Welding in India

Problems and Perspectives

By K HARTLEY

Presidential Address at the First Annual General Meeting of The Indian Institute of Welding on 14th September 1967

(We have pleasure in publishing in this issue of the journal the Presidential address at the first annual general meeting, as the subject is one of continuing interest to all in the country engaged in promoting the use of welding).

India's welding industry has been making rapid strides during the last three decades since it was first born and there can be no doubt that it can now be said to have come of age. There are, of course, some who might want to set the date of the inception of the welding industry in this country much further back, to the third century B.C. when the famous iron pillar of Ashoka was built, probably the earliest recorded welding job in history, but welding as an industry in the modern sense of the term came to India only in the thirties of the present century when engineers introduced the techniques already developed in more industrially advanced countries.

In the beginning it was an uphill task for the pioneers of this industry to convince users that welding as a technique for joining metals was far superior to the traditional method of rivetting because it speeded up enormously the task of fabrication and at the same time economised on the use of steel and other metals or their alloys. But once the idea caught on, it was put to wide use by every metal-using industry. In the shipbuilding industry, in the fabrication of rail coaches and locomotives, in the automobile industry, in river valley projects, in oil refineries, steel plants, and in the structural industry, welding has gained wide acceptance. The welding blowpipe, the ubiquitous electrode and electric welding equipment, from simple transformers to the most sophisticated type of machine, are now a familar sight wherever engineers are faced with the task of joining and cutting metals.

Just one example of the extent to which welding has replaced older methods of fabrication is that of the ship-building industry. In the early period, welding and cutting played a relatively minor role in the Visakhapatnam Shipyard and the "Jala" ships were of over 80% rivetted design ; electric welding was limited to short transverse butts in bottom plates and shell plates. Today the ships under construction there are of almost 90% welded design. Modern oxygen parallel cutting plate edge preparation machines, cross carriage profile cutting machines with multiple cutting torches on each arm and numerous hand cutters are now carrying out the plate cutting work speedily and accurately. Piped supplies of gases (Oxygen is actually delivered to this shipyard in liquid form) have helped to increase productivity. There are a large number of manual arc welding machines and the yard also has multi-operator transformer welding sets suitably placed around the shops, berths and fitting jetty. Automatic arc welding has been introduced and self-propelled machines have been added to cope with the increasing tempo of fabrication.

Shipbuilding is not the only sphere, however, where welding has spelt modernisation and higher productivity. In the fabrication of the integral coach at Perambur rivetting has been entirely replaced by welding resulting in a lighter and stronger coach and productivity is considered to be comparable to international standards. Welding with strict radiographic testing is extensively used in the manufacture of railway locomotives both at Chittaranjan and at Tata Engineering & Locomotive Company at Jamshedpur. Very large diameter water pipelines in Bombay and Calcutta also bear witness to the welder's skill.

In the most modern of all fields, atomic energy, welding has an equally important role to play. The

atomic reactor project at Trombay is centred around a 165 feet high all-welded reactor dome. This gigantic structure in which every inch of weld was radiographically tested is certainly an achievement in welding.

One of the most classic examples of an industry which is almost completely dependent on welding is the petroleum industry. The cutting edges of the bits used to drill oil wells consist of a hard weld metal fused to a tough backing. The oil is conducted to the surface through pipe sections fabricated from plate by welding, and these sections are in turn welded end-to-end to form a leak-proof casing. At the refinery, the oil is processed in equipment of which almost every permanent joint is welded. Transportation to and from the refinery is via all-welded pipelines, ships, road tankers and drums. And ultimately, petrol is pumped from welded underground vessels into the welded fuel tank on the consumer's motor car, while in countries with cold climes, heating oil is delivered into a welded tank in the consumer's basement. In fact whenever a piece of apparatus is intended to contain a liquid or a gas, welding is the logical method of fabrication and has almost completely replaced other methods. Water, fuel gas and a host of other fluids are, like petroleum and its products, stored, processed and transported in welded equipment. Power boilers and other pressure vessels built to contain fluids are welded with complete reliability.

Welding Processes

To cope with the increasing purposes for which welding is required and the ever-growing variety of metals and alloys for the joining of which it is being used, welding technology is developing rapidly, new processes are being evolved and these processes themselves are being automised wholly or in part. The number of these processes is large and, as technology develops, keeps growing ; it would be remiss of me not to mention just a few. Beginning with gas welding and manual arc welding, which still remain the principal means of welding, the list includes automatic submerged arc welding—so named because an arc is formed between a continuously fed bare wire and the base metal is submerged in a layer of granular fusible flux—, automatic open arc welding using a continuous coated electrode and the Tungsten-Inert Gas (TIG) and Metal-Inert Gas (MIG) processes, which have made the welding of the older metals like aluminium, copper and stainless steel easier and more economical and which provide for some of the more modern metals like titanium, zirconium and molybdenum the only methods of fusion welding. Modifications of the MIG process include carbon dioxide shielded metal arc welding used mainly in structural and boiler shops, in railway workshops and for the manufacture of heavy machinery. The short-arc or "dip transfer" technique is in use in the automobile and other industries, and electro-slag welding for welding of pressure vessels and machine tools. Electron-beam welding has proved itself a very satisfactory process in the welding of reactive metals such as zirconium, titanium, molybdenum and their alloys which are finding increased use in the fields of atomic energy and rocket development. There is also the process of consumable nozzle welding and multi-wire submerged arc welding which greatly increase the rate of weld deposits. Finally, there are those last words in sophistication in the field of welding, ultra-sonic welding and laser (the use of sound and light as sources of power in place of the oxy-acetylene flame and the electric arc.) The ultra-sonic welding process is in use for welding fine-wire leads to silicon and germanium crystals in the manufacture of transistors, for joining bi-metal components and for welding thin sections of titanium, zirconium, molybdenum etc. to other metals where comparatively little or no inter-diffusion is desired. Welding with light is based on the principle that if rays of light can be made of the same colour and phase, i.e. entirely coherent, a parallel beam can be projected with practically no spreading. Laser equipment is designed to produce a coherent beam of light which is several million times as powerful as sunlight and which can be focussed to a pinpoint.

Most, but not all, of the electric and gas welding techniques I have mentioned are in use in India. The TIG and MIG welding processes have been practised for some time and even electro-slag welding machines have been imported into the country though they have yet to be put to extensive use. If some of the more sophisticated welding techniques in use in more developed countries have not yet gained currency in this country it only underlines the importance of an Institute such as ours which can help us to catch up with and spread modern techniques throughout the country in the interests of the national economy.

Welding goes hand in hand with cutting and here too many interesting developments have taken place in the world such as computer controlled cutting machines which have yet to come to India. But in this field also India has been moving quite fast and there is no reason why in the near future even as sophisticated a machine as the computer controlled device may not be put to use, provided facilities for giving training in skills required in handling complicated machines are made available.

Training of Welders

And this brings me to another important question—that of training India's welders without which all talk of using the latest modern techniques would be a mere waste of breath. There is unfortunately a serious lag in this respect in India. Our Engineering Colleges and our Technical Institutes have not been keeping pace with modern developments with the result that students who pass out of these Institutes and even the engineers who graduate from the Colleges have only a rudimentary knowledge of welding. In my opinion, the curricula of our Institutes and Colleges should give considerably greater emphasis to the subject of welding.

Basically, three types of personnel are involved in welding. There is the welding specialist or the engineer who is concerned with the designing of the welds in a fabrication, determining the welding processes and has the overall responsibility; then there is the craftsman welder who is responsible for laying down the welds and finally the supervisor or the inspector who interprets the instructions of the engineer to the welder and checks on the quality of the job and whether it conforms to specification. For the training of the craftsman, facilities have been organised by a number of large industrial undertakings including some in the public sector where courses have been arranged to impart training in general workshop practice and in the theoretical and practical aspects of welding. A number of State Governments have also sponsored institutes where training up to craftsman level is given. The defect in such training courses, however, is that they are of too general a nature and do not always succeed in turning out craftsmen with the requisite skill for the particular job they will be called upon to perform. In addition to the basic training, there is need for short intensive courses which will equip craftsmen for the specific types of welding they will be required to perform. The Indian Standards Institution has recommended codes of practice for the training and testing of metal arc and oxy-acetylene welders which are based on the principle of short term and intensive training with a view to meeting the immediate needs of industry and I sincerely hope that those responsible for sponsoring training at this level will take due note of I.S.I.'s codes.

Whilst facilities of a sort exist for the training of craftsmen, those for the training of supervisors and engineers are inadequate. The growing use of welding and the complexities resulting from the rapid technological advance during the last decade or so justify in this country much greater emphasis being laid on the training of the welding engineer.

The problem therefore of integrating university curricula with the developing needs of industry is more acute in this country than in most. This is again another field where The Indian Institute of Welding can perhaps play a role by impressing upon those concerned the need to revise curricula and to associate representatives of the industry more closely with the Council of Technical Education and other similar bodies.

The Recession

I come now to some of the problems facing the welding industry. The first of these is the serious recession that has overtaken the country and slowed down the pace of industrial development over the last three years. As against the rising tempo of industrial growth in the first three years of the Third Five Year Plan which had resulted in increasing the rate of growth to 8.5%, industrial production increased by 7% in 1964-65 and and 3.9% only in 1965-67. In 1966-67 it had further deteriorated and the rate of increase over the previous year was only 3%. The recession has had its impact on the economy as a whole but one of the sectors most severely hit is the engineering industry with which we, in the welding industry, are most intimately linked. The cut in railway expansion schemes, the delay in getting the Fourth Plan off the ground, the successive droughts leading to acute scarcities in foodgrains and agricultural raw materials have all combined to create a situation where the engineering industry is facing an unprecedented crisis. And, since the demand for electrodes and gases for welding and cutting equipment is geared to the activities of engineering units, the recession is naturally having its effect on the welding industry. The extent of the impact can be gauged from the figures for installed capacity and actual production of electrodes. In February 1967, the latest month for which official statistics are available, the installed capacity for electrodes was 33.2 million metres per month while the production was only 18.0 million metres ; in other words 46 per cent of the capacity of the industry was idle.

Apart from the causes already mentioned, the responsibility for the great extent to which the engineering and electrode industries are idle today rests on over-optimistic estimates of steel demand resulting in many instances in over-licensing. There are examples in the engineering industry where the capacity has been duplicated in the public sector although excess capacity already existed in the private sector. Similar is the position with the manufacture of electrodes ; industrial licences have been issued for the establishment of uneconomic units although existing capacity was adequate

to meet the demand for many years to come. I can only hope that we will all draw the proper lessons from the present crisis and, in future, avoid the mistakes that have been made in the past.

Export Possibilities

The effects of slackening internal demand might have been mitigated if overseas markets could have absorbed the production of electrodes, but there are certain built-in difficulties that restrict the export potential of this industry. The first of these is that electrodes are high in the order of priorities that any developing nation sets when launching upon the path of industrialisation. There is general acceptance of the fact that without indigenous production of electrodes, no worthwhile advance is possible in any country and it is because of this that electrode producing plants have been set up in almost all the countries in West and South-East Asia. Some of these countries currently follow a liberal trade policy in that they continue to allow imports of welding electrodes, in spite of the fact that they have their own means of production, but this is unlikely to last for long because they are bound to feel, sooner or later, the necessity for protecting their indigenous industry by banning imports.

There is also the problem of competition from the more industrially advanced countries many of whom are in a very advantageous position enjoying, as they do, the benefit of heavy export subsidies. Then there is the very important question of costs which prevent us from orienting our prices to overseas markets although the recent decision of the Government of India to offer steel at international prices will help to meet this difficulty to some extent but the full implications of the Government offer have yet to be determined.

Cost of Steel

The problem of costs is one that is not related to exports alone. The price of weldable quality steel and the question of quality extras charged for special steels is one that has the most vital significance for the welding industry.

One of the biggest advantages of welding is the saving that it effects in total steel consumption. It has been calculated for instance that in structural steelwork a saving of between 5 and 15 per cent can be obtained depending on the type of structure, if welding is used, but unfortunately much of the advantage so gained is lost in India by the higher cost of weldable quality steel in this country. This naturally puts a premium on the continuance of antiquated methods of fabrication.

The price of basic steel is of vital concern for the economy of the country as a whole. As the Committee on the Cost of Production of Steel has observed in its report : "Steel is one of the important sinews of industry. Stability of steel prices ensures stability in the prices of manufacturers in particular and wholesale prices generally. It helps to contain inflation and stimulate growth". Despite this it is an unfortunate fact that extraordinary increases in the prices of Indian steel have taken place over recent years. Steel manufacturers in India have pointed out that the signficant differential in the prices paid by Indian consumers is found in the large impact of Government imposts on steel, which for saleable steel increased by Rs. 156 per tonne between 1948/49 and 1964/65, and that ex works prices of Indian steel do not compare too unfavourably with the internal prices ruling in other countries. Whosoever's is the responsibility, it is the economy as a whole that suffers.

The position with regard to special steels is even more disquieting. In fixing the basic steel prices, all adverse factors involved in our steel economy have already been adequately covered and there can therefore be no justification for the very wide disparities that lie in the charges for quality extras as between, for example, British and Indian steels. In the case of electrode quality steel billets, quality extras in U.K. add 22.1 per cent to the basic price of steel in that country ; in India the same extras amount to 51.4 per cent over the basic price of steel. It should also be borne in mind that the basic price of steel itself is much higher in this country than in U.K. The high cost of electrodes resulting from this not only imposes a heavy burden on the welding industry but it adds to the cost of fabrication generally and makes all weldments dearer. In U.K. again, no extras are charged for weldable quality steel whereas in India for this type of steel 12 per cent extra is added to the basic steel price.

These are only a few of the many problems with which the welding industry is faced today. The solution of these problems will undoubtedly be rendered simpler once we are able to get over the recession and industrial production in the country reverts at least to the rates of progress that were achieved earlier. How soon that will take place depends to a large measure on suitable Government action to stimulate the economy but, when the revival begins, the industry should be ready to aid the process by developing techniques of welding that will add speed of fabrication, increase productivity and reduce costs.

Tasks before The Indian Institute of Welding

An essential precondition of this is to strengthen The Indian Institute of Welding which we have established. To enable it to play its proper role it is necessary first of all to increase the membership so as to make it fully representative of all who are interested in the development of welding; whether they be structural engineers, machinery manufacturers, manufacturers of welding gases, electrodes and equipment, producers of light engineering goods or any others—all have a vital stake in the future of The Indian Institute of Welding.

To enable it to perform its function as a clearing house for information on welding, technical sessions will need to be organised frequently. Through such sessions and symposia on specific aspects of welding technology, the gaps between theory and practice will be bridged as also the gap between technology abroad and in this country. Another function of the Institute is to assist the development of standards in welding and in this it is necessary to work in close cooperation with the Indian Standards Institution.

It must also be our aim to bring out, at the earliest possible opportunity, a Welding Bulletin which will reflect the activities of the Institute and also be a channel for inter-communication of ideas and experience.

To enable the Institute to serve more effectively those engaged in or connected with the welding industry, it is imperative that the organisation spreads its wings into the various regions of this vast country ; otherwise there is a danger that it will remain remote from those actually engaged in welding—the craftsman, the supervisor or the specialist—and become a purely academic centre. This will require the setting up of branches in various parts of India particularly where there are large engineering complexes.

Our desire to remain close to the welder should not however deter us from playing our role in the field of welding research. In all developed countries considerable importance is attached to research and many of the advances registered in welding technology are the result of research carried on by national Welding Research Associations which work in close collaboration with the national Institutes of Welding in those countries. In research of this nature in this country and in the activities of The Indian Institute of Welding generally there should be close coordination between the Institute, the Government, Institutions like the Council of Scientific & Industrial Research and the Indian Standards Institution.

There is much to be done but we must bear in mind that the Institute's resources are presently limited. While therefore keeping all our objectives before us we have to take up in order of priority such tasks as our limited financial and other resources permit us to undertake. While we must be ambitious, it would be wise to be realistic—hasten we must but "hasten slowly" must be our slogan. We know, however, that a bright future awaits us ; if we have faith in the future of this country—and despite temporary setbacks, I believe that this is something we all share—we can proceed secure in the knowledge that welding will play an increasingly important role in the building of the country in the years to come.