHYSICAL PROPERTIES

Visual examination is till to-day one of the means of evaluating coke quality. It is particularly true in India where limited laboratory facilities exist for testing coke. Fine grained, silver grey, lumpy coke is preferred to dull looking coke. Over-quenching, unequal distribution of moisture and of the different coal constituents may lead to dark patches on the coke surface. Rusty spots may often develop on the coke surface due to the oxidation of ferrous compounds. Appearance is thus deceptive since, despite poor appearance, the coke may otherwise be excellent. Tests corroborating this have been carried out in the Central Fuel Research Institute.

Sizes larger than 2" is generally preferred for foundry use. Cupola trials have shown that better performance is generally obtained from 3"-5" and over 5" size cokes. Uniformity and close grading of size are important. Wide variation spreads the combustion zone, hinder smelting rate and lowers maximum temperature. Generally coke of sizes 1/8 to 1/12 of the internal diameter of the cupola is recommended. Coke, however, forms only one-tenth of the burden of a cupola and attention has therefore to be given equally to the size consist of the other constituents of the burden.

The coke must also be strong and hard to support the burden. The shatter test is one of the most commonly used methods for the assessment of the strength of coke. A known weight of coke is dropped several times from a specified height, the residue obtained is screened on different square meshes, the percentage remaining on the respective sizes giving the corresponding shatter indices. Tumbler and trommel tests are not usually employed. Individual tests often give anomalous results. Results from any single index being thus insufficient—several

combined indices have been suggested from time to time.

There are other important properties of coke. Coke with low reactivity is preferred to highly reactive coke with low ignition temperature which leads to solution loss by reaction between carbon monoxide and carbon in the coke. A suitable coke is expected to be of fairly low reactivity. A value of 50 to 60 by the Fuel Research Station (England) methods has been suggested as desirable. Indian coke, however, generally shown higher values. The reactivity depends mainly on the carbonising condition. It is found possible to produce coke with low reactivity from blends of good and weakly coking coals carbonised at high temperatures.

Small celled dense coke is preferred to porous coke. Although the value of porosity usually ranges from 40-50%, for Indian coke it is on the low side. Bulk density of the coke depends on porosity. In this case too other properties of the coke being there, porosity is believed to take care of itself.

Special Coke. Scarcity of high class metallurgical coke diverted attention in some countries to making briquettes from various blends containing coke dust, caking and non-caking coals, anthracite, pitch and tar. By employing special techniques for carbonisation and briquetting, briquettes are being made from non-caking coals. These are found to be suitable for use from the view point of both chemical and physical properties.

Experiments at Central Fuel Research Institute have shown the possibility of producing coke with low ash and low phosphorus by using specially selected coals with or without washing. The higher cost of such coke would be justified by its better quality.

No systematic and scientifically planned tests have been carried out in India to study the relation of the properties of cokes with their behaviour in foundry cupolas. The National Laboratories in India contemplate such studies in collaboration with the foundry industries who are becoming more and more conscious of this need.

CONCLUSION

The contemplated expansion in the iron and steel and the various engineering industries will demand a manifold increase in the production of hard coke in the country. It has been estimated on a statistical

basis that by the end of the Second Five Year Plan the various engineering industries would be requiring about one million ton of sized coke of the metallurgical grade.

There will be little surplus coke available for the market from the existing steel plants and from those under construction now after meeting their own requirements.

The existing merchant coke plants are mostly old, and are hardly expected to maintain their output at the present level not to speak of increasing their production. The beehive coke is already in disfavour because of its inconsistent and poor quality. Matters will be even worse in the near future with the decreased availability of better grades of coal for use in beehive ovens.

At present there is a dearth of standard quality of metallurgical coke. The steel plants in their own interest have to maintain the quality of the coke up to certain minimum standard. This is facilitated by

the partial use of washed coal in their coke ovens. Both beehive and by-product, merchant-coke plants have perforce to use coals of inconsistent quality due to drawing their supplies from erratic sources. The result is the production of non-uniform coke in respect of both chemical and physical properties.

Besides, being high in ash, the Indian foundry cokes contain high phosphorous and are thus unsuitable for making special casting. It has been indicated from tests carried out in the Central Fuel Research Institute that by judicious selection of coals and/or washing suitable coals it is possible to produce coke of low ash and low phosphorous content.

There is enough scope of investigation in the field of quality of foundry coke, particularly correlation of coke quality with its behaviour cupolas.

Such studies are under consideration of the Central Fuel Research Institute and the National Metallurgical Laboratory.

BICC AT THE CUMM EXHIBITION OF MINING MACHINERY

Olympia, 9th - 18th July

On Stand No. 15 at the Council of Underground Machinery Manufacturers Exhibition British Insulated Callender's Cables Limited will be giving demonstrations of repairs to trailing cables, utilizing the pressure-type and copper-tape vulcanizers.

In addition the following exhibits will be displayed on their stand ;

Cables and accessories for mines and quarries, including plastic, rubber and paper insulated cables ; mineral insulated cables and accessories ; cable couplers and adaptors (quarry and F. L. P. types) ; shaft cable cleats ; claw-type cable cleating system ; pressed steel mining-type straight joint box ; moulded polychloroprene plugs ; mining-type capacitors for power factor correction ; and overhead equipment for underground haulage in mines.

The display of interrupted face signalling equipment will comprise a demonstration panel.

* * * * *

The Application of the Koepe Hoisting System to a South-African Gold Mine

By a Mining Engineer

The South-African gold mines are among the deepest mines in the world. Their shafts are over 2,000 m. deep, and a total depth of 3,000 metres can be reached with the help of additional sub vertical shafts of equal diameter and equipped similarly to the main vertical operating shafts. The technical equipment of one such sub vertical shaft with a depth of 1100 metres, in which a Koepe hoist was recently installed, has been described in detail by F.H.G. Waller, Manager, and J. Byass, Resident Engineer, of the Libanon Gold Mining Company, Ltd. Please find below an excerpt from their report.

WHEREAS the old gold mines in South Africa are all equipped with drum winders, Koepe hoisting, too, has recently been introduced there. One of the first Koepe hoists to be installed is in the No. 1 Sub Vertical Shaft of the Libanon Gold Mine of the Witwatersrand.

This shaft has a diameter of 6.1 metres. The top of the headgear is on 10 level and the bank on 12 level (Fig. 1). For sinking purposes an A. C. double-drum winder was installed. This dual-purpose winder was ultimately to operate double-deck cages and 10-ton skips. As the mine is highly mechanised, it was essential to install another conveyance of at least a deck area commensurate with the large vertical-shaft cages. This conveyance, when installed in the shaft, would leave a small segment for a cage for shaft services (Figs. 2 and 3).

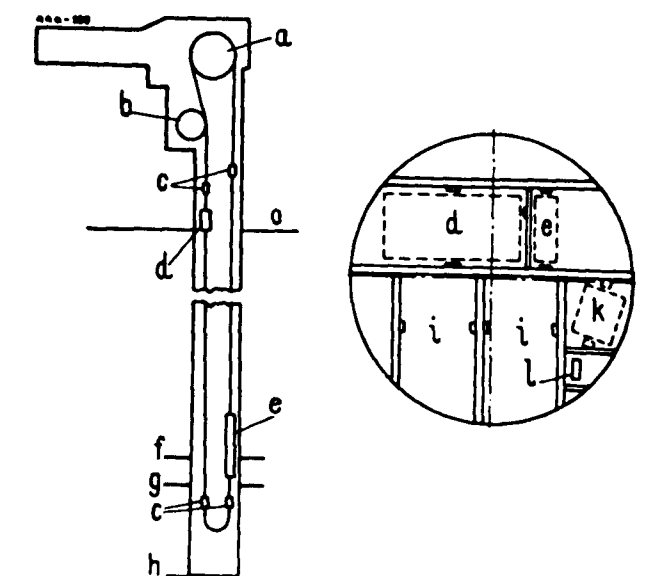
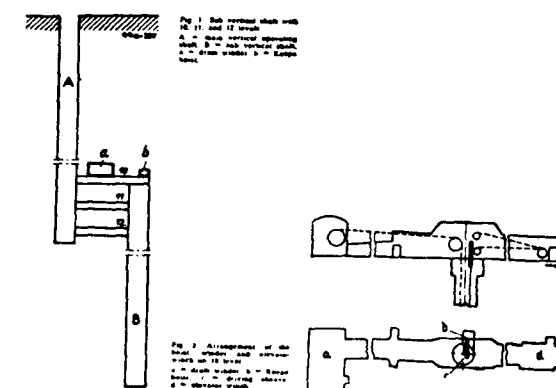


Fig. 3 Sketch of Koepe hoisting system.
a = driving sheave, b = deflection sheave, c = terminal guide rods
d = cage, e = service cage with counterweight, f = 27th level, g = level for material haulage, h = pit bottom, i = ore hoisting compartment, k = shaft service cage, l = counterweight.

expenditure on hoist excavations. 1400 cu. m. of excavation are required for a tower Koepe hoists compared with 5100 cu. m. for a drum winder installation. To expedite the shaft headgear a vertical raise was put up from 12 level to 10 level. Enlarging to full shaft dimensions commenced from 10 downwards.

As the hoist was to be positioned over the shaft, the support had to be designed to enable it to carry the full weight of the hoist together with conveyances, lifting and balance ropes, plus the permitted loads, totalling approx. 44 tons.

The hoist is of the Ward Leonard design with a single-reduction, double-helical gear box. The main Koepe wheel shaft is supported in three bearings, two of them being in the gear box. The outside bearing and centre bearing are supported on the main pillars, whereas the motor-side bearing is supported in the footwall by a concrete wall, as shown in fig. 4.

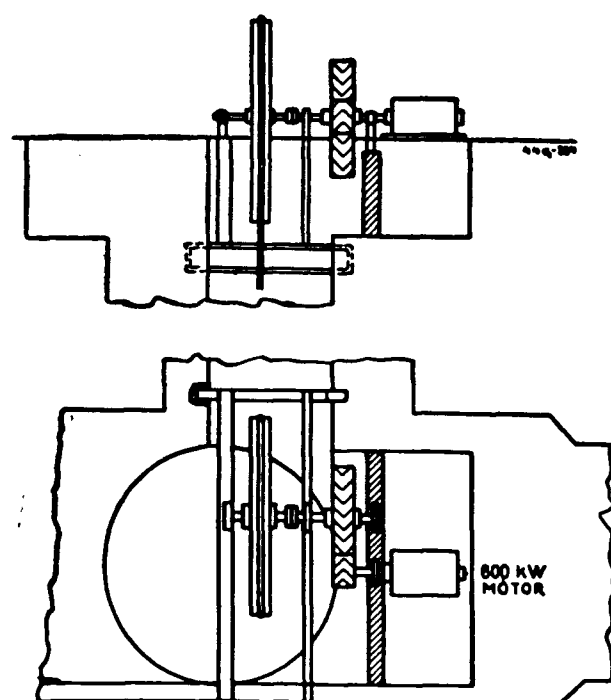


Fig. 4 Layout of hoist at top of sub vertical shaft.

Total weight of mechanical portion	65.8 metric tons
Total weight of electrical portion	31.1 metric tons
Depth of wind	1048 m.
Hoisting speed	12.8 m./s.
Man load	80 persons
Material load	5.45 metric tons
Diameter of Koepe driving sheave	5.2 m.
Speed of Koepe driving sheave	46.7 rpm.

Diameter of Koepe deflection sheave	4.57 m.
Arc of rope contact on Koepe sheave	200°
Reduction gear ratio	10.7 : 1

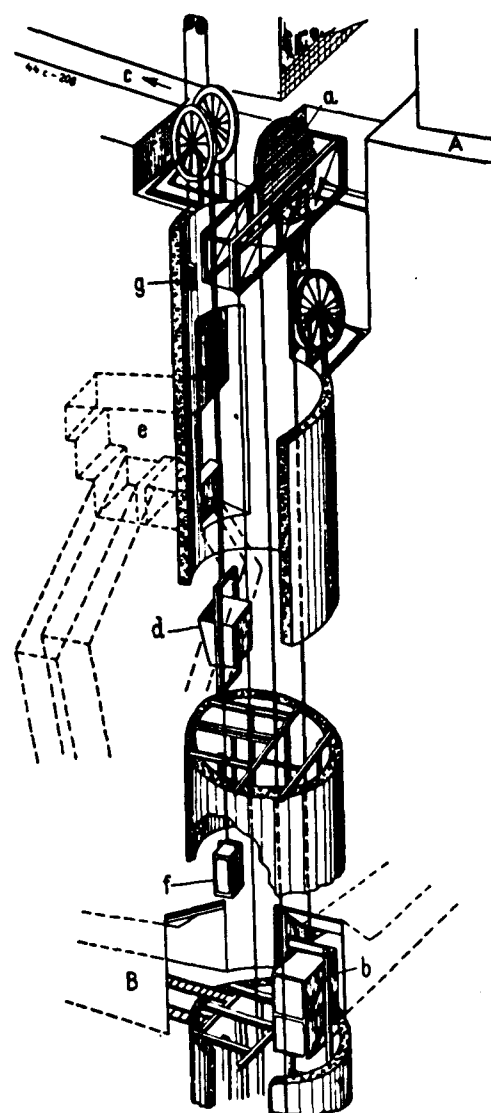


Fig. 5 General arrangement of conveyances.

A = 10 level, B = 12 level, a = driving sheave, b = cage, c = to drum winder, d = 10-ton skip, e = discharge bin, f = shaft service cage.

There is a difference between the brakes fitted to this Koepe and the normal brakes installed, in that the brakes are applied through a service cylinder by compressed air and not by a dead weight

The depth indicator is driven from the main Koepe wheel shaft through bevel gearing and is the

vertical-post type of indicator with knife edge pointers. Cams are driven from the indicator drive to control acceleration, deceleration and the limit contacts.

The Koepe wheel, a two-piece welded fabricated design, is held rigidly to the shaft by means of heavy shrink rings and located by means of tangential keys. The brake treads, one of either side of the rope friction drive, were machined accurately during the erection, so that there could be no unevenness of the brake run and snatching of the brakes. The friction drive treads are held in position on the Koepe wheel by wedge-shaped wooden blocks. An interesting feature of the brakes is that they are set in the "off" position with very fine clearances of only 1 to 2 mm. between the actual shoes and the brake path. The time lag is thus reduced to a minimum when they are applied.

Lubrication is effected through mechanical pumps to the gears, two pinion-shaft and two main-shaft bearings.

The main conveyance is a two-deck cage 3 m. deep $\times$ 1.5 m. wide, weighing 5.5 metric tons. The cage runners are fitted with specially strengthened wedge shoes at the top and bottom. The main frame is of a very rigid construction, as it is required to support the balance ropes as well as its own weight. The counterweight is in effect a 13 m. long service cage. It can accommodate 300 mm. $\times$ 9 m. long pipes for installation in the shaft.

The 1150 m. Langs Lay hoisting rope has a diameter of 48 mm. and a breaking load of 179.5 tons. It is galvanized and only internally lubricated. The outside of the rope is, therefore, free of lubricants but will be protected with a suitable lacquer or paint. The 50-mm. dia. non-spin balance rope has a breaking

load of 135.0 tons. This rope is lubricated in the normal way, i. e., both inside and out, and is made of low-tensile drawn steel, as it is required to support only itself.

For maintenance purposes an elevator was installed early on the small unused segment of the shaft cross-section. Incidentally, the travel of this elevator is stated to be the longest in Africa. Without this elevator the installation of cages, ropes, etc., would have been a prolonged and arduous process, as it was essential for the responsible persons to keep in personal touch, particularly as they had no experience in South Africa of running a balance rope without a bottom sheave.

As the introduction of Koepe hoisting to the South-African mines was a complete innovation in winding systems, it was deemed advisable to allow certificated drivers to accustom themselves to the control of the hoist without ropes and conveyances. Furthermore, this initial period was utilised for setting brakes, profiling indicator cams, checking bearings, lubrication systems, gears, etc.

It is felt that a Koepe hoist should be easier to maintain than a drum winder, as there are no clutches, drum bolts, drum bushes, etc., to be maintained. In addition, as no rope dressing is used on the Koepe hoist ropes, it will be very much easier to keep the engine room spotless.

As the Koepe hoist was erected over the shaft, the erection naturally had to be scheduled to suit other shaft work. The installation of the Koepe hoist was started on the 27th January, 1956, being completed and passed by the Inspector of Machinery on the 17th May, 1956.

JAPANESE TEAM IN BANGALORE

BANGALORE:— The Nagoya Chamber of Commerce, Japan, has presented to the Government of India's Small Scale Industries Service Institute here a foundry and a sand-testing machine valued at Rs. 20,000.

A Nagoya industrial mission, headed by Mr. Kakichi Nagai, which arrived here during the week-end, visited the major industrial units here and rounded off the day's programme with a visit to the Mysore Chamber of Commerce.

Mr. Nagai asked Mysore's industrialists to utilise increasingly the services of Japanese industrial consultants functioning in Bangalore for the past three years. This, he said, would help speedy industrialisation and promote cordial relations between Japan and India. Mr. Jeenabhai Devidoss, President of the Mysore Chamber of Commerce, reciprocated the friendly feelings expressed by Mr. Nagai and expressed the hope that Japanese collaboration would be forthcoming in exploiting the industrial potential of Mysore.

The New Blast Furnace Plant at Rourkela

By L. Edens, Dipl. Eng. (Berlin)

DUE to the heavy shortage of steel in the year after World War II India was dependent upon imports from distant areas. As a result, foreign exchange was swallowed up to an ever increasing extent and many serious difficulties arose in so far as war damage had caused an extreme shortage of steel even in the exporting countries. For these very reasons the Government of India took the decision to develop the national steel industry generously by expanding and modernizing the existing plants and constructing three new ones with an annual capacity of 1,000,000 tons each. When these projects are realized by the end of the second Five-Year Plan, national steel production will be raised to 6,000,000 tons per year, which means an important step forward towards industrialization and a higher standard of living. Hopes cherished for a long time will come true by the realization of this huge industrialization programme, because many people will gain a living not only in the steel plants, but also in the manufacturing industries which, being closely linked up with steel production, will gradually come up in the near future according to requirements.

In 1955 a German Group of Contractors undertook the project engineering and construction of one of these new steel plants, viz., the one at Rourkela for which Gutehoffnungshütte Sterkrade Antiengesellschaft, of Oberhausen-Germany, not only supplies a large amount of equipment, but also builds the blast furnace installation.

When the head of the State of India will honour Rourkela by his visit on the 3rd of February to inaugurate the blast furnace plant as the first section to come into operation at Rourkela work-site, an important moment will have come not only for Rourkela, but also for the Indian steel industry as a whole as this inauguration also heralds the starting up of the entire public sector of Indian Steel Industry comprising three steel plants under erection.

Three 1,000 tons blast furnaces have been provided for the Rourkela steel project, which means an annual production of approximately 1,000,000 tons of pig-iron.

The blast furnaces are of American type. They have a hearth diameter of 24'-6", a height of approximately 102' from hearth bottom to throat platform and a

capacity of approximately 25,000 cubic feet. The total height above mill floor is approximately 213'. Each blast furnace is provided with one iron taphole and two slag notches. Suitable cranes are available in the cast houses. The hot metal is discharged into ladles which are taken on cars to the steel plant or the pig casting machine. The slag is removed by special slag-cars and dumped.

A group of three hot blast stoves is provided for each blast furnace. The hot blast stoves have a diameter of 26'-3", a total height of 121' and a heating area of approximately 12,00,000 sq. feet. They are rated for 50,00,000 cubic feet (50 lakhs) of blast to be heated up to a maximum temperature of 950° centigrade.

A lift is available at each blast furnace for transport of passengers and materials as far as the throat level. Walkways inter-connect the blast furnaces, hot blast stoves and bunkers.

The double strand inclined skip hoist is fully automatic. It is operated by one man from the control stand. The hoist winch, the two bell winches and the three stockline gauge-rod winches are located in an engine room which is located above the bunker plant.

Uniform and even charging of each furnace is ensured by a hopper which is rotated by a certain angle after a predetermined number of skip travels. Sequence control is provided for the correct timing of the various operations, i.e., discharging of the coke weighing hoppers and of the scale car, skip travelling, hopper rotating, bell lowering or raising respectively. Interlocks and safety switches prevent failures. All the indicators necessary for the skip hoist are accommodated at the control stand. Charging is made completely automatic according to a predetermined programme. However, manual operation of the various process is also possible after the automatic control has been cut off.

An ore and coke storage yard is available for quantities delivered in excess. As a rule ore and coke are charged directly into the blast furnace bunkers without intermediate storage. The ores have already been graded at the mine. An ore bridge with a span of 148

feet and a capacity of 20 tons is provided at the ore and coke storage yard. The bridge is used to reclaim and re-load any spillage into the wagons available for transport to the blast furnace bunkers. The ore bridge is provided with a clamshell with a capacity of 117 cft. for ore transport and another one of 282 cft. for coke handling. Coke of correct lump size is delivered by a roofed conveyor arranged between the coke oven and the blast furnace plant.

In order to increase the portion of work which can be done locally by Indian Contractors, the huge bunker installation has been designed by GHH as a construction in reinforced concrete.

Sixteen ore bunkers are required for each blast furnace to cover the requirement of raw materials for at least three days. The coke bunkers located at either side of the inclined hoist can accommodate the requirements of more than half a day.

The raw materials are discharged from the bunkers into a scale car. Each blast furnace has one scale car at its disposal. A fourth car is available as standby for all the three blast furnaces. Each scale car has two 212 cft. receptacles in which the required grades of ore are weighed to obtain the desired mixture. The loads thus transported by the scale-car are discharged into the skip buckets of the inclined hoist. The bottom flap gates of the scales car are locked during travelling and loading. They can be opened only when the car is positioned over one of the two skips. The travelling speed of the scale car is approximately 500 feet per minute.

For the Rourkela steel project Gutehoffnungshütte have also build the pig casting machine which operates as follows:

The filled 80 tons hot metal ladle arriving on a car is taken by the travelling crane of the cast house and placed on the tilting chair of the stationary trestle. Thereupon it is lifted and tilted by remote control. The hot metal flowing out of the ladle runs along a double discharge runner into the moulds of the casting machine. The moulds are arranged in the form of a belt conveyor, the speed of which is infinitely variable between 16 and 39 feet per second. Each of the 760 moulds accommodates approximately 100 lbs. of hot metal. When the moulds have covered approximately half the way from feed to discharge, the metal is cooled by water according to requirement in order to ensure sufficient solidification. Any pigs (solidified metal) sticking to the moulds at discharge end are

detached by a rapper. Through baffles and chutes the pigs pass from the machine into wagons. Due to the pivoted arrangement of the chutes it is possible to load the pigs either into railway wagons or into factory owned wagons at the siding of the storage yard. Milk of lime is sprayed on to the empty moulds in the lower belt run after approximately half the return way has been covered. As a result, the pigs will be separated more readily at discharge. A coke oven gas heating system is provided for the moulds to be preheated after a major shutdown of the installation. The twin belt casting machine has a system length of 180 feet and a capacity of 2,400 tons per day.

Apart from the foregoing installations some further GHH equipment will be employed at Rourkela. For the major part such additional equipment has been supplied through other German contractors. Particular reference should be made to four twin flow radial type blast furnace blowers with steam turbine drive and condensing plants.

Each of these blowers has been rated for 58,27,000 cft./hr. of air discharged at a pressure of 39 lbs. per sq. inch absolute. The power rating of each turbine is 6,700 kw. The blower speed is 3,570 RPM. Three of the installation will be in actual operation, whereas one will serve as standby. GHH blast furnace blowers of the particular type referred to have already proved successful in India. Two units of almost the same capacity have been operating in a steel plant at Burnpur since January 1958, whereas a third was started up there in July 1958.

A GHH back pressure steam turbine for generator drive has been supplied for the power station of the Rourkela steel plant. It has been rated for a live steam pressure of 796 lbs. per sq. inch gauge, a live steam temperature of 475°C and a power of 3,000 kW. Three GHH turbo compressors of a capacity rating of 14,00,000 cft./hr. of air and a discharge pressure of approximately 85 lbs. per sq. inch absolute are installed in the tonnage oxygen plant at Rourkela. Two further compressors have been supplied for oxygen flow.

The gas produced in the Rourkela coke oven plant will be handled by five GHH screw compressors, the largest so far built by the Company. Each of these three-stage machines has been rated for a flow of 8,12,000 cft./hr. and a discharge pressure of 215 lbs. per sq. inch absolute. Further more three GHH turbo blowers and three gas exhausters have been supplied for the coke oven plant.

Schemes of this magnitude are no easy proposition for contractors supplying their equipment from distant countries. Gutehoffnungshütte (GHH) alone has delivered approximately 20,000 tons of mechanical and structural parts by the end of 1958. The capacity of the Port of Calcutta was inadequate to cope with the large quantities of material arriving not only for the Rourkela project, but also for the steel plants under construction by American, English and Russian contractors. Through the assistance given by the Indian purchaser and the initiative taken by the German suppliers it was, however, possible to recover largely the time thus lost by accelerating the erection work at site.

For the erection of the blast furnaces Gutehoffnungshütte has sent more than 100 specialists to India. Local manpower was available in the number of approximately 300 to 400 men. Most of the Indian labour had never worked on any such scheme so that certain time was necessary for training and acquiring the necessary skill.

In order to facilitate work at site, Gutehoffnungshütte has provided most up-to-date erection tackle. In many cases completely new tackle was devised and applied for the first time in the field. Two truck cranes are a particularly remarkable example to demonstrate what has been done by GHH as far as erection tackle is concerned. With a lift of 230 feet these cranes can cover even the topmost part of the blast furnaces. Their masts are 256 feet high whereas their bases are 118 feet long. The maximum capacity of each truck is 20 tons.

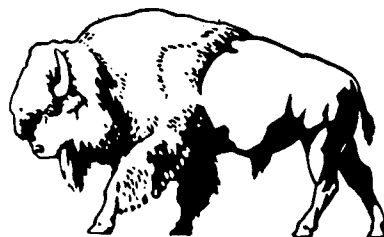
For the start up of the first blast furnace Gutehoffnungshütte delegated a staff of experienced specialists who also will instruct the Indian operational crew. Many Indian engineers who will be in charge of running the blast furnace plant at Rourkela have been trained by GHH in its own plants and design offices or in other German steel plants.

CAPITAL GOODS

The licence for the import of capital goods obtained in the initial stage had to be amended during the year, several items which were formerly available locally had also to be imported. The directors state that the company has been able to obtain the licence for all machinery and equipment required.

The accounts of the company for the period from March 10, 1958 to December 31, 1958 disclose a profit of Rs. 27,205, after providing Rs. 2,892 for depreciation and Rs. 30,000 for taxation. The profit resulted entirely from the sale of imported tyres and tubes.

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June 1959

JOURNAL OF INDUSTRIAL ENGINEERING

M.I.19

GHH Equipment in India

THE relations which Gutehoffnungshütte maintains with India have a long tradition. They were only interrupted for a short time by World War II. However soon after 1945 when GHH had reconstructed its plants and factories, the first orders were again received from Indian customers. During the time meanwhile elapsed GHH has constructed a large number of industrial plants in India, and even today there are many GHH erectors engaged in various parts of India on the establishment of industrial plants and factories. Within the framework of a short paper on the more recent GHH supplies of a certain importance besides the Rourkela project, we are restricted to describing only those which are particularly remarkable.

For Mysore Iron & Steel Works, of Bhadravati, GHH has supplied a pipe spinning factory with an annual capacity of 17,000 tons, the cast iron pipes produced ranging in diameter from 3 to 12 inches and in length up to 16 feet. A pan sintering plant for ore fines with furnace dust, mill scale, lime etc. is under construction for the same customer. It has been laid out for a capacity of 250 tons per day. A considerable increase of pig iron production arises out of the operation of this sintering plant.

Within the development project of the Indian sugar industry GHH had received the order for the construction of six complete white sugar factories each processing 1,000 tons of sugar cane per day. In order to meet the customer as far as the saving of foreign exchange is concerned, GHH had agreed that large part of the equipment was manufactured locally on the basis of its drawings. Erection of the factories was carried out by qualified local labour under the supervision of GHH.

Operation has meanwhile commenced in part of the factories; output, yield and sugar quality come up to every expectation.

The complete mechanical equipment of a cement factory has been delivered to Panyam Cements & Mineral Industries Ltd., at Betamcherla, Kurnool District. The factory concerned has been laid out for a capacity of 200 tons of Portland cement per day. Upon start up the output guaranteed was exceeded by



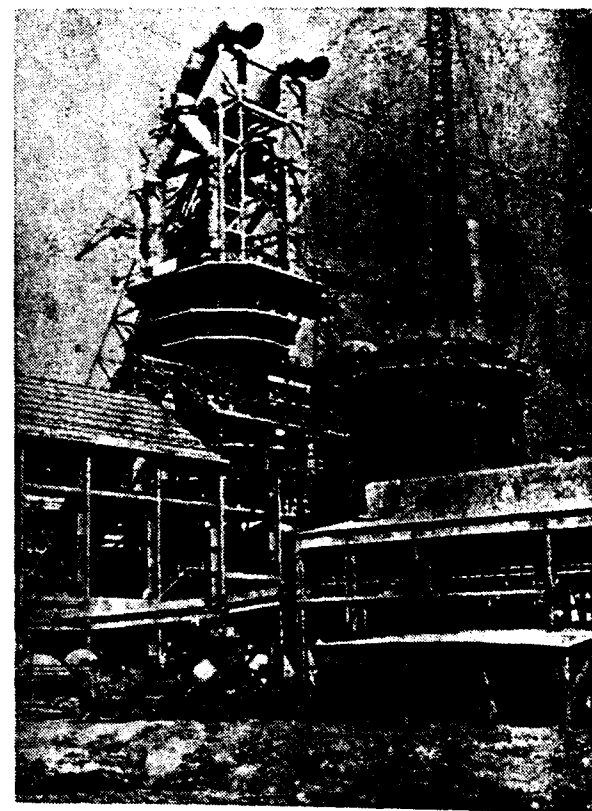
St. Antony Iron Works, the parent undertaking of GHH, in 1835



One of the Up-to-date GHH Workshops

10 per cent. Another cement factory in Madras received two GHH cement grinding plants with a unit capacity of 16 tons per hour as well as parts of a rotary kiln with a capacity of 400 tons per day. The Associated Cement Company Ltd., of Bombay, has installed five GHH limestone crushing plants with a capacity of 250 tons per hour.

The development of a country is closely linked up with the availability of power resources and the improvement of water supply to raise agricultural production. For this reason the Government of India has encouraged particularly the construction of dams and water reservoirs. GHH has contributed to the construction of some dams by delivering the necessary cableways and aerial ropeways. For the Koyna Dam, approximately 200 miles south of Bombay, it has supplied and erected the cableways required to

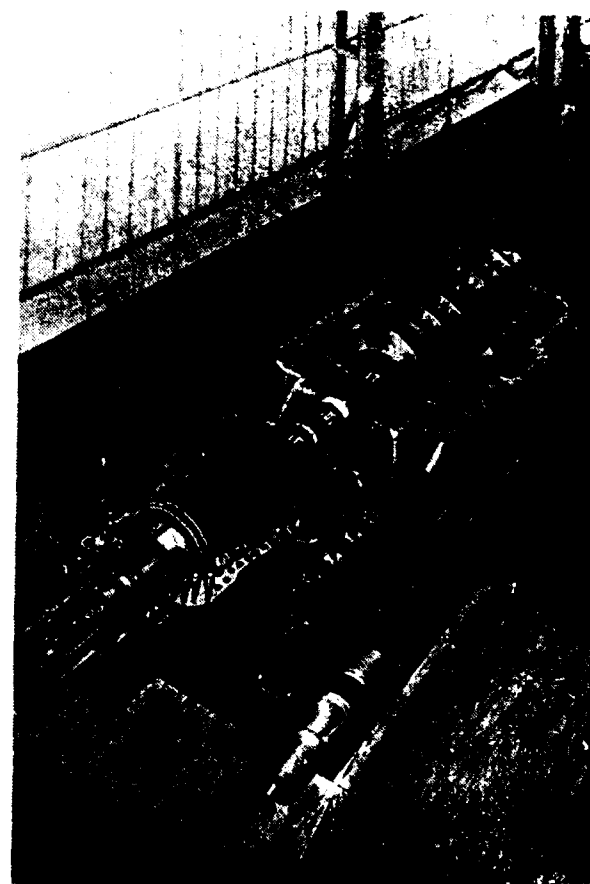


1,000 Ton GHH Blast Furnace during erection at Rourkela.

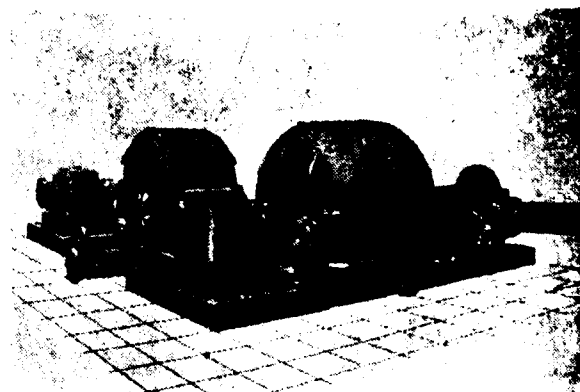
transport approximately 1,200,000 cbm.+ of concrete to the various points of application. The payload capacity of each cableway is 15 tons and the span is as long as 760 metres.+ The engine towers are 75 metres.+ high. The cableways are capable of placing 400 tons/hr. of concrete into the dam. By their large towers and the travelling buckets they dominate the picture at worksite and catch the eyes of the many visitors assembled from near and far to watch the gigantic work. Within the Bhakra Dam Project GHH is building a timber handling plant which includes a particularly large aerial ropeway crossing several mountain ridges. The timber drifting downstream on the Sutlej River is collected in the reservoir ahead of the dam and transported, by the aerial ropeway, to Nangal, the nearest place where there is a railway station.

+) 1,200,000 cbm = 4,23,00,000 cubic feet
760 meter = 2,500 feet
75 „ = 246 feet

(Continued on page M.I.21)



GHH Blast Furnace Blower for the Rourkela Steel Plant, capacity 165,000 cbm/hr.



GHH Gas Exhauster supplied for the Rourkela Steel Plant

The foundations required for the timber handling installation have been computed for their static stability by Indian engineers. Similarly they have been built by Indian contractors. Erection of the steelwork and mechanical equipment supplied by GHH was also carried out under supervision of the Indian engineers. GHH specialists were sent over to train the operators of the plant.

Du Pont Products for Oil Industry Use to be shown at World Petroleum Congress

DU PONT products for the petroleum industry, ranging from weed killers, explosives, and special photographic films for seismic prospecting, to tetraethyl lead that helps make knock-free gasoline, will be shown in a 100-foot-long exhibit at the Fifth World Petroleum Congress in New York City early this summer.

First international meeting of its type to be held in the United States, the Petroleum Congress is expected to attract 5,000 scientists and technologists from more than 35 countries to a six-day series of meetings beginning May 31. Exhibits alone will occupy two floors of New York's huge Coliseum, while two more floors in the new exhibit center will be devoted to technical sessions at which more than 250 scientific papers will be presented.

Six of the Du Pont Company's 12 manufacturing department will participate in the week-long commercial exhibits. The Congress coincides with the centennial celebration of the United States oil industry, which traces its beginning from the first commercial oil discovery made at Titusville, Pennsylvania, in 1859.

Among Du Pont products to be featured in the company's exhibit are specialized additives for improving the quality of gasoline and other petroleum products, and a number of aids to seismic exploration, such as "Cronar" recording film, Lino-Flex film, Seismo-Writ photo recording papers, "Cronaflex" engineering reproduction films, "Nitramon" blasting agents, and "Elcord" explosive delay units. Contributions to drilling processes and equipment on display will include jet perforators, sodium carboxymethyl cellulose, and critical parts made with "Viton" synthetic rubber (Du Pont's new high-temperature and oil-resistant fluorocarbon elastomer), neoprene, "Hypalon" synthetic rubber, and "Teflon" TFE-fluorocarbon resins.

The importance of Du Pont "Telvar" and "Karmex" weed killers in eliminating fire-hazardous vegetation, improving maintenance and prolonging equipment life, will be illustrated from actual experience in refinery, production, and storage areas throughout the world. Five-year records of petroleum companies show better results at lower costs where a chemical weed control program has been substituted for weed control by such means as grazing, mowing, scraping, digging, or treating with salt water, oil or asphalt.

(Continued from page M.I.20)

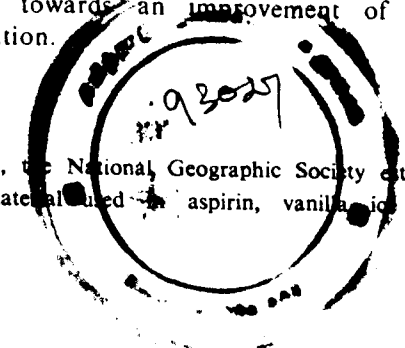
An extraordinarily large amount of GHH turbo machinery, predominantly turbines, compressors and blowers for chemical factories and steel plants, has been supplied to India. Indian sugar factories have received complete turbo generator sets for power ratings of up to approximately 2,000 kW as well as nearly 30 small steam turbines for mill drive. The GHH equipment is engineered to suit the specific local conditions. The case of some turbo blowers destined for operation in a seismic area illustrates how efficiently the Company solves the problems arising. Indeed, the construction of the foundations for the very sensitive machines was a very difficult proposition.

In spite of all the complications met, the GHH turbo blowers operate most satisfactorily.

The present paper can only give a short abstract of the large variety of GHH equipment delivered to India. The examples chosen show however to how far a degree Gutehoffnungshutte contributes to the industrialization of India. It is clearly demonstrated that the Company based on its two centuries of experience has the capacity enabling it to participate generously in the industrial development of countries on the move towards an improvement of their economic situation.

BY-PRODUCTS OF COAL

More than 200,000 chemical by-products are made from bituminous coal, the National Geographic Society estimates. The society said the following were some of the derivatives on the long list: material used in aspirin, vanilla ice cream, explosives, moth balls and fingernail polish.



EXTRACTS FROM THE ANNUAL REPORT OF THE COMMITTEE OF THE INDIAN MINING FEDERATION, FOR THE YEAR ENDED 31st DECEMBER, 1958

Adoption of Coal Controller's Specifications for the purpose of Indian Coal Grading Board Act and the grading of Collieries by the Board for the purposes of the Colliery Control Order

THE Industry suggested that the Indian Coal Grading Board's grading should be substituted by Coal Controller's grading and that all grading should be done by the Grading Board for export as well as for internal consumption. The Industry wanted this principle adopted, as the Coal Grading Board was considered to be a representative body which included the Industry as well, but the Chairman commented that price fixation was an executive function and, therefore, should not be entrusted to anybody in which, besides the Government, the interests of producers, exporters, consumers or traders were represented. The Chairman, however, agreed that a note on the subject giving details about the present function and constitution of the Coal Grading Board and the method and process of grading followed both by Coal Grading Board and the Coal Controller's Organisation Coal Board would be circulated to the members. It is not known as yet what decision has been reached in this regard.

Movement of block rake of soft coke without coupons and allotment of wagons without colliery consent letters

The Industry strongly criticized the steps taken by the Allotment Office in this regard and it was ultimately decided that the sanctions would be issued valid for 45 days and collieries would be given 15 days to advise the D. C. C. (D)'s Office in case they were not in a position to load the wagons.

Coal Transport Advisory Committee

Shri Mulchand C. Parkeh represented the Federation on the Coal Transport Advisory Committee the principal activities of which as recorded by him are given below:

During the year 1958 ten meetings in all were held, the discussions at which were mainly related to the problem of Rail transport for despatching coal from the collieries.

At the meeting of the above Committee held in 1958 Mr. Parkeh raised the question of exploring the

possibility of supplying covered wagons to Bee Hive Hard Coke and Soft Coke manufacturing collieries instead of restricting the same to 4 coke plants producing Bye-products Hard Coke. This was agreed to by the Railways.

Supply of Iron & Steel Materials to Collieries

While the collieries obtained sufficient quotas from the authorities in respect of the requirements for iron & steel materials, the position of supply of such materials was unsatisfactory. The difficulties experienced were brought to the notice of the Committee and the Iron & Steel Controller took due notice of the same. It was stressed that priority of supply of iron and steel materials by the producers to controlled stockists, who had outstanding orders against quota, should be granted. As a result of deliberations of the Committee, supplies of particular kind of iron and steel materials were arranged from time to time on an ad hoc basis.

PIG IRON

The Industry suffered from scarcity of pig iron and the representatives emphasized the need for separate quotas for the Coal Industry. The matter was taken up with the Government by the Coal Controller's Organisation and during the year an ad hoc quota was fixed. The allotment of a separate quota for the Coal Industry has also been ensured.

Import Trade Control & the Mining Industry

The Import duty on mining machinery was fixed at 5% by the Government of India, but some difficulties were experienced in receiving such materials at the said rate of duty, because the Customs Authorities were of the view that machinery in question was not meant for use only in mines. This point was brought up before the Committee and the Coal Controller agreed to take up the matter with the Collector of Customs. No final decision has been taken up till now, but during the year it was agreed that the Coal Industry would list those machinery which are now charged at the full rate and which by their very nature were such as could

be used only in mines. The suggestion was that the Customs Department would then be moved to amend the Tariff clarification so as to permit a levy of import duty at 5%. The outcome of this effort is still awaited.

The representatives of the Industry drew attention to the recent liberalization of the policy regarding import of wire ropes, spares and safety lamps, and the issue of licences for those improved during the year. The difficulties in obtaining mining equipment, however, have continued in view of tight foreign exchange position.

The authorities are insisting on import of American machinery, but the Industry is unwilling to accept such machinery, because the prices of American machinery are at least 25 to 30% more than the machinery of Continental or U. K. Origin. Secondly, Indian Engineers are not accustomed to use American machinery. Thirdly, the difficulties in obtaining spare parts for such machinery were also stressed. Fourthly, absence of any representative organisation dealing with American machinery was also keenly felt.

It has been suggested, however, that the Industry should make out a list of machinery it wanted and then it could be seen what types were available from American sources.

COAL PRODUCTION

In the context of the restrictions imposed by the Government on private collieries with regard to the opening of new mines, the inadequacy of transport, siding and loading accommodation, the difficulties in obtaining supply of adequate mining machinery and equipment, pig iron, iron and steel, and other materials, the increase of 1.31 million tons in the output of coal in the private sector, excluding the production of Singareni collieries, out of a total increase of 1.81 million tons in the year 1958 over the output of 1957 may be regarded as satisfactory. Even excluding the production from the year 1956 of Singareni Collieries, which were previously in the private sector, the private sector will have to produce an additional 4.3 million tons during the next two years to reach its target of 10 million tons, which appears to be well within its reach. It has been emphasised in the reports of the previous years that the private sector would have been in a position to produce more than 22 million tons required during the second plan period without imposing any burden on the public exchequer if it was given adequate

opportunity and sufficient encouragement for its expansion.

PRODUCTIVITY IN COAL MINES

The productivity of workers employed in the coal mines is very low and negligible as compared with that of workers employed in other countries. The output per man shift for all workers employed above and underground during 1957 was 0.37 tons as against 0.38 tons in 1956. The fact, however, remains that even slight improvement is not worth mentioning when compared with that of other countries. The overall output per man shift is as high as 6.66 tons in U. S., 1.28 tons in U. K., 1.11 tons in Germany, 0.90 tons in France and 0.74 tons in Belgium. The rise in productivity in coal workers noted above has not at all been proportionate to the increase in wages and emoluments given under the Colliery Award. In the Jharia coal mines, for example, the average weekly earning of an underground miner is as high as Rs. 28.09 which compares favourably with the average of Rs. 20.46 in 1957, Rs. 17.37 in 1956, and Rs. 14.20 in 1955. Similarly, in the Raniganj mines, the weekly earning was Rs. 20.25; the corresponding figures for the abovementioned years were Rs. 19.33, Rs. 15.73 and Rs. 14.91 respectively.

This low level of productivity must be attributed partly to general lack of interest among miners and partly to want of adequate mechanisation and adoption of old mining methods. It must be admitted that productivity cannot be raised even by the introduction of up-to-date machinery and scientific mining methods unless the workers give up their attitude of indifference and takes sufficient interest in the works entrusted to them. The problem has therefore to be studied and solved as to why the workers are indifferent to the job entrusted to them and why they do not put forth their best.

COAL WASHERIES

In view of the estimated requirements of washed coking coal of about 9 million tons for the three steel plants at Rourkela, Bhilai and Durgapur in the Public sector and also the two expanded Steel Plants of Tata Iron & Steel Co., and Indian Iron & Steel Co., in the Private Sector, the washing of coking coals will be a special feature during the Second Plan Period. Some of the coking coals would be washed at the existing washeries at Jamadoba, West Bokaro and Lodna and for washing the rest of the coal, a central washery has been installed at Kargali (Bokaro Coalfield) and

three central washeries are being installed at Dugda, Bhojudih and Patherdih in the Jharia coalfield. In addition to the three central washeries there will be another washery set up by the Durgapur Steel Plant at Durgapur. The associated Cement Co., is erecting a washery in Central India to wash non-coking coals from its own mines. The technique of blending semi-coking coals with good coking coals would also be adopted on a large scale during the period of the Second Five Year Plan. It has been proposed that at Bhilai 10 to 20% of coal from Korba would be used and that in the Durgapur Steel Plant, Dishergarh coals to the extent of 20% would be used. In the coke plant at Durgapur also semi-coking coals would be used in blends on a large scale for producing metallurgical coal.

OPEN-CAST MINING

It was considered that when stowing costs increased to Rs. 10/- per ton of coal, it would be worthwhile to investigate whether the expansion of open-cast mining should not be encouraged by a grant of subsidy. It had been considered essential to do open-cast mining by present methods where the thickness of overburden was not more than twice the thickness of the coal seam. It was suggested that the Board might consider granting a subsidy for open-cast mining when the thickness of overburden was more than twice the thickness of the coal seam. The thick seams of Jharia like 15, 14, 14A which had been standing on pillars and the Jambad and Kajora Seams could be extracted by open-cast mining more economically than with stowing with safety and a high percentage of extraction provided collieries were given some kind of an incentive or subsidy for such operations.

It was pointed out on behalf of the Industry that open-cast mining could be carried out only upto a certain depth and that beyond a depth of, say, 100 feet, open-cast mining would not be feasible. The Federation's representative pointed out that it should be considered whether in the 14, 15 and 16 seams of Jharia, which contained very good coking coal, encouragement should be given to quarry these coals to the maximum depth as an alternative to the recovery of these seams with stowing at such a high cost.

Representation made by the Industry regarding assistance for stowing

A representation from the Indian Mining Association which was also endorsed by the Indian Mining

Federation and the Indian Colliery Owners Association was made in which the average cost of stowing in 1955-56 was shown as under :—

Hydraulic stowing with sand	Rs. 1-12-9 per ton
Stowing with crushed materials	Rs. 2- 2-0 per ton

In 1956-57 after the Award the rates were approximately as follows :—

Hydraulic stowing with sand	Rs. 2-0-5
Stowing with crushed materials	Rs. 2-8-11
Dry stowing	Rs. 3-7-2

An assurance had been given that increased wages actually paid to stowing labour would be admitted.

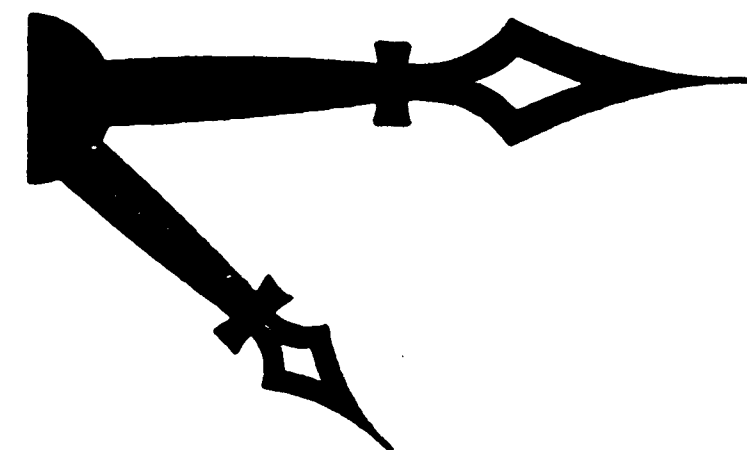
IX STATISTICS

Statement showing Raisings and Despatches of Coal in India during 1957 & 58

	Raisings	
	1957 (in tons)	1958 (in tons)
January	36,27,151	39,47,427
February	35,18,681	37,12,113
March	36,52,777	37,00,990
April	37,25,106	38,01,657
May	37,94,092	38,83,822
June	33,30,400	35,54,419
July	32,96,150	37,49,030
August	33,75,791	35,38,972
September	36,47,255	38,48,186
October	35,55,099	37,46,601
November	39,29,735	36,87,722
December	40,50,924	41,48,752
Total	4,35,04,071	4,53,19,691

	Despatches	
	1957 (in tons)	1958 (in tons)
January	31,36,528	33,25,642
February	28,50,781	30,62,660
March	32,48,899	33,53,638
April	31,84,079	34,32,528
May	31,87,466	33,73,611
June	29,15,343	31,06,367
July	30,44,875	33,67,971
August	32,39,380	34,77,605
September	32,27,150	34,74,966
October	33,23,019	34,73,875
November	31,64,728	33,73,507
December	31,63,747	35,05,890
Total	3,76,85,995	4,03,28,260

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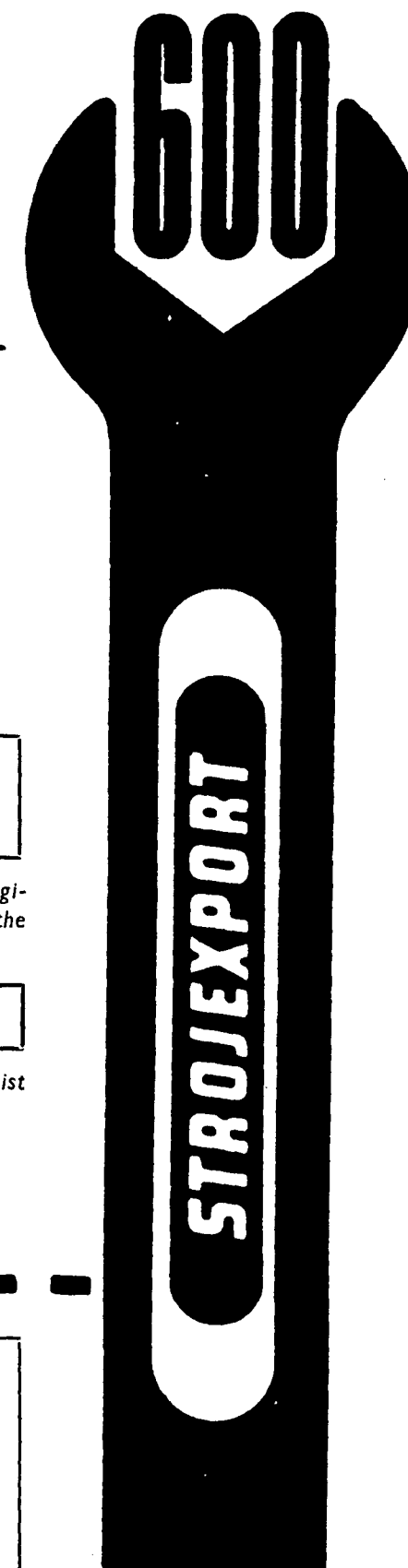
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"KRISHNA" Earth Leakage Protective Device

By Kamal Kumar Chandra

INTRODUCTION

RULE 116, of Indian Electricity Rules, 1956, requires that Earth Fault Detectors shall be connected in every system in a mine to draw immediate attention to any defect in the insulation of the system.

Not to comply with this rule is a violation as the earth fault detectors ensure safety of personnels and plants.

Accidents due to a cable or apparatus becoming energized can only be prevented by installing Earth Leakage Relays in every system in the mine. Earth Leakage protective device, as such is an essential accessory to any Electric Installation and as India was not manufacturing any suitable Earth Leakage Relay in sufficient quantity to meet the ever increasing demand in our present day Industrialisation and the quick pace of Electrification Shree Ram Krishna Engineering Co. (Private) Ltd., Dhanbad manufacturers of Mechanical and Electrical apparatus came forward to design and manufacture the Earth Leakage relay which is now available in sufficient quantity and is known as "KRISHNA" Earth Leakage Relay.

ENCLOSURE

The "KRISHNA" Earth Fault protective device, for this purpose is simple and robust. The base is made of Phenol fiber sheet of $\frac{1}{4}$ " thickness and the enclosure is of welded sheet steel of sufficient strength to withstand any injury.

The cover is provided with a glass window through which a flag indicator shows if the earth fault release has operated. The release, after operating, must be reset by means of a push button device before the breaker can be reclosed. In order to avoid unauthorised tampering, this push has been provided with some suitable locking device.

Another push button with such locking arrangement is also provided to test the earth Leakage with a battery to see whether it is in working order. The utility of this has been discussed later on.

CORE BALANCE TRANSFORMER

A ring type core—balance current transformer is supplied with the relay. A ring type C. T. has been designed in the interest of safety as no primary windings are there. The straight cable leads function like the straight primary conductors and give the equivalent of one turn.

FUNCTION

The protective device operates when an unbalanced magnetic field arises due to an earth fault in any one of the current carrying conductors resulting in the flow of earth leakage current.

At a normal state of insulation the resultant three-phase current does not produce any Voltage in the Secondary winding of the core balance transformer, whereas an earth fault in one of the cores will excite a voltage across the secondary winding of the current transformer and will energise a relay coil in the earth leakage relay. This energised relay coil creates a magnetic flux in the lamination in which the coil is mounted and it attracts a trigger to operate the mechanism of the Relay.

"KRISHNA" leakage Relay is not a direct acting relay and it is to be fitted with the No-Volt system of the circuit breaker. When the mechanism of the relay operates as stated before, it disconnects the No-Volt circuit of the circuit breaker and trips it.

BATTERY TESTING DEVICE

An earth leakage relay is called upon to operate only in an emergency and unless the cable switches etc., are in very bad condition, a fault to earth may not occur for some considerable time after the equipment is installed. Nevertheless any failure of the earth leakage to operate may mean serious injury to personnel or plant. The only way to avoid such risks is to test the leakage relay regularly and for this purpose the battery testing device has been inserted. The push as previously mentioned is used to connect a battery in series with the earth fault release coil. If the relay is in working order this operation will

trip the circuit breaker. An indicating lamp has also been introduced to operate at the time of testing the relay.

SETTINGS

"KRISHNA" earth leakage Relay can be operated with the minimum earth leakage current of 2 amps. It can be set to any higher Amps upto 10 Amps by rotating the setting dial which in general is marked for 2, 5, 7 and 10 amps. If required, markings for other settings between 2 to 10 Amps can be arranged.

RATINGS

"KRISHNA" leakage relay can be fitted to any circuit breaker upto 400 amps and 3.3 K. V. provided the circuit breaker is fitted with a No-Volt system.

Floor Scouring by Battery-Driven Cleaner

One of the greatest restrictions on the wider use of electric vacuum cleaners and similar machines in large areas has been the fact that long lengths of cable, or, alternatively, a multiple number of plug-in points, are called for. This handicap has now been overcome with a new range of machines introduced by the British Vacuum Cleaner and Engineering Company, Ltd., after extensive and stringent tests with prototypes in many parts of the world. One set of machines was used to clean the vast Atomium structure at the Brussels Universal and International Exhibition last year, and has been retained for use in this one permanent building to remain on the exhibition site.

The new range of machines covers every type of floor cleaning from shampooing valuable carpets to scarifying greasy and dirty factory floors. The machines are available as mains-operated models, if required, but the more important development is the fitting of batteries to the machines to make them completely self-contained. With an ordinary car battery, a machine can be in continuous operation for eight hours, without the need for the battery to be recharged.

For factory and similar use, there are the "Otter" wet-scrubbers, which can remove "concrete-

Shree Ramkrishna Engineering Co. (Private) Ltd., Dhanbad, was registered in the year 1949 and since then, in spite of many difficulties, has been trying to manufacture Mechanical and Electrical Machineries specially for the mines. Previously, for all mining Machineries India had to depend solely on Imports and due to shortage of Machineries, Mines had to suffer a great deal.

This concern has started manufacturing Pumps, Mining type cable boxes, Busbar chambers, Mining type lighting fittings, Earth leakage Relay etc.

Now within a short time they are releasing Mining type Bell Transformers of capacity 50 VA, Primary 110 Volts and Secondary for the tappings of 12 Volts, 16 Volts and 24 Volts with mining type Bell of chromium plated gong of 6 inches and 4 inches to work with the above transformers. They are also arranging to manufacture Mining type lighting transformers.

hard" compact dirt and grease, and also a heavy-duty machine, the "Hedgehog", which scarifies a dirty floor with its two intermeshing spring-steel wire brushes. Despite their necessarily heavy construction, these machines can be moved with the lightest touch and are, of course, unencumbered by trailing cables.

The most versatile machine in the new range is the "Musquash", which can be used for carpet shampooing, wet scrubbing, mopping, dry cleaning, light sanding and polishing for every type of floor surface.

* * * * *

NEW TOUGHNESS TEST FOR TITANIUM

Battelle Institute of London, England reports it has developed a new method of micro impact testing to determine toughness of titanium alloys. It needs less than 15% of the material required for conventional tests using Charpy V-Notch specimens. Battelle has successfully used its technique for detailed toughness tests of titanium alloys machined from $\frac{1}{4}$ " plates. Although given in inch-pounds results are said to approximate accuracy of results in foot-pounds obtained with the V-Notch test.

INDIAN MINING ASSOCIATION EXTRACTS FROM THE SIXTY-SEVENTH ANNUAL REPORT OF THE COMMITTEE FOR THE YEAR ENDED 31st DECEMBER, 1958

AT the last Annual General Meeting held on 20th March 1958, the following gentlemen were declared elected members of the Committee for the year :—

Mr. J. N. Banerjee
Mr. N. B. Ghosh
Mr. D. Hogg
Mr. W. D. Holton
Mr. Indra Kumar Karnani
Mr. R. Maulik
Mr. R. H. Mody
Mr. H. B. Mondal
Mr. R. H. Wright
Mr. A. S. B. Yeoman

At the first meeting of the Committee held on 20th March 1958, Mr. D. Hogg was elected Chairman and Mr. R. Maulik, Vice-Chairman.

Mr. A. A. G. Weir, Mr. P. Prashad, Mr. S. C. Ghosh and Mr. J. K. Stoddart acted in place of Mr. D. Hogg, Mr. W. D. Holton, Mr. R. H. Mody and Mr. A. S. B. Yeoman respectively during the absence of the latter on leave.

On the retirement of Mr. J. N. Banerjee, Mr. K. K. Dosaj was nominated to serve on the Committee in his place. In February 1959, Mr. J. K. Stoddart filled the vacancy on the Committee caused by the death of Mr. A. S. B. Yeoman.

During the year under review and upto the time of writing the Report, the following Companies had been admitted to membership of the Association :—

The East Laikdih Colliery Co. Private Ltd.,
Indian Aluminium Company Ltd., in respect
of their Bauxite Mines.
The Indian Iron & Steel Co. Ltd., in respect
of their Gua Ore Mines and Manoharpur
Ore Mines.
The Tata Iron & Steel Co. Ltd., in respect of
their Noamundi Iron Ore Mine.

Review of the Labour Situation in the Bengal and Bihar Coalfields

With the exception of a strike at West Bokaro

Colliery, brought about by a rival organisation trying to displace an established union, relations between labour and management at the collieries owned by members of the Association in Bengal and Bihar were reasonably satisfactory. Rivalry between the unions, however, continued to be a problem and this aspect of labour relations and its bearing on assaults on managerial and supervisory staff and on indiscipline has been stressed from time to time.

One of the most serious problems facing management is the housing situation. Although managements attempted to regulate the allocation of quarters and the grant of permission for families to be brought to the collieries the position has been extremely difficult and the unions have often been either unwilling or incapable of rendering any assistance and have often hampered managements in attempts to regulate the influx. Unfortunately, Government failed to sanction the construction of houses under the New Housing Scheme until it was too late for managements to commence work before the monsoon broke. In this connection a proposal was made to the Ministry of Labour and Employment, Government of India, that as a temporary and short-term policy the construction of single-roomed quarters should be taken up as even a single room per family would be an improvement on the present position. The suggestion, was turned down.

Bengal Field

The year has been a peaceful one on the whole although early in the year there was a brutal attack underground on the manager of a colliery not belonging to the Association which has been ascribed to the activities of a political organisation. With this exception, assaults on managerial and supervisory staff have been less than in the past.

Bihar field

Generally speaking, 1958 has been a quiet year and such strikes as did occur did not affect the larger collieries or were not of long duration. Inter-union rivalry was usually responsible for stoppage of work and in two cases in the Jharia Field, in which a Political party was involved.

xth Session of the Industrial Committee on Coal Mining

During the year under review, the Government of India, Ministry of Labour and Employment announced their intention to hold the sixth session of the Industrial Committee on Coal Mining early in 1959. The more important items of the agenda include :—

1. Abolition of contract labour system of employment in coal mines.
2. Abolition of the C. R. O. and other private labour camps and the further continuance of the Gorakhpur Labour Organisation.
3. Revision of the Standing orders in the coal industry.
4. Water supply in the coalfields.
5. Gratuity and old age pension.
6. Conclusions reached at the Mines Safety Conference.
7. Implementation of the code of discipline in the coal mining industry.
8. Training scheme for coal mine entrants.

ABOUT WELFARE LEGISLATION

The report makes reference to various draft amendments published during the year by the Government of India to the Mines Rules, 1955, Mines Maternity Benefits Act, 1941, Coal Mines Pit-Head Bath Rules, 1958, Mines Creche Rules, 1957, and the views and recommendations submitted to the authorities by the Association in these respects.

Safety, Welfare & Training

The reference to the setting up of the Steering Group by the Government of India, Ministry of Labour and Employment, for a full discussion of safety in coal mines and the views of the Association with regard to various proposals put forward at the conference has been made in the Annual Report.

The Standing Coalfields Committee, on behalf of the Association, drew up a suggested memorandum on safety dealing with the subjects mentioned. In the opening preamble it was stated that the subject of

safety in mines was a complex and world wide problem which required that the facts and statistics should be studied dispassionately so that the deliberations of the proposed Conference could result in concrete and effective steps being taken to improve the already high standard of safety in India. Generally speaking colliery owners more than anyone else realised that mining was a hazardous occupation and were fully alive to the importance of safety and the necessity of reducing accident risks to the minimum. This attitude along with comprehensive mining legislation had resulted in India having an accident rate second to none. The points made in the memorandum brought out that there was already sufficient mining legislation and, while every effort was being made by conscientious managements to carry out their responsibilities, they were seriously handicapped by the present shortage of suitably trained and qualified men.

SHORTAGE OF TECHNICAL PERSONNEL IN MINING INDUSTRIES

During the year under review the Coal Controller wrote to the Association enquiring how the requirements of the various categories of technical personnel were being met, what action the private sector was taking to increase the supply of technical personnel and whether the present arrangements were adequate. The Association as also the Indian Mining Federation and the Indian Colliery Owners' Association replied to the effect that there was a severe shortage of technical personnel in all grades and Government should take immediate steps to increase the number of such personnel for the private sector. Coal companies, however, were not aware of the precise facilities available for training and it was felt that there was room for more co-ordination between the various schemes which were already working or would be introduced in the future. The whole of this matter was discussed at a meeting in September called by the Coal Controller and the first point made was that the original discussions already referred to only covered the requirements of technical staff for the Second Five Year Plan; it was now necessary to extend the assessment to include requirements during the Third Five year Plan.

Conservation & Safety Legislation

Referring to the representations made during the previous year to the Coal Board in regard to an upward revision in stowing assistance the report for the year under review, inter alia, states that the Association's case for an upward revision in the

stowing assistance is based on increased wages and allowances which had to be given to labour, rising costs in respect repairs and renewals and the inadequacy of the present depreciation allowances and the quantum of assistance.

It was finally considered that the present ration should be revised as follows with effect from 1st April, 1956 :—

	Present rate	Revised Rate
Hydraulic Stowing with Sand and other materials	85% of the cost with a maximum of Rs. 1—8—0 per ton	90% of the cost with a maximum of Rs. 2—8—0 per ton
Hydraulic Stowing with Crushed material	85% of the cost with a maximum of Rs. 1—11—0 per ton	90% of the cost with a maximum of Rs. 2—11—0 per ton
Dry Stowing	85% of the cost with a maximum of Rs. 1—9—0 per ton	90% of the cost with a maximum of Rs. 2—9—0 per ton

The report contains references to the principles governing sanction for assistance towards blanketing operations undertaken as protective works in collieries, method of working thick seams, pegging of production of coking coal during the year under review, delay in the finalisation of the applications to the Mines Department, controls, price, distribution and grading, sales tax structure, mining leases, royalties and rights, etc.

In regard to the transport bottleneck due to the non-availability of adequate number of railway wagons, the report stresses the need for the quicker

and timely supplies of wagons at collieries in order to increase production and move the coal to the required centres. The report states that during 1958 the position in regard to the supply of railway wagons has recorded an improvement except at collieries served by the South Eastern Rly.

IMPORT OF MINING EQUIPMENT AND MACHINERY AND OTHER SUPPLIES

Import Control Policy : At the present time little of the equipment used by the mining industry is manufactured indigenously and therefore large and continual imports are necessary. The Association although aware of the serious shortage of foreign exchange, felt it necessary to press throughout the year for more liberalization in the import of mining equipment and machinery.

In 1957 the import licensing period which commenced on the 1st July related to three months only instead of the usual six monthly period and no new licences were granted to established importers. The period which commenced on the 1st October, 1957 was for six months and applications for import licences from actual users were requested by the Deputy Coal Controller (Production) in November in respect of motors and by the 15th December for machine tools, iron and steel and wire ropes etc. These, after scrutiny, were forwarded to the Import Trade Control Authorities for licences to be issued. For the period April to September the Deputy Coal Controller (Production) called for actual users' applications for import licences for machine tools and flame-proof motors by the 14th June and in respect of capital goods and heavy electric plant by 31st May.

The report focuses attention that grant of licences by the Import Trade Control Authorities was being drastically curtailed in spite of the repeated representations of the Indian Mining Association and other representative organisations of the Mining Industry.

CHEMICAL ANALYSIS OF PRINTING METAL

An Indian Standard covering the methods of chemical analysis of various grades of printing metal [Doc: SMDC 2(139)] has been drafted by the Indian Standards Institution, and issued for wide circulation with a view to eliciting comments from the interested parties before finalising it as an Indian Standard. The last date for the receipt of the comments is 24th July 1959.

The methods, prescribed in the draft standard, deal with the determination of lead, antimony, tin, copper, iron, arsenic, zinc, nickel and aluminium in printing metal.

Copies of the draft are available, free on request, from the office of the Indian Standards Institution, New Delhi, or from its Branch Offices at Calcutta, Bombay and Madras.

India now makes Commercial Blasting Explosives



Part of the Indian Explosives Limited factory at Gomia, Bihar

FOR OVER 75 YEARS commercial blasting explosives manufactured by I.C.I. and its predecessors have been used in India. They have acquired an unrivalled reputation for safety and dependability.

India's vast new development projects—her dams, her power houses and her other civil engineering achievements—are being created with the aid of commercial explosives. The coalmining and iron-ore industries, the working of quarries, the building of railways and new roads—all these use explosives to shift rock and earth and to drive tunnels. The Indian Explosives factory at Gomia—the first of its kind in India—makes commercial blasting explosives, and it will eventually ensure the nation's supplies of these products.

Indian Explosives Limited is a joint venture of the Government of India and Imperial Chemical Industries. I.C.I.'s Nobel Division was responsible for the layout, for design of plant and equipment, and for erecting the factory. Personnel from Nobel Division will operate the plant until Indian technicians are trained to take over. And Indian Explosives will continue to have at its disposal the benefits of the research and technical know-how of Nobel Division.

Commercial blasting explosives made by IEL with the trade mark 'Torch Brand' will carry the same guarantee that has made the name 'Nobel' famous throughout the world for quality and dependability.

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New Developments in the Field of Precision Instrument Technology

By Dipl. Ing. Heinz Zill

Scientific Departmental Manager with VEB Carl Zeiss Jena.

THE continuous advance in engineering as employed in modern methods of production calls for the increased adoption of greater refinement and exactness of industrial fine-limit measuring and inspection instruments. Some of these new instruments made by VEB Carl Zeiss JENA aroused considerable attention when exhibited on the occasion of recent International Fairs. It is the object of this article to acquaint investigators, professionals and production engineers with the features of these new instruments.

The *Nuclear Track Measuring Microscope* (Fig. 1) is used for the determination of properties and energy of particles by means of the tracks left by them on photographic emulsions. This instrument, designed by VEB Carl Zeiss Jena in conjunction with Prof. M. Cosyns, Brussels, has produced the highest precision so far attained with regard to stage movement and adjustment of the objective. The instrument is intended primarily for scatter measurements of tracks of high energy particles. Depth, angle and gap measurements can be carried out. By means of an interfero-

metric device the accuracy of the stage and objective movement can be checked at any time. By switching over, all measurements and readings of the values are effected in the same tube which obviates the operator being influenced when reading the values. To avoid re-accommodation which would become necessary when writing down the values, the recorded values can be spoken into a tape recorder built into the instrument. The size of the plate to be used is 125×150 or 135×135 mm with a stage movement in x-direction of 55 mm, in z-direction of 3.2 mm. The magnifying range for the searching objective varies from 160 to 250 times, for the measuring objective for the time being from 800 to 1250 times when using plane-field achromats $10 \times / 0.20$ for the searching system and monochromats $H 1 50 \times / 1.35$ for the measuring system. PK 8 $\times$, PK 10 $\times$ and PK 12.5 $\times$ are used as eyepieces. A mains supply of 200 V A.C. operates either an incandescent lamp of 12 V/100 W or a mercury high pressure lamp HQE 40 for the object illumination, as well as an incandescent lamp 6 V/15 W for the scale illumination. For interference measurements a thallium lamp TLES is used.

The contact-free measurement of thickness has increased in importance in cold-rolling mills, in the paper, plastics and textile industries, especially where it can be combined with automation in the manufacturing processes. The most refined method is doubtlessly that of *absorption of radioactive radiation*. In co-operation with the Research Institute Manfred von Ardenne, VEB Carl Zeiss Jena have designed an instrument of this kind operating according to a difference method with automatic compensation. On a recorder connected to the output of the electronic amplifier the change in surface weight is indicated as measured value. The measuring range varies from 5 to 1000 mg/sq. cm. As the efficiency of the instrument depends on the radiation energy, the maximum sensitivity is around 30 to 50 mg/sq. cm. To specify it, it should be mentioned that even surface weight alterations of 0.1% are clearly discernible which means that, for instance, at a foil thickness of 150 μ a

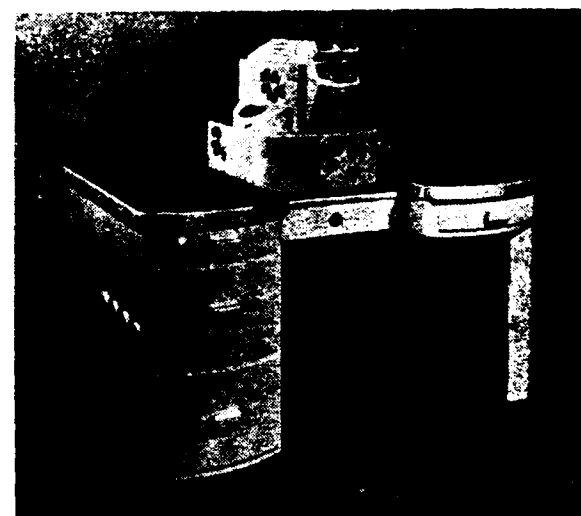


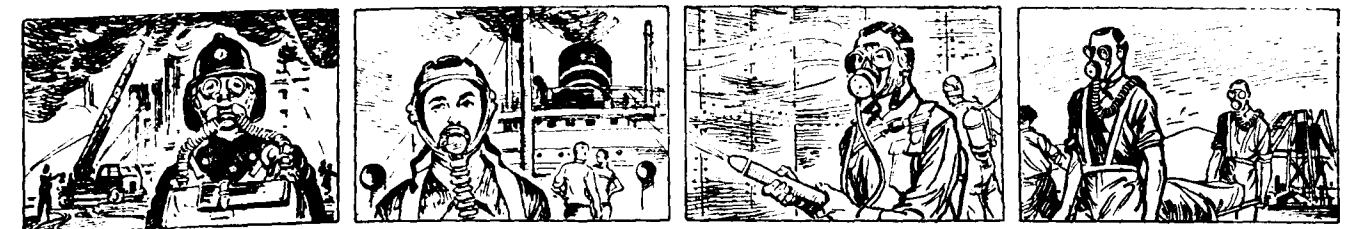
Fig. 1. *Nuclear Track Measuring Microscope*
The table contains a magnetic tape for recording the measured values, as well as a switchboard and accessories.

deviation of 0.15 μ is recorded. Thallium 204 and strontium 90 are used as radiation sources. The design differs from the instruments produced by other firms because it operates according to the compensation method, whilst the other instruments use the deflection method for which the zeropoint stability requires considerable electrical consumption.

The new *Angle Division Tester* (Fig. 2) is a valuable supplement to the dividing heads and rotary attachments which have always been used in general mechanical engineering. With mechanical dividing heads a reduction in accuracy occurs — as is well known — in the course of time, especially on the areas extensively used. To be able to measure this systematic defect, it becomes necessary to check at certain intervals with a precision measuring instrument which is now provided in the form of the Angle Division Tester. The design of the instrument is basically as follows: In the casing is a graduated glass circle firmly connected to the take-up bush.

In addition, the bush which can be rotated through 360° is connected to a rough scale let into the outer wall of the casing. An auto-collimating telescope housed also in the casing effects the alignment with a double index mark by means of a mirror placed close to the instrument in a fixed, vibration-free position. To facilitate this adjustment, a sighting device is attached to the instrument and an auxiliary telescope to the mirror. With this adjustment the initial value is read as with a theodolite. To eliminate eccentricity errors of the graduated circle the reading is taken at 2 diametrically opposite places (coincidence reading). The double image of the graduated circle appearing in the eyepiece is made to coincide by means of an optical micrometer and the angle is read off the base scale to 10 minutes. Units of minutes and seconds appear in a special window. Starting with this initial position, the setting of the required angle is then effected. For measuring star wheels and gear wheels a swing-out ball stop with precision indicator is

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This new equipment for use in toxic atmospheres is specially designed to eliminate errors in fitting or use. The safety line and hose coupling are permanently fixed to the harness. Even if the bellows are left unattended, the wearer can continue to breathe through blower or bellows. The special 'non-fogging' facepiece

gives unimpeded vision in all directions. The 'Vista' Mask is approved by the Ministry of Transport for use in ships, including tankers.

SIEBE, GORMAN are long-established suppliers of all types of safety equipment to the Admiralty, the Public Services and Industry.

Siebe, Gorman & Co. Ltd., Davis Road, Chessington, Surrey

AGENTS: BURN & CO. LTD., P-10, MISSION ROW EXTENSION, CALCUTTA-1



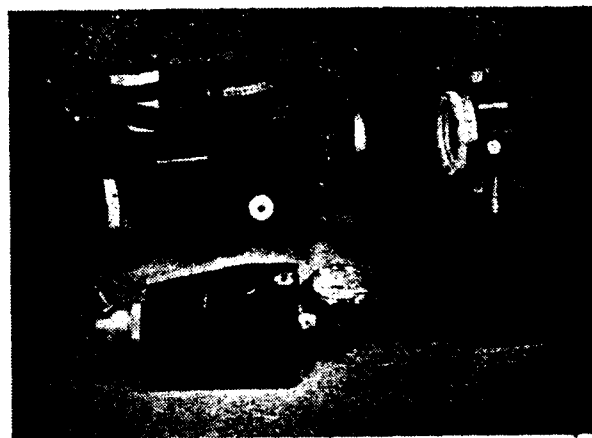


Fig. 2. Angle Division Tester.

also supplied. The parallel path of the rays between the telescope and the mirror permits a parallel displacement of the instrument and the mirror towards each other. The instrument can be used in a vertical as well as horizontal position and is therefore superior to the theodolite with collimator with regard to its possible applications. It is primarily used for the testing of dividing heads, rotary stages, gear wheels, star wheels and polygons; also for the adjusting of angle sizes when machining graduated plates and star wheels, gear and worm wheels (single dividing method) as well as divided circles of any kind. Some important specifications are: diameter of take-up bore 45 H6, its length 120 mm, reading accuracy of the graduated glass circle on the precision scale 1". The graduated circle is divided into degrees from 0 to 360°.

The *Automatic Control Tolerance Indicator* (Fig. 3) is a contribution of VEB Carl Zeiss Jena towards instruments indicating tolerance limits by contact

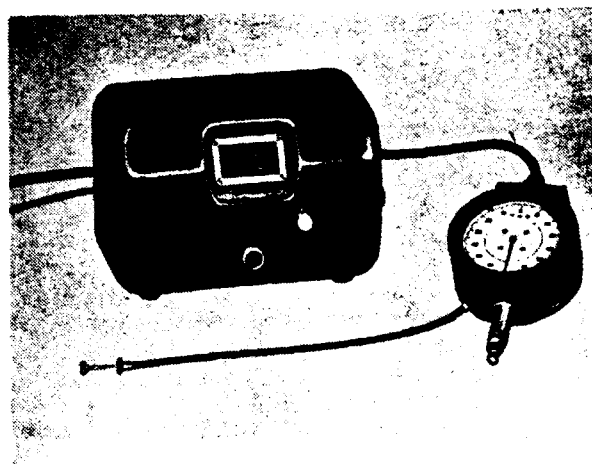


Fig. 3. Automatic Control Tolerance Indicator.

making. With such instruments light signals can be given, sorting switches controlled, multi-point testing devices equipped and manufacturing processes influenced. Compared to other instruments on the market, the Zeiss Automatic Control Tolerance Indicator has the advantage of permitting the setting of tolerances from an initial value by means of curves in the instrument, without the additional use of slip gauges or threaded spindles which are never free of errors. Furthermore, the contact and tolerance marks on the scale are coupled to each other, so that any displacement of contact becomes immediately noticeable. The contacts themselves are designed in such a manner that a change through flow of material or mechanical effects due to flattening is eliminated. True contact is maintained over hundreds of thousands of switching operations, as prolonged experiments have proved. The maximum deviation between tolerance mark adjustment and contact is 0.8μ within the range of $\pm 50 \mu$. The possibility of adjusting the contact over the central zero-point to the + or - range enables one contact to be used as a first contact and the other as an end contact. The outside dimensions of the casing of 82 mm diameter and 37.5 mm thickness are only slightly larger than those of a dial gauge. Furthermore, the casing is sealed against spray water and protected against water of condensation by a hygroscopic element inside the casing, which are factors of great importance to the safety of the Automatic Control Tolerance Indicator when in operation on a machine, because of the coolant. The pressure shaft diameter is 12 h6. The indication is precise without consideration of the position of the contact marks at any time over the entire measuring range of $\pm 60 \mu$ to a scale value of 1 μ . With a deviation of the measured value of $\pm 0.1 \mu$, a reversing span of 0.5 μ , a free lift of 3 mm and a measuring pressure of 150 p, this instrument conforms to the requirements of the Special Class of the State Inspection Authorities in the German Democratic Republic.

An instrument of above-average importance is the *Universal Length Measuring Machine* (Fig. 4). It is a design further improved according to the most up-to-date points of view of the Eppenstein Length Measuring Machine. As indicated by its name, the applications of this instrument have been considerably extended, i. e. in addition to physical contact, it is also possible to measure without contact pressure by applying the silhouette or the axial section method. One of the main objects to be tested is probably the lead screw. Therefore, an accurate rotation about the horizontal axis is provided with the aid of a 12-face polygon with auto-collimation. Due to separate



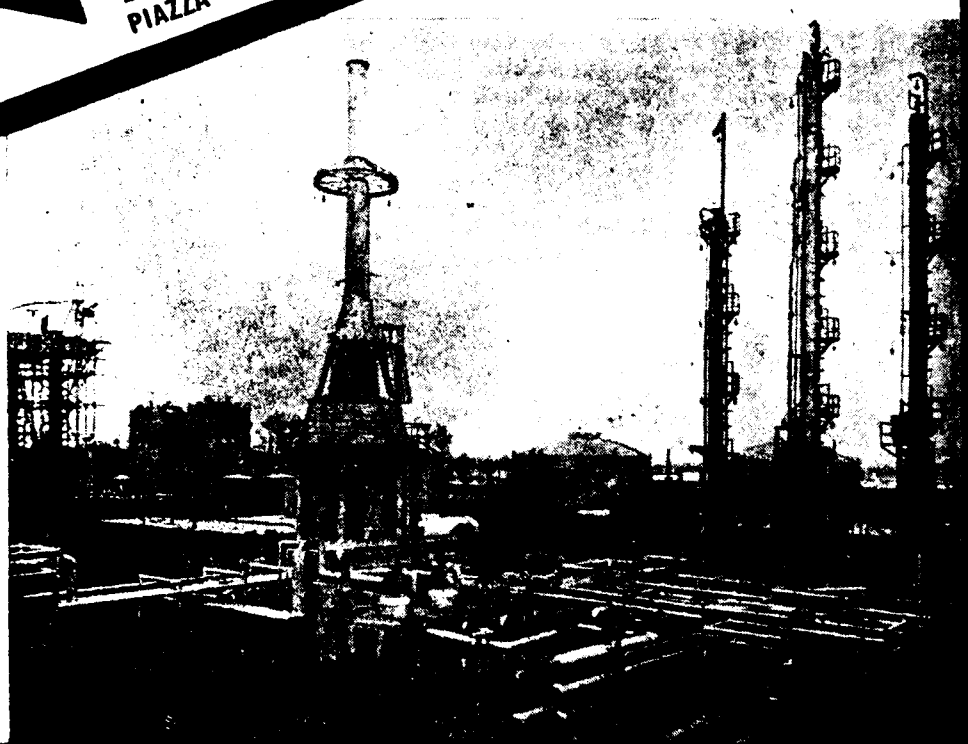
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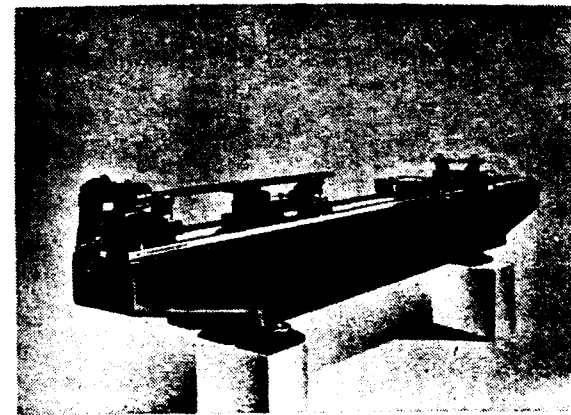


Fig. 4. Length Measuring Machine.

guideways for testpiece and measuring equipment, damage of the measuring bed is safely avoided, preventing guide errors of the measuring carriage when placing the testpiece on awkwardly; in addition, there is also the possibility of measuring the entire length at any given point on the testpiece. Measuring is carried out by direct comparison of the testpiece with built-in precision scales which are read with a microscope. A special arrangement of three co-ordinated collimators makes it possible to obtain a reading on the scales free from guide errors, an electrical contact indicator ensuring with mechanical scanning the maintenance of a constant measuring pressure. This instrument makes it possible to carry out exterior and interior measurements by mechanical contact, pitch measurements on threads and lead screws by mechanical as well as optical methods. For mechanical scanning sphere calipers are used, and for ascertaining the effective pitch error a nut component belonging to the respective threaded screw. Optical scanning can be carried out by the silhouette or axial section method as well as by the interference line. In addition, a direct optical shape comparison is provided for by using revolving eyepieces with corresponding graduated plates. The flank diameter can, furthermore, be determined according to the two or three wire system; also division measurements on scales can be carried out with great accuracy. Important features to be recorded are: measuring length of 3000 mm, total magnification of the various optical systems 10 to 50 times, reading accuracy on the optical micrometer of 1 μ , on the angle measuring eyepiece of 1 minute. For interior and exterior measurements the following are supplied; a plane table and a large plane table with height adjustment, tilt, rotation and length movements (floating), also a pointed jack, roller V bearings for pitch measurements and an angle adjuster with adjustment from 30° to 30° by polygon.

Finally, yet another efficient large apparatus is to be discussed — the *Knauthe Hob Cutter Testing Machine* (Fig. 5). As is known, high quality gear wheels are primarily manufactured by the hobbing process, whereby the quality of the hob cutter is of decisive importance on the precision of the gear wheel. The perfect measuring of hob cutters still presents some difficulties, as few useful instruments are available, and with these, measurements are highly complicated and time-wasting, and the evaluation of the measured values requires considerable mathematical efforts. The Hob Cutter Testing machine remedies these shortcomings. It permits to a great degree the automatic testing of milling cutters as to their pitch, pitch engagement division and base pitch angle, also the testing of the division and pitch of flutes and helices, the true running over the crown of the teeth and the cutting edge distance, as well as the true running of the curved surface and end faces of the inspection collar and the pitch on multi-start helical milling cutters. Measurement is effected as difference measurement, i. e. the perfect movement of the inductive scanning head mechanically produced in the instrument is compared with the shape of the milling cutter. The measured values are clearly recorded on a paper strip at 100, 200 or 500 times magnification. On the basis of these figures the typical milling cutter errors can then be ascertained. With point-by-point measurements it is

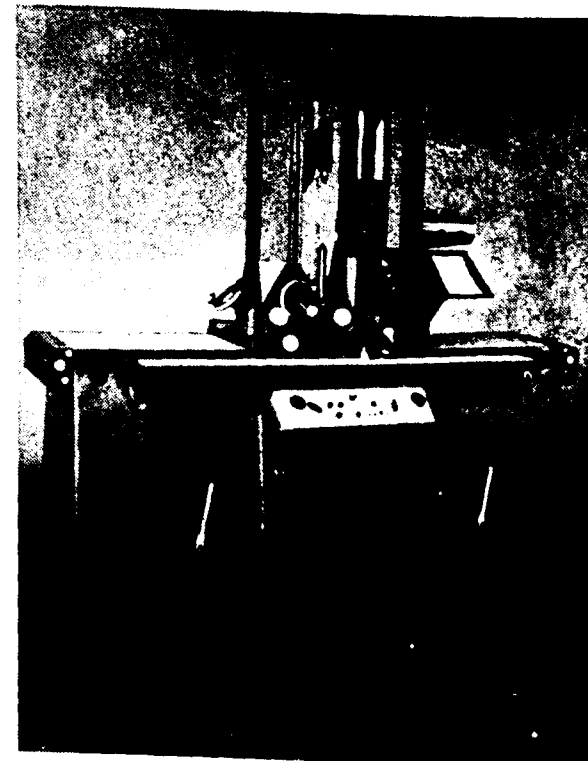


Fig. 5. The Knauthe Hob Cutter Testing Machine.

possible to determine in addition to the above mentioned values, the undercut of the flank of the tooth and the flank of the tip of the tooth, the pressure angle and the cutting edge distance. Contrary to other instruments of this kind where the longitudinal movement of the cutter carriage is transmitted positively with a ruler and a wheel as rotary movement on to the testpiece, the Knauthe Hob Cutter Testing Machine operates locked on to the profile only with a measuring screw controlling the movement, whilst for the transport of the carriage a second transport screw is used. In this manner the disadvantages of the friction gears are obviated which are particularly apparent with milling cutters of small diameter. To characterize the efficiency of the instrument it should be mentioned that it is possible to test with this machine milling cutters with α modulus 2 to 20, milling cutter diameters of 40 to 280 mm, pitch 0 to 64 mm,

with a separation of the tips of 260 to 485 mm over 5.2 revolutions of the milling cutter. This instrument the dimensions of which are: 1.8 $\times$ 0.8 $\times$ 1.8 m (weight 1.8 tons) makes it therefore possible to determine quickly, yet thoroughly, all the important milling cutter values, thus contributing considerably towards improving the quality of manufactured gear wheels.

The instruments described above represent only a cross-section of the new developments produced in recent years. However, the variety of applications and the latitude of the research programme point to the numerous domains. This reflects the great capacity of the precision mechanical and optical industry in the German Democratic Republic, capable of solving further problems and indeed actively engaged in doing so.

TRAINING OF ENGINEERS

Services offered by Foreign Firm

The benefit of its technical skill, gathered over the past 100 years, and modern engineering knowledge was offered by Skoda Works, a leading Czechoslovakian engineering enterprise, at its centenary celebrations in Bombay, to Indian Industrialists and the Government in their industrialisation plans.

The offer was made by the retiring Managing Director of Skoda (India) Private Limited, Mr. R. Hrazdira, while welcoming leading industrialists, businessmen and prominent Government officials to a function held in the conference hall of the Indian Merchants' Chamber.

UNIQUE POSITION

In a brief account of the origin, growth and the many-sided expansion of the Skoda enterprise,

Mr. Hrazdira stated that it today enjoyed a unique position in the engineering world because of its skill in the design and manufacture of industrial plants of all kinds.

He said that skoda's share in the industrialisation of India had gradually increased with the added requirements of Five-Year Plans. Skoda also provided technical training to Indian engineers to enable them to run different engineering plants independently.

Mr. C. V. Mathews, Director of Skoda (India), and Mr. J. P. Mukherjee, Chief Engineer, Walchandnagar Industries, also addressed the gathering.

The function was followed by a film show "Water power stations in Czechoslovakia" and "Engineering Exhibition in Brno".

Electrical explosionproof equipment in the Polish Mining Industry

By A Technical Correspondent
of ELEKTRIM, Warsaw, Poland

GASSY mines in Poland constitute approximately 50 per cent of the total number of mines. These mines, with the exception of several very gassy ones, are to a high extent electrified and this almost exclusively with the Polish made equipment.

The explosionproof equipment used underground in gassy mines must comply with the requirements of the Polish Standard PN-57/E-08101.

According to this standard the following types of explosionproof design are in use:

- (a) the flameproof design
- (b) the design using a plate enclosure
- (c) the reinforced design
- (d) the oil protected design
- (e) the special design embracing the spark proof arrangements, the enclosures filled with solid insulating materials, the ventilated enclosures, and so on.

Depending on the type of design, the electrical equipment is permitted for use in surroundings with a various degree of the risk of methane explosion. In Poland, gassy mines are divided into three groups.

- I. Surroundings classified under class of risk "a" in which there is no possibility for an explosive mixture of methane and air being produced. In this surroundings electrical equipment of standard design can be used.
- II. Surroundings classified under class of risk "b" in which the possibility for an explosive mixture being produced is very small and may occur only in the event of a serious damage to the ventilating system. Normal content of methane in such surroundings must not exceed 1 per cent.

The electrical equipment permitted for use in such surroundings must be at least of explosionproof reinforced design or of oil immersed design.

- III. Surroundings classified under class of risk "c" in which the forming of explosive mixture is rather possible and may occur even under normal working circumstances due to ventilation troubles or excessive production of methane. Normal content of methane in such surroundings can be higher than 1 per cent but if it exceeds 2 per cent the electrical equipment is disconnected from the supply and men are brought to the surface. In such surroundings apparatus of flameproof or special design can only be used.

In Polish gassy mines the electrical equipment of flameproof design is most commonly used even in surroundings classified under class of risk "b".

According to the definition given in the standard, the flameproof design is one in which all electrical components and all connections of current leads are housed in a flameproof enclosure. A flameproof enclosure is one that will withstand the test pressure and will prevent the transmission of flame from inside of enclosure to the surrounding atmosphere. The most essential requirements with regard to equipment of flameproof design are as follows: the minimum gap length, if the free space to be protected by the enclosure exceeds 2 cu. dcm., is 25 mm.

Minimum spacing between the edge of the screw hole and the inside of enclosure for this gap length is 10 mm.

Maximum gap width if the free space to be protected by the enclosure exceeds 2 cu. dcm. is 0.5 mm. Enclosure test pressure—8 kg per sq. cm. These requirements are in general identical with those set out by the Soviet Standards.

The standard also precisely determines the way of



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bolting together the individual parts of flameproof enclosures so as to obtain reliable joints. The bolts or nuts used for securing together the individual parts of flameproof enclosures must have triangular heads placed in protecting sleeves and be protected against getting loose by themselves.

The standard specifies the minimum insulating spacings and the minimum spacings in air depending on the kind of insulating materials used and the magnitude of voltage.

The terminal boxes used for flameproof apparatus must also be of flameproof design.

The rubber sheathed or other cable must in the place where it is lead into the terminal box be safely sealed and protected against being pulled out.

All explosionproof equipment, before being put into commission underground in mines, must be certified by the Supreme Mining Authority, as being suitable for use under the given circumstances.

The certificate is issued by the Mining Authorities on the base of tests which are carried out on the prototype by the Mining Safety Institute at the "Barbara" experimental colliery at Mikolow.

The following tests are carried out in the "Barbara" experimental colliery:

- (a) checking for conformity with the technical documentation, measurements of gap lengths and widths for all flameproof joints, measurements and checks of all bolt connections;
- (b) electrical voltage and heat tests, checking of the insulating spacings and of the spacings in air between live parts. If the tests here referred to will prove the conformity of the design of prototype with the requirements of the Polish Standard, further tests are carried out;
- (c) testing of the flameproof enclosures for mechanical strength by application of a hydraulic pressure of 8 kg per sq. cm.;
- (d) checking of the enclosure for the transmission of flame from its inside to the surrounding atmosphere; the test is made 6 times by means of an explosive mixture of methane

and air (Approximately 9 per cent of methane).

If all these tests and examinations have given satisfactory results the "Barbara" experimental colliery issues a statement in which it suggests to the Mining Authorities to approve the prototype under test for use in gassy mines, at the same time giving the flameproof mark and the registered number.

The electrical equipment certified as being suitable for use in surroundings classified under class of risk "c" receives the mark BM, while the equipment approved for use in surroundings classified under class of risk "b" only is marked by letters BW. After the certificate has been issued by the Mining Authorities the production of the flameproof equipment is started by the respective works.

In each factory manufacturing flameproof equipment works inspectors are present. These inspectors, which are trained in the "Barbara" experimental colliery and approved by the Mining Authorities are responsible for the safety of flameproof equipment.

These inspectors carry out the static pressure tests of enclosures and check the apparatus for conformity with the approved documentation.

Each apparatus is subjected to such tests and it receives then a works certificate signed by the inspectors.

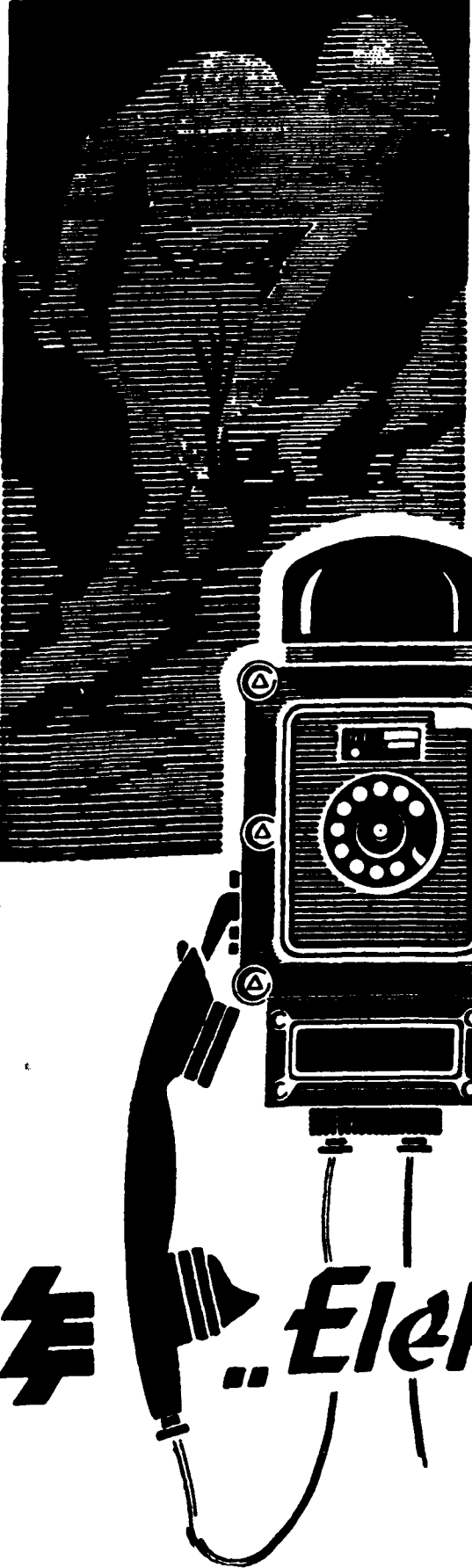
It should be noted that with regard to the dimensions of flameproof gaps the factories go considerably farther than it is required by the Polish Standards.

The length of flameproof gaps is in general much greater than that required by regulations and the width is much smaller than 0.5 mm.

For flat covers, the gaps are in general not wider than 0.05 mm and for shaft bores—not wider than 0.1 mm. Only for the packing glands of motor shafts and for the sleeves of couplings—the radial fit is not much lower than 0.5 mm.

Smoothness of flameproof surfaces is usually very high and in the majority of cases these surfaces are ground.

The Polish works are producing the following explosionproof equipment:



Mining Communication and signalling equipment for use in mines in reinforced and flameproof enclosures

For all particulars please contact:

THE POLISH COMMERCIAL COUNSELLOR'S OFFICE
42-44, Sundar Nagar, New Delhi
TEL: 43762

Elektrim

Polish Foreign Trade Company for Electrical Equipment Ltd.
WARSZAWA, CZACKIEGO 15/17, POLAND
Telegrams: ELEKTRIM WARSZAWA

A. Flameproof equipment

1. Electric three-phase induction motors with squirrel-cage rotor, for voltages of up to 500 V rated between 0.5 and 80 kW,
2. Gate and face coal cutters of an hourly rating up to 60 kW.,
3. Coal combines of an hourly rating of cutter driving motor up to 95 kW, and that of loader motor up to 37 kW,
4. Circuit-breakers incorporating air type contactors, remotely controlled, for rated currents from 15 to 200 A, with a thermal protection against overloads and a fuse protection against short-circuits,
5. Isolating switches for rated currents up to 300 A,
6. Fixed and disconnectable couplers for rated currents from 25 to 200 A,
7. Air transformers for outputs between 1 KVA and 6 kVA and 200 kVA,
8. Three-phase hand drills of a rating 1 kW,
9. Telephones and equipment for shaft signalling,
10. Lighting fittings for lamps 100 and 200 W,

11. Electric fans of a diameter 400 and 600 mm,
12. Signal and control push buttons.

B. Reinforced design equipment.

1. Electric three-phase induction motors with squirrel-cage rotor, for voltages of up to 550 V, rated from 1 to 80 kW.,
2. Oil transformers rated from 100 to 320 kVA,
3. Mining locomotives, type "Karlik" with motor rated at 2.8 kW.

C. Special design equipment.

1. Battery hand and cap lamps
2. Battery-less telephones
3. Methane meters
4. Ohmmeters for detonator circuits.

The sole exporters of the Polish elektro-technical equipment are Messrs. ELEKTRIM, Warszawa, ul. Czackiego 15/17, Poland, who will furnish all information covering possible technical changes, delivery times, prices, etc.

INDIAN INTEREST IN LONDON NUCLEAR ENGINEERING SHOW

Many Indian visitors have been among hundreds from overseas who have so far attended the Engineering, Marine, Welding & Nuclear Energy Exhibition now being held at Olympia, London. The visitors represent about 40 countries.

The Indian visitors included Mr. D. N. Sud, representing the Heavy Electricals project at Bhopal; Mr. R. N. Bam, of the Industrial Planning & Development Corporation, Calcutta; Mr. A. Basu, of the Aluminium Manufacturing Co., Calcutta; Mr. D. S. Chosdia, National Engineering Industries, Jaipur; and Mr. J. R. Aurora and Mr. A. K. Chopra, both of Delhi.

Many of the exhibits on show are unusual and spectacular. The Royal Navy is displaying a full-scale replica of the control room of an Ashanti-class frigate with automatic and remote control. There is a loom weaving steel wires; the largest ball bearings known

to be made; and a 500 cu. ft. transportable cold chamber designed for use on a ship.

Three major branches of engineering are fully represented at the exhibition—shipbuilding, welding, and nuclear energy. So far as the first is concerned, the tonnage under construction today is twice as great as that of any other country, and the latest figures show that some 22 per cent. of the world's new tonnage is now under construction in British yards.

In the field of nuclear energy, British engineers—backed by more than 100 years of general progress and experience—have taken this new development in their stride, with the result that a large proportion of the 500 exhibiting firms are displaying examples of nuclear equipment or research work on their stands. By 1966 Britain expects to have an output of 6,000 megawatts from nuclear power stations.

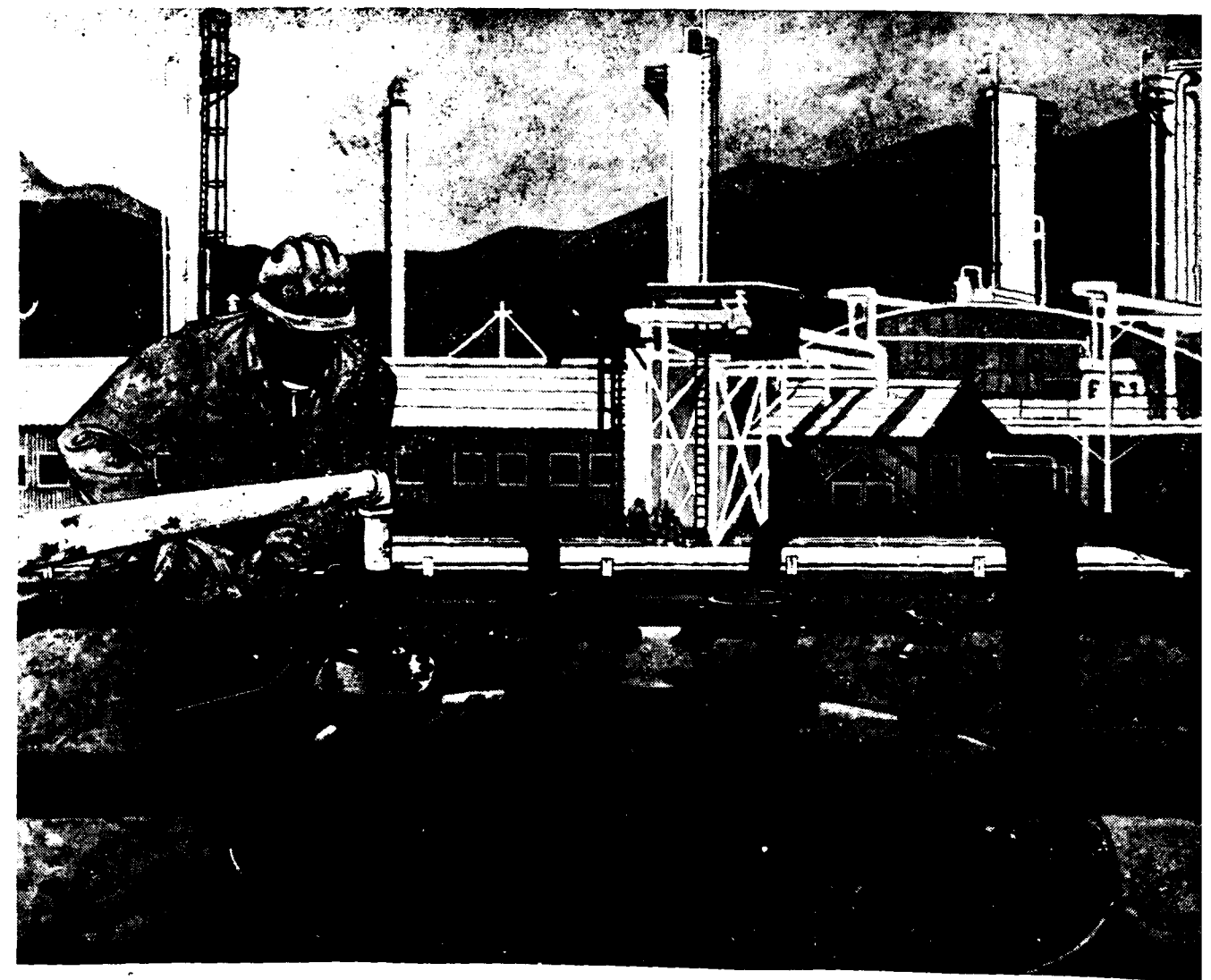
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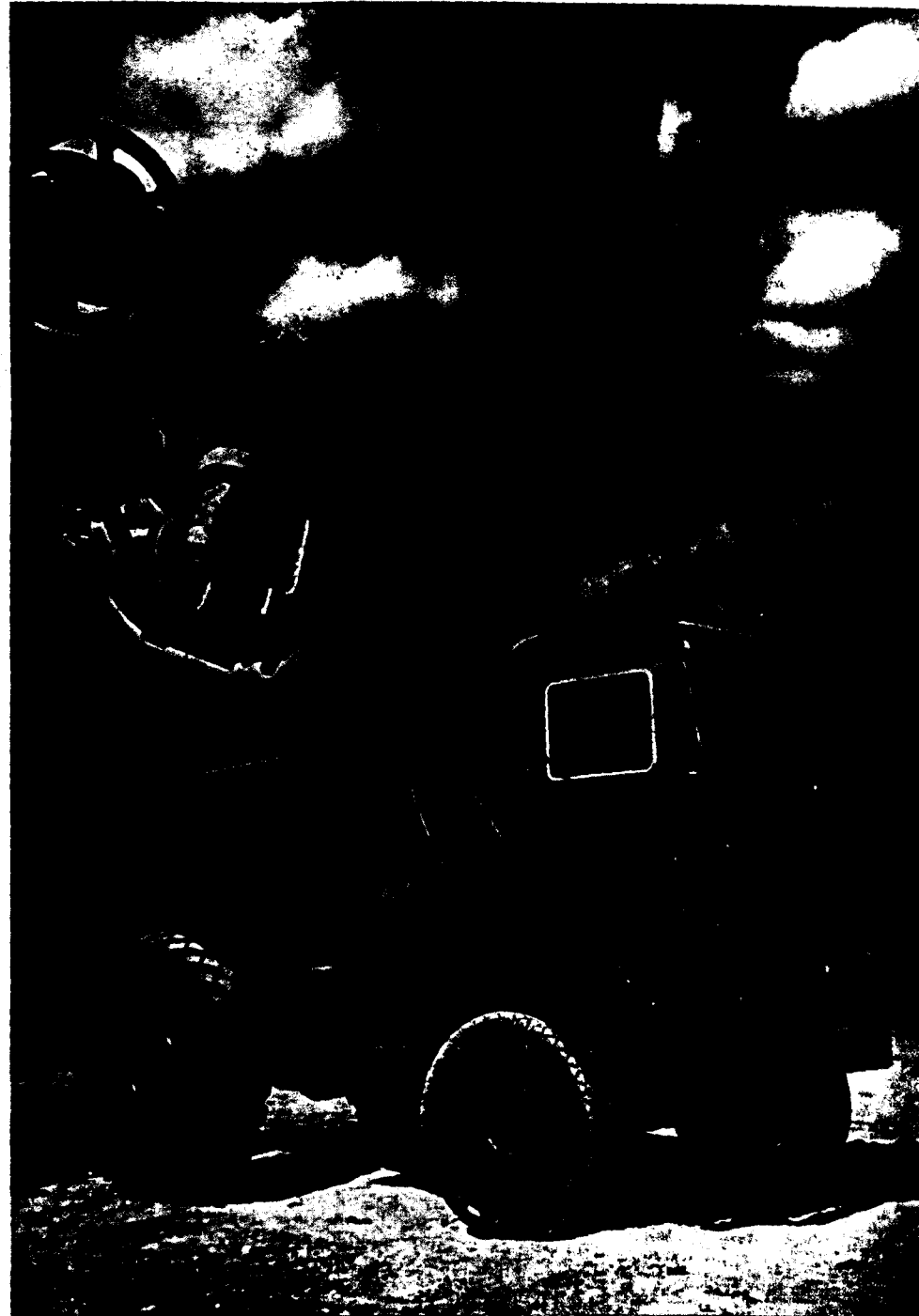
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