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Concerning the A.M.E.E.

The Association of Mining Electrical Engineers has ever been kindly favoured in regard to its Presidents. Looking down the list of those who have occupied the premier office in past years, one cannot but be impressed with the always very high but widely diverse credentials of those leaders of thought and practice in every branch where electricity and mining come together, who have voluntarily given their best for the Association as President. The members of the Association must feel proud and grateful in recognising the honour which is theirs in having gained the confidence, the esteem and active cooperation of these leaders. Nor, as being in keeping with the generous interest with which those past presidents are imbued, will any one of them begrudge the mutually congratulatory sentiments which animate the Association, respecting this year's appointment.

It has come to be usual in this column each year to give such items of biography as will serve to introduce more closely to every member the personality of the new President. It is good to know something of the home life and interests of the man with whom you deal: it begets confidence and creates a pleasurable atmosphere in intercourse. The fortunate members who attended the Convention will already rejoice in the possession of the unassuming and genial friendliness of Capt. Walton-Brown. So that those who have not met him may have some compensatory means of sharing the happy acquaintanceship, we have been at pains to gather for them some items of the career and life interests of Capt. Walton-Brown. It was no light task, in fact it was unsatisfactory to the point of impossibility to get Capt. Walton-Brown to say anything about himself. Perhaps it was by very reason of his modesty that we soon found good friends of his who were just as ready and willing to speak for him and to accord him the credit to which he is so fully entitled. Here then are some of the facts (some of those more strictly relevant to our present purpose) which we learned.

Captain S. Walton-Brown, President of The A.M E.E.

Capt. Walton-Brown was educated at Shrewsbury School and graduated at Durham University, obtaining the degree of Bachelor of Science. He served an apprenticeship with the late Mr. C. C. Leach, of Seghill, and obtained a First Class Mine Manager's Certificate and Surveyor's Certificate. He was appointed Manager of the Seghill Collieries in 1911 and General Manager in 1923; his services are also in demand, in a consulting capacity, for other important collieries. Capt. Walton-Brown saw active service in France and Salonika during the Great War.

Of the many influential public offices held by Capt. Walton-Brown may be mentioned: Justice of the Peace for the County of Northumberland; Member of the Northumberland County Council; Member of the South Northumberland Assessment Committee; Chairman of the Seaton Burn Valley Joint Sewerage Board, of which scheme he was one of the prime movers; Member of the Earsdon Joint Hospital Board; Member of the Seghill Urban District Council; and Chairman of the Seghill School Managers. He also serves the temporal needs of his fellows as Chairman of the Seghill Colliery Institute Committee; President of the Seghill Nursing Association and Child Welfare Centre; Chairman of the Seghill Comrades' Club; and President of the Seghill Staff Association. Nor is the spiritual welfare of the people neglected by Capt. Walton-Brown, for he is ardently interested as an active Member of the Seghill Parochial Council and is the Ruri-Decanal and Diocesan Representative; furthermore, he is a Member of the Bishop of Newcastle's Commission.

His technical interests are indicated in that he is: Member of Council of the Institution of Mining Engineers; Member of Council of the North of England Institute of Mining and Mechanical Engineers; Member of the National Association of Colliery Managers; and now President of the Association of Mining Electrical Engineers. He has been responsible for the electrification and re-organisation of the Colliery and Coal Preparation Plant at Seghill. This colliery has been described as "the best example of the all-electric-power operated type of colliery in the country." An account of the extremely enjoyable and useful visit paid to Seghill by the A.M.E.E. during Convention week, as well as some technical details of the plant, appear elsewhere in this issue.

Only a man of pleasing personality, tactful and far-seeing, could have earned this enconium of a well-known Labour Leader, who said: "I meet many men to-day who advocate Socialistic Principles but in Captain Walton-Brown I find a man who, whilst he may not in thought be Socialistic, cannot deny that he has many times by his kindly actions shown himself to be more than Socialistic in deed." He acknowledges the good fortune which has attracted capable officials to his service and is the first to attribute any success he may have obtained to the abilities of those whose duty it is to work under his direction. Capt. Walton-Brown is always progressive in outlook: he is a keen and determined advocate of the principle of a High Wages Policy allied closely with high production per man per shift. Moreover, he believes in practising at home the policy he preaches and strongly supports the saying, "There is no place like Seghill"; he is a patriotic Northumbrian, much interested in his county's customs, history and products such as Northumberland Sword Dancing and Music and in the merits or points of Border Terriers.

The spreading of Education is one of his keenest desires: he is very proud of the fact that two men from the coal face at Seghill Colliery have qualified as First Class Colliery Managers and obtained positions as such. He holds the firm opinion that the skilled workman of the future, in addition to being manually capable, must use his brains to save his muscles, and should have a better technical preparation. He looks to the Miners' Welfare Technical Schools to provide this and also to act as feeders for the Universities. Naturally, therefore, any branch of sport has attraction for him. He represented Northumberland County at Lawn Tennis and Rugby Football, still acts as a Member of the County Committee for each game and is Captain of the Brandling Lawn Tennis Club and President of the Seghill Golf Club. He is the Chairman of the Seghill Miners' Welfare Committee, which movement he characterises as the "Miners' Public School," takes a similar interest and position in the Seghill Brickworks' Welfare, and encourages the youth to follow the right road by acting as President of the Benton and District Boy Scouts' Association.

Here then in Capt. Walton-Brown is a forcible example of the precept that if you want anything done quickly and well give it to the busy man. The affairs of the A.M.E.E. are in good hands.

By way of summarising the lasting impressions of an exceptionally successful Convention may be noted: the unflagging efforts of the men of the local Organising Committee; the whole-hearted hospitality of the City of Newcastle, its leaders in civic and county affairs and in coal and electricity, who did not spare themselves in the aim to instruct and entertain their guests; the generous and candid recognition accorded to the Association by Coal Owners and Managers, who in acknowledging that the A.M.E.E. had indeed played an essential part in securing such a considerable degree of progress in British Mining as was already in being, were convinced that the Association was destined to carry forward its good work with greater strength and more effectively than ever.

Convention Humour.

Captain Walton-Brown may not know it, but he is a member of the "tight-boot brigade," as are all colliery managers, whose only joy in life is when they take off their shoes.—*Col. W. C. Blackett at the A.M.E.E. Dinner.*

Referring to the impending visit to the Seghill Collieries of the Women's Electrical Association, one of the pitmen was heard to remark that he knew something about the peculiarities of the "iron-man," but what on earth was an "electrical woman"?—*Capt. Walton-Brown at the A.M.E.E. Dinner.*

In the old days when neither the electrical engineer nor the colliery engineer knew anything about electricity, the electrical man beguiled the coal man into a wonderful maze of experiments; to-day the electrical man did not seem to know very much more, but he had set up a fence of weird and wonderful terminology behind which to shelter.—*Mr. E. J. George, at the Consett Iron Co.'s Dinner.*

The Ultra-Modern.

As representing all that is most up-to-date in scientific engineering and in politics surely the little ceremony of July 5th last would be hard to beat. On that date the youngest Woman M.P., Miss Jennie Lee, journeyed by Aeroplane to set in operation the newest and largest Low Temperature Carbonisation Plant completed in Great Britain. She had flown over from Croydon in a six-seater aeroplane which was driven on Coal Petrol, one of the products of this carbonisation process. The breaking of an electrical contact by Miss Jennie Lee, which meant overturning a 10-tons wagon of coal slack into the carbonisation plant, inaugurated the process. Then began the conversion of this slack into coalite smokeless fuel, rich gas coal oils (suitable for naval and general purposes) and coal petrol.

The plant has been erected for Doncaster Coalite, Ltd., by Low Temperature Carbonisation, Ltd., and is situated at the pithead of the Askern Colliery owned by the Askern Coal and Iron Coy., with whom arrangements have been made for a supply of coal direct from the pithead over a period of years. The section now completed is capable of carbonising 90,000 tons of coal a year, and the eventual through-put will be 180,000 tons of coal, which will yield approximately the following main products: Smokeless fuel, 127,000 tons per year; oils and petrol, 3,731,000 gallons per year.

Presidential Address

TO THE

Association of Mining Electrical Engineers.

Capt. S. WALTON-BROWN, B.Sc.

ON this occasion our Annual Meeting is being held amidst somewhat unusual surroundings, and I trust that, as a consequence, I may be permitted to crave your indulgence and make use of a somewhat unusual subject which, in its effects, is of vital importance to the Mining Industry and which, in its ramifications, may not be very fully understood by all our members.

It will be admitted freely that the North-East Coast Exhibition has come into being not for the purpose of providing amusement or recreation, but solely as a business proposition bravely inaugurated during a period of trade adversity by a very insular and, in some respects, a not too adequately known part of England, with the definite intention of advertising its products widely; of studying and if possible improving its methods of selling; and, most important of all, for the purpose of stimulating and effecting actual sales.

It seems therefore an opportune time in which one might reasonably and briefly review the manner in which coal is marketed, both from the publicity and sales points of view. It is impossible satisfactorily to condense so wide a subject into a short address and I must apologise if my inclusions and omissions have not been selected most advantageously.

PUBLICITY.

In considering the subject of publicity, it may be best to divide it into two sections.

(a) Advertising with a view to increasing sales.

(b) Publication of statistics, paragraphs, etc., concerning the Industry. The featuring of intolerable trivialities by the "Stunt Press" is included under this head.

Advertising.

It is extremely difficult to say whether Press advertising really is a financial success from the point of view of a colliery undertaking. I have never seen any figures illustrative of results which provided effective proofs. Even the recent Advertising Convention was strangely silent as to its powers of inspiring coal sales. Most collieries, however, do a certain amount of Press advertising and hope for the best.

Collieries are not in the position of manufacturers with a world-wide market available for certain standard articles at fixed prices, each of which can be made in any quantity desired, but they have to dispose of a large number of varying articles of varying constituents and prices. Coal consumers all have their likes and dislikes, and any form of definite standardisation has hitherto been impossible. It is often necessary to embody the products of more than one undertaking in order to get the quantity or the combination of price and quality desired by certain buyers. It might be possible for the collieries to agree amongst themselves on certain gradings and say to consumers "you must take what we offer or nothing at all," but the policy of the trade salesmen in the past has been to do everything in their power to meet their consumers' requirements, and this still seems to be the wisest course. Dictatorial action, either by producers or consumers, will not cement business friendships.

A colliery makes a number of grades of coal and, by advertising, may stimulate the demand for one grade much in excess of the others. Whilst this may facilitate the disposal of this one particular grade it must be remembered that all the other grades also must be made and sold contemporaneously. The quantity of one grade cannot be increased without increasing the quantity of the others. They are not interchangeable, except as far as breaking from a larger to a smaller size is concerned and this is not usually a financial success with bituminous coal. The sale of all products must therefore be maintained in the proportion in which each is obtained from underground. Demand is not always active or equally proportional in every grade at the same time and the grade which is dull has to be forced on the market to enable the sale of the active grades to be continued.

We have not yet solved the problem of how to advertise to prevent such happenings, bearing in mind that coal cannot be satisfactorily stored and that the dullness of the sales of the particular grade most probably will not be merely confined to one undertaking, but will be common throughout the district and possibly even throughout the industry.

As far as price publicity is concerned, the Press news is very good and circulates daily throughout the world. The telegraph and telephone enable rapid business to be done and wireless has greatly helped the loading of boats and general docking arrangements.

On the whole the best export advertisement seems to be that obtained through the Commercial Exchanges where buyers and sellers meet together and rapidly ascertain each others' views.

Advertising in the Inland Trade does present better possibilities, but it is difficult to increase prices by so doing. Transport costs definitely limit the active inland sales area of each undertaking. It is not always realised that to send an average ton of coal by rail 100 miles costs more than the value of the coal itself. A general diversion of sales to a more favourable outlet seems to be the only effective price reviver.

One does not see a great deal of mass advertising in other manufacturing industries. Each individual firm seems to prefer to manage its own advertising affairs, even although they may be financially interconnected with others. The same spirit pervades the Mining Industry, which has always been supremely individualistic.

The commercial interests of individual collieries are not necessarily the same in as much as their products are utilised for varying purposes. An example of this is contained in a recent intimation in the Press to the effect that although Craigweil House, at which His Majesty the King spent his recent convalescence, was adequately centrally heated, on the recommendation of his medical advisers open coal fires were installed in His Majesty's personal apartments. On reading this, persons supplying household coal for domestic fires at once polished up their office texts "Coal fires for Health and Comfort" and felt better; whilst disappointed gas or coking coal operators possibly showed their disapproval by joining a Smoke Abatement Society or subscribing towards the publication of some journal furthering the development of low temperature carbonisation.

In other words, "What is one Colliery's Meat is another Colliery's Poison": and, therefore, mass advertising in the coal industry is not as yet a really popular suggestion.

Dissemination of Information concerning the Industry.

Whilst it is possible that, in the opinion of some, the trade advertising may not be sufficient, I think there will be general agreement amongst the technical employees and many others that the publication of "notorious news" regarding our industry is much overdone, especially in times of strife and dispute. To quote an example one notes that even now, when we are all striving hard to rebuild the industry and recover our markets, we are handicapped by Press news relative to possible political or internal trade dissensions which may or may not cause trouble at some future date. Such statements cannot fail to instil into the minds of foreign buyers the thought that they may not secure proper delivery of the fuel for which they may be making contracts at the present moment. The Coal Trade has had plenty of trouble of its own creation in recent years, and I think we may ask that persons unconnected with the industry should exercise the utmost discretion and do nothing which might give rise to a recurrence.

There is no other industry in which the financial and general position is more freely made public than that of the mining industry. Statistics showing the working results of each district are published quarterly by the Mines Department; and monthly figures for each district are computed by special accountants for the purpose of the Wages Ascertainments. Having regard to the decline in the financial success of the trade since this course of procedure was adopted, one is struck by the thought "Is it wise to give such publicity to production charges? Are we likely to obtain higher prices when the consumer is made fully aware of the costs of production?" Few, if any, of the other industries supply similar information, and certain Producers' Associations have even gone so far as to write to their members urging those who have hitherto published cost figures to suppress such data in their balance sheets in future. The results of the Export Trade in particular since such figures were first published have certainly been most disappointing.

From the colliery point of view one cannot clearly see where an immediate advantage is to be reaped from the publicity and research work which has been expended on efforts to increase the heating value obtained from coal burnt, and as a consequence reducing the consumption, unless there is to be an increase in price. It will probably be argued that if the consumer gets increased heating value per ton he will produce his goods cheaper, sell more and then require more coal to make additional products. This may be correct, but there is also a saying that "While the grass is growing the horse is starving," and one feels that the coal trade horse is very lean nowadays and badly in need of a good financial feed.

THE SELLING OF COAL.

To control the disposal of its produce each colliery company usually places one man at the head of its sales department. In the North of England he is known as "The Fitter." His duty is to dispose of the colliery produce to the best advantage of his employers, and in so doing he should work in the closest touch with the colliery technical staff who are responsible for the production side. It is an advantage if the General Manager is technically qualified and permitted to supervise both production and sales. The closest personal touch should be maintained with all customers and all products supplied properly followed up in order to ensure that the consumer is getting what he desires in the most suitable condition for his purpose. Personality is still a factor of the utmost importance in the successful selling of coal.

The cost of the Colliery Sales Department should be in the neighbourhood of one penny per ton sold or in round figures about one per cent. of the selling price.

The sales, as in other industries, subdivide themselves into two groups:

(1) Inland Sales; (2) Export Sales.

Although some collieries may employ more elaborate methods, in the simplest form such sales are usually effected as follows.

Inland Sales.

The colliery may maintain depots at the more important local rail centres and distribute coal direct to householders and others by means of its own transport and, or, it may sell by truck quantities to depot merchants who themselves retail to householders, etc. Both, in cases, may sell by cartloads to hawkers who, in turn, distribute to consumers of small quantities. The coal is usually sold to merchants at a price delivered at the depot, and to householders at a price delivered to the house.

Export Sales.

The colliery may sell its coal direct to foreign consumers or to a merchant who acts as an Exporter and sells either direct to foreign consumers or to foreign importers. Such coal is usually sold F.O.B. (i.e., free on board) which includes the value of the coal in trucks at the pit plus the cost of transport to the port and the cost of loading; or C.I.F., which is the F.O.B. price plus the cost of insurance and freight, the latter of which includes trimming and discharging at the point of destination by sea. It is doubtful if C.I.F. sales are proper business for a colliery company if freight rates are to be gambled on. The merchant's charges are usually not excessive for this class of work.

It will be noted that the Inland Sales and Export Sales methods already described are very similar to those employed by producers in other industries who sell through large wholesalers to smaller wholesalers and finally, by means of retailers, to consumers. In the coal trade similarly additional middlemen who buy in bulk and distribute in bulk may operate. Some of the largest consumers buy through such middlemen in preference to purchasing direct from the collieries.

Collieries are often criticised because they do not restrict sales to householders to direct business. Why should other trades who also sell through retailers not be similarly criticised? The reason in both cases is the same, i.e., except within certain limited areas it does not pay to sell direct. A small dealer who buys a truck of coal and loads and leads it direct to his own special customers can always do the work cheaper than a large business concern owing to the differences in the overhead charges involved and in the labour standards maintained. Further, just as a shopkeeper would not be very successful if he only sold one article made by one manufacturer, so also a depot merchant usually has to sell coals from more than one colliery to get the best results. The personal preferences of individual consumers have to be satisfied. Like the retail shopkeeper, the Depot Merchant does useful work and cannot be dispensed with.

The work of the Export Merchant is also of a valuable nature. His duties are very similar to those of an agent who looks after the interests of his consumers at the time of the purchasers' shipment. In addition, at his own risk, he may undertake C.I.F. contracts and may personally or on behalf of others be responsible for the freight and insurance. Matters of exchange are also considerations.

Speculation.

There is unfortunately, from some points of view, a certain element of speculation which is inseparable from coal trade business. Collieries must have their coal sold before it is produced so that it can be promptly despatched, or otherwise the railway trucks available for its reception would all be filled and production would have to cease until they were cleared. It is possible to stock certain coals on the ground, but some depreciation always ensues and the cost of putting down and picking up again is appreciable.

Sales often are effected months ahead and in such cases there must be speculation as to what the actual value of the coal, freight, etc., will be at the time of delivery.

When arranging forward sales the Coal Buyers and the Colliery Fitters negotiate together and agree on prices. Both are guided by their own views as to the future trend of the markets. Merchants may buy from the collieries with a view to selling to customers at enhanced prices subsequently, or they may sell coal at present-day or other prices to their customers with the expectation of being able to purchase from the collieries at lower figures at the time when delivery has to be given.

At a first glance this appears to be quite ordinary business, but there is one specially vicious element which in my opinion should be removed and that is the "bearing" of the coal market by merchants who hold coal. Market prices may have risen and collieries may be trying to hold to the increased prices, but the position is very adversely affected when the merchant offers at prices below those asked by the collieries. The position is even worse when the market is falling or weak and the merchant has a large order to place. The results of such action in recent years has been to tend not only towards the reduction of prices but also to keep them reduced. Further, one fears that the goal of such procedure has been to keep prices down to or under the cost of production. There would not be objection to sales by merchants at or above colliery prices, but some arrangement should be come to in order to prevent coal being sold at any time at prices less than those fixed by the collieries. This might be best effected by the Trade as far as possible retaining in some manner control of its coal until it is consumed and by exporters, etc., acting as Agents instead of as Merchants; Agency Rates dependent upon the amount of business done and the margin of profit prevailing in the industry might be laid down. Fair conditions of working should be agreed on with the large distributing agencies. So far as I can gather other trades do not allow their distributors or retailers to sell below certain fixed prices, and while one cannot be too definite as to the effects of the introduction of such a policy on the Export Trade until it is actually tried, there appears to be every reason why it should be a proper and advantageous departure in the Inland Trade.

Results of the Existing Selling System in the Past.

The Coal Trade in Britain, in the nineteenth century, was of a steadily expanding character, and reached its maximum output in the year 1913 when it was approximately 287,000,000 tons. Except for occasional periods demand rose satisfactorily with supply and whilst Inland Trade steadily forged ahead, good progress also was being made in the Export Markets.

The whole situation was revolutionised by the incidence of the Great War, which resulted in the production of coal in this country being seriously curtailed owing to the recruitment of workmen for military purposes. It was realised then how vital an article coal was. The ordinary export trade had to be entirely scrapped and coal was employed solely as a counter for war purposes. Not a ton was allowed to be exported except direct to Allies for war purposes, or sold to friendly neutrals in exchange for facilities which we could not do without. Other countries, as a result of such limitation of their supplies, had to cast about and develop their own internal power resources, whether in the form of coal or water, or oil, etc., or obtain other sources of supply elsewhere. A further impetus to such developments was the high price which persisted during the period of Government Control after the termination of hostilities. On the conclusion of the Control period, selling prices fell rapidly and it was found that the arrangements which had been made by other countries for the use and protection of their own resources, and in the opinion of many, the effect of War Reparations in kind, were having a very serious effect on the Export Trade of this country; and, although an American coal strike in 1922 and the French occupation of the Ruhr in 1923 temporarily delayed the depression which had already overtaken most of the other heavy industries, the period from 1924 to 1928 has been probably the most unsatisfactory from the point of view of successful trading in the history of the British Mining Industry.

From the sales point of view some of the results of the post-war years may be summed up as follows:—

(1) We are not producing a total coal output per annum in excess of the pre-war figure, although production capacity is said to be higher. The Coal Trade, of course, is not exceptional in this respect.

(2) We are not maintaining our pre-war percentage of the world's export trade, although we should have increased it.

(3) We have been loaded up with extra legislative costs, taxation costs, transport costs, material costs, short hour costs (until 1927), etc., and as a consequence our production charges have been increased.

(4) We have had to face subsidised competition abroad, together with other onerous restrictions on our trade.

(5) We have been suffering from the aftermath of the War.

Can British Coal Sales Methods be Improved?

In a situation of this kind critics usually flourish, and amongst other matters the selling methods of the collieries have been subjected to their adverse strictures. It is argued that a large number of individual sellers cannot obtain as good prices as might be obtained by some centralised system. The critics also argue that if the collieries were to buy their supplies of materials by centralised methods they would be able to do so at cheaper rates. The two arguments do not seem to coincide in all respects. Several large colliery undertakings have definitely found that it is cheaper and more efficient to buy their materials by pits instead of as one unit. German Cartel results indicate that even a Semi-National Export System does not necessarily ensure success, and to counter this the critics suggest International Action. Some of us are not very pleased with the result of the War Reparations Settlements from the British point of view in general and the effect on our mining industry in particular. Is it imagined that we would emerge with great advantages from an International Conference fixed to allocate Coal Exports? I doubt it.

If we put forward a scheme of Coal Sales of the crudest nature, i.e., the monopolisation of the industry solely in the interests of those connected with it, we get the idea which is bound up with Nationalisation or the various schemes of Unification or the American Trusts. Under a monopoly of this nature the home consumer would have to pay the uttermost farthing until, tired of its rapacity, he would take some action which would bring it to an end. No one, I think, would suggest that such a state of affairs would be the best for the country as a whole, however excellent it might be for any one particular industry. Trade combinations are heartily disliked in Great Britain both by producers and consumers, although it is possible that the future may change old ideas. It is reasonable, however, that Home Consumers of coal should pay such prices as are necessary to enable our Export Trade to expand, as by so doing they obtain other benefits in return, such as reduced freight rates on incoming goods, lower prices through collieries working to capacity instead of part time, etc.

Most of the marketing schemes of other industries are based on the principle of higher prices at home to facilitate trade abroad.

A more reasonable suggestion entails the use of some method of co-ordination, rather than centralisation of the working of the various districts, and three of the methods of Co-ordination advocated are as follows:—

(1) Co-ordination by Regulation of Output alone.

(2) Co-ordination by Regulation of Price alone.

(3) Co-ordination by Regulation of Price and of Output.

To all three schemes various subsidiary systems of compensation may be added. Suggestions of this kind are not new. They were tried by our fore-fathers years ago, who soon discovered the weaknesses but not the remedies for them. It is always quite an easy matter to talk theory but it is quite different if one has to get down to it and produce a workable proposition which is to be fair to all concerned.

Regulation by Output.

Generally speaking schemes for the Regulation of Output are disliked. Amongst the objections are the following:—

(1) Regulation of output is not a common factor in the marketing of other industries.

(2) Enforced reductions of output below the individual capacity to produce and sell kills local incentive.

(3) A large colliery undertaking can temporarily curtail its production and at the same time reduce its cost by eliminating its most expensive pit. A smaller undertaking usually can curtail production only at an increased cost. Action of this nature even by large undertakings is not good practice, as it adversely affects its productive life by reducing the quantity of its economically marketable coal and also by increasing the future costs of working.

(4) The costs of ceasing production for, say one day, are not equal. Some collieries, with heavy water loads, high ventilation charges, or costly faces to maintain would find an enforced rest much more expensive than others which are more favourably placed.

(5) Collieries which work regularly, whether trade is good or bad, and who have possibly spent large sums of money on plant for preparing and improving the quality of the products marketed, hesitate to agree to give up a certain proportion of their annual production and (without receiving anything in the way of compensation in return) hand it over to other undertakings which have not been so progressive, and who have not been able, by their own efforts, to achieve equally satisfactory results.

(6) Collieries which have spent capital to reduce working costs do not desire to be placed on a similar output basis to others with high working costs which therefore do not possess equal competitive marketing capacity.

(7) Colliery owners take a pride in providing full employment for their own men and object to novel schemes which ignore the personal relationship which governs their joint working. Some of the schemes of output regulation already in vogue are not popular with the workmen, as they do not like policies of part time employment except in case of dire individual necessity, and the ruthless application of such a policy would not in the long run produce the happiest understanding between the Owners and their Workmen.

Regulation by Price.

As already stated, some method for the co-ordination and for the maintenance of Inland Prices does seem to offer advantages. It is a factor in practically all other marketing schemes. The Wages Agreements in the Mining Industry contain rates below which wages cannot fall, irrespective of the state of trading, and if the trade fails to earn such rates any shortage has to be provided out of the pockets of the Colliery Owners. If at the very least prices for coal in Great Britain could be maintained so as to obviate any loss on the average in any district, a great step would have been taken and one to which consumers in this country could take little exception.

I am firmly of opinion that no consumer in this country has the right to expect to buy coal below the cost of production. Many have been doing so for some time past, but the sooner this comes to an end the better.

The principle of Price Maintenance has already been applied by one district to its export trade with success.

There is an impression that the present method of Price Fixation is entirely haphazard and that districts are quite independent of each other. This is not the case, as there are varying proportional relationships between prices in different districts and these reflect themselves as price adjustments are effected.

A rise or fall in one district may cause a somewhat similar result in others. Our problem really is to prevent price diminution, but for collieries or other undertakings engaged in the World's Markets this is not easy as World's Prices have to be accepted.

In most of the districts there are also definite trade groupings of collieries, and price relationships and alterations of them are usually allied in some way. The great weakness is that one colliery in a group when hard-up for trade may "put the cat amongst the pigeons" and, by making personal price concessions, force down the prices of the other members of the same group and, as a further corollary, also those of the other groups.

If this course of procedure could be checked in some way so as to obviate loss on the average in the district as a whole, the situation would be greatly strengthened. The present trouble is that in bad times in the struggle to obtain trade prices may be forced down much below the cost of production. The ordinary man in the street always finds this action hard to understand and is inclined to disbelieve the figures published.

The explanation is, however, a simple one. A colliery is not like a factory and it is not possible simply to shut the door and wait economically until times are better. The cost of standing may vary from 1s. to 2s. per ton of normal output. This is an awkward factor, as it may be better financially for an individual colliery to work at quite a heavy loss, always provided that such loss is smaller than that incurred by lying idle. There is also the advantage of continuing the maintenance of the workmen in employment.

In passing, a reply may be made to another question the aforesaid man in the street also often asks. He says, "I pay 25s. per ton for my household coal delivered. The cost of production shown in the Mines Department figures is, say, 12s. per ton: why are big profits not being made?"

The explanation is as follows: Firstly the 25s. includes the Railway Rate, Merchants' Delivery Rates and Charges, and the colliery actually may be paid 17s. 6d., or less, for such coal.

The coal sold to the householder is of the best grade and the price referred to is therefore not the average price for all coal sold. Further, all large coal cannot be sold for household use, and that sold for other purposes does not realise so good a price. An average price received for all grades of coal has to be computed by taking the quantities and prices of all grades into consideration.

Coal, as produced, despite efforts to prevent degradation, always contains a very big proportion of the cheapest class of coal. In Northumberland, at the present moment, the average price received by the collieries for their coal only works out at about 11s. per ton. The figures published by the Mines Department represent the average prices obtained by the collieries for the coal in trucks at the pits. The cost of grading and cleaning coal is expensive. It is not always easy to get consumers to pay full value for improvements effected: a 5% ash reduction may entail a 20% reduction in quantity. It is obvious that there exist sharply defined limitations on the preparation of coal, as each successive improvement entails a greater proportionate addition to the cost. Cheapness and quality do not coincide and, although under existing conditions it may be the prerogative of the consumer to call the tune, it must be remembered that it is impossible to give him the advantage both ways.

For some time collieries have been urged to sell on what might be called a "Scientific Basis." One would imagine that this was being advanced as a new idea, but there will be few, if any, of the large consumers who are not fully aware of all the characteristics of the coal they buy. Assuming, however, that all collieries were to attempt to give guarantees, there is still the obstacle of the question of the system and point of sampling to be adopted so as to avoid serious discrepancies. If penalties are to be imposed on the sellers for failure to maintain guaranteed figures it is only fair to demand that bonuses should also be conceded for improvements on the standard guaranteed and that such bonuses should be on an increasing scale. It would be essential that a certain amount of elasticity be permitted in order to allow for the effects of transportation, weather, or other matters outside the control of the sellers.

To sum up, inasmuch as price maintenance has been possible in other industries it does seem to be well worth while trying it in the coal trade.

Restriction of National Productive Capacity.

At the present moment there is no restriction on the opening out of fresh coalfields and new collieries. This does seem to be a matter worthy of the most serious consideration because if the productive capacity of Great Britain were allowed to rise much above the present figures our coal trade problem would become much more difficult. In Germany they are not greatly troubled with new developments as they seem to be able to keep them under control, but in America the figures have grown alarmingly and the productive capacity is probably two to three times the consumption. It is suggested that new developments, for a time, might only be permitted if they replace output cancelled elsewhere. Such a policy appears to be much better than allowing a great increase in the number of colliery undertakings and then attempting to throttle their effective working by regulation or restriction of output.

Changes of Thought.

There is a Latin saying, "Tempora mutantur nos et mutamur in illis." It applies to coal selling ideas quite aptly. It is not so many years since coal for export was taxed by the State. Now if anything it requires to be subsidised. The miners for years have believed in restriction of production with the idea of maintaining prices. Now when a system of this nature has been applied in certain districts they dislike it. Customers at one time preferred large coal. Well-cleaned and graded sizes are growing more popular and the large coal preference, although still prominent, is not so absolute as it once was.

Coal versus Oil.

Within recent years, competition between oil and coal has not resulted very satisfactorily from the coal sales point of view. It is more than unfortunate that we, a coal-producing nation, should be drifting steadily into the increased use of oil for purposes for which coal was previously employed. The development of Road Transport at the expense of the Railways, the more extensive use of oil in the Navy and Mercantile Marine and other similar changes have all affected coal sales by reducing consumption. The pendulum may have swung back again a little within recent times, but it would do so much more effectively if we could discover a really remunerative method of obtaining oil from British coal: but that happy consummation has not yet been attained. Every effort possible, however, should be made to discover advantageous alternative uses for coal. We have not only to produce coal but we have also to sell that coal at a profit.

Oil has acted rather as a brake on coal prices. This is due to the fact that the continued employment of coal as against oil in many cases has to be financially justified. It may even become necessary to safeguard home-produced coal against imported oil and the Derating Scheme in a mild form possibly acts in this way. National encouragement should certainly be given to developments which will enable coal to be utilised as the source of power where oil is now in service.

Conservation of National Coal Resources.

The problem of the conservation of the National Coal Resources is a matter of such vital importance to Great Britain that no marketing proposals should be permitted to ignore it. We are frequently urged to scrap all except our most up-to-date and cheapest producing mines and seams, but as technical men we have very unhappy recollections of a similar policy which was forced upon us during the great War. Doubtless in a time of national stress such as the War the procedure was wise and necessary, but to press for a continuance in peace time appears to be a heinous offence. It is our duty to extract the greatest quantity possible of our natural coal resources in an economical manner, and not just live for the present and leave the future to take care of itself.

A similar Coal Conservation Policy should govern the affairs of individual undertakings where the cheaply worked and the more expensive seams, and the high quality and the poorer seams should be worked in conjunction so as to prolong the lives of undertakings to their proper duration. If all the best and most cheaply worked seams were concentrated on and extracted we might have a good time while they lasted, but economic reasons would then probably preclude the other seams from ever being worked. This would result in loss not only to the particular undertaking but to the nation as a whole.

WHY NOT A HIGH WAGES POLICY.

In addressing myself to the problem of the effect of wages and conditions of working on the selling of coal I do so solely from the technical perspective and resolutely decline to be drawn into any political arguments. Rightly or wrongly I have always advocated a policy of the highest possible wages subject to economic laws and would recommend all other issues being set aside in its favour. Why should not all of us concentrate in an endeavour to raise wages? At the collieries we are always being handicapped in our prosecution of such a policy by the introduction of factors which render it more and more difficult for us to achieve our object. We know that high wages must be accompanied by high production per person employed unless the costs of production are to be sadly increased, and therefore any departure tending to reduce production is to be deprecated. It is difficult to be other than very much disturbed if after all our efforts and all our hard work of the past two years we, as technical men, are to be sentenced to have the millstone of the seven hour day hung round our necks once more. Districts and collieries operating almost entirely in inland markets to some extent may be able to compete with such a problem, but the export districts such as Scotland, Northumberland, Durham and South Wales can hardly regard it as other than a death warrant. An average increase of working costs of from two to three shillings per ton at a time when at the best collieries are only just paying their way cannot fail to produce disastrous results unless some financial relief is afforded.

It is true manual work underground is steadily being lightened by the introduction of machinery, and on the whole represents a great improvement on the hard standards of 30 to 40 years ago, but men are not machines and to suggest that production in seven hours would not be less than that which we are now obtaining in eight appears to me to be absurd. I doubt if the miners would support this contention if they were asked to accept the same piecework rates as now operate under an eight hour day if a seven hour day were to be introduced.

We are all anxious for British miners to have the best possible conditions and best possible rates of pay, and most of us have lived and worked long enough with them to view with disfavour any further wage cuts which can be avoided. Personally I would even prefer to see wages subsidised nationally to some reasonable figure with an eight hour day as an alternative to shorter hours, reduced wages, and the expenditure of a similar amount of money on Unemployment Pay. Dearer coal would have an adverse effect on all British industry and the increasing of the purchasing power of British miners by a national subsidy in return for cheaper coal might not turn out to be an unreasonable business proposition for the State.

One would be very interested to hear the result of a Miners' Referendum on the question of shorter hours and reduced pay as opposed to a continuation of the present hours with an increased rate of remuneration.

Some method of financially assisting colliery development such as a liberal extension of the Trades Facilities Act would be a wise departure. To me such a step seems to be just as wise as spending money on roads and other industries. After all we do produce a raw material, so why not facilitate the continued employment of men in their own trade and in their own district.

I am convinced that at the present moment there is a wonderful opportunity afforded of effecting a judicious settlement of affairs in the mining industry if only those concerned are sufficiently broad-minded, and whatever decision is come to it is to be hoped that it will be based on sound economic principles so as to assist the expansion of the sales of British coal.

CONCLUSIONS.

The conclusions I draw, as to the possibilities of improving our existing Selling System, may be briefly summed up as follows:—

(1) That any form of Inter-District or Inter-Colliery rapprochement should take the form of Co-ordination and not Centralisation.

(2) That some scheme for the maintenance of Price to prevent loss on the average in any district is most desirable.

(3) That the re-sale of British Coal by Buyers should be subject to the control of the Industry in the matter of Price at all times and that the distributive trades should act as Agents, instead of as Merchants.

(4) That there might be some control of the further extension of British Coal Production capacity.

(5) That there should be no output regulation of any kind other than that which will be effected by price maintenance or as outlined in conclusion number 4.

(6) That every effort should be made to develop alternative uses for coal.

(7) That every encouragement should be given to the technical and scientific advancement of all branches of the Industry.

THE ASSOCIATION OF MINING ELECTRICAL ENGINEERS.

Finally it does appear that, of all the specialist technical and scientific bodies connected with the mining industry, our own Association at the present moment has before it the greatest opportunities of rendering assistance to those engaged in the Marketing of Coal. As we are all aware, the extension of the use of electrically operated machinery, both above and below ground, is progressing daily, and it is our duty not only to provide fully and adequately trained men to supervise and control the working of such plant but also to study it and improve it and even to instigate new developments. By so doing, we should be able not only to make mining safer, but also to cut the costs of production and enable better coal to be put on the market, better wages to be paid and better profits to be made. The extension of profit-making should attract Capital to the Industry, and we must ensure that such Capital is lucratively and judiciously expended.

If we do our job as we should, one feels certain that, as Mining Electrical Engineers, we will obtain all the status and all the rewards which we may deserve.

The Association of Mining Electrical Engineers at the North East Coast Exhibition, Newcastle-on-Tyne.

Proceedings of the Association of Mining Electrical Engineers.

THE ANNUAL CONVENTION: NEWCASTLE-ON-TYNE.

THE Annual Convention of the Association was held in Newcastle-on-Tyne from July 2nd to July 5th. The energy and ability of the local organising committee call for the first acknowledgment; for the whole of the exceptionally crowded programme was carried through from beginning to end without the slightest hitch and to the extreme enjoyment of everyone. When it is noted that this year's attendance was much greater than at any of the previous annual meetings and, moreover, that the organisers were called upon to provide for many more visitors than they had bargained for, it will be agreed that their good services merit every word of praise.

The proceedings opened on the Tuesday with a Re-union of Members from all parts of the country. They were received by the President, Mr. Frank Anslow, and Mrs. Anslow; took light refreshments and indulged in the pleasant interchange of the past year's news and renewal of friendship.

Visit to the Derwenthaugh Works of the Consett Iron Co., Ltd.

The forenoon of Wednesday, July 3rd, was spent in an interesting exploration of the Derwenthaugh coking plant where coal as received from the Consett Collieries is broken, cleaned, distilled and resolved into large hard coke for iron furnaces, smaller coke for smokeless domestic fuel, gas to augment the public supply of Gateshead, crude oils for the chemical manufacturer, benzole and lighter spirits for the motor-car user and other processes. Here the Consett Company are doing exactly what up-to-date coal-owners should do; they are themselves breaking-up or refining the coal into the concentrated marketable products.

A description of the plant is published later in this number (page 31).

After inspecting the whole of the works the visitors returned by road to Newcastle, where the Consett Iron Company had made ready to entertain them to such a luncheon as could be thoroughly appreciated after the hot and dusty, though always interesting, tour of the morning.

Mr. FRANK ANSLOW (President of the Association) proposed success to the Consett Company and expressed the gratitude of the visitors to the Company's directors and staff for their courtesy in permitting the visit and their generous hospitality. He drew attention to the works as being a modern example of the "electro-mechanisation" of the coal industry, and in particular to the notable automatic and interlocked step-by-step control of a complicated continuous process. The electric control was such that should any piece of apparatus or machine fail the whole chain of the process would be automatically arrested and any risk of expensive and disastrous piling-up was thereby avoided.

Mr. Anslow coupled the toast with the name of Mr. E. J. George, the general manager of the Company; mentioned with regret the absence of Mr. Middleton who was unhappily prevented by illness from attending the reception; and also paid tribute to Mr. MacFadyen, deputy manager, Mr. Harrison, coke-oven manager, and to his, Mr. Anslow's colleague in the Association, Mr. S. A. Simon the chief electrical engineer of the Company.

Mr. E. J. GEORGE, in response, said they of the Company were rather like a small boy with a new toy. The boy with the new knife shared the joy of possession with his friends and was only too happy to exhibit its beauties and capabilities. There had been some outside criticism as to the beauty of the coking works blending with the natural charms of the country-side but, as engineers, they could not be expected to appreciate too keenly such objections. Mr. George said the works represented the meaning of true co-operation in industry, without which progress would be impossible. His Company marketed coal, iron and steel, silica blocks, castings, coke, gas, motor-spirits, and crude oils. They looked to electrical engineers for orders and they looked to them also for the means of getting the very best methods and plant for production. So it was that Mr. George said he could hardly do anything else but extend to the Association his most cordial welcome and wish it every success.

Visit to the Reyrolle Works.

After luncheon, on the Wednesday, the visitors proceeded to the Hebburn Works of Messrs. A. Reyrolle & Co., Ltd., the well-known manufacturers of metal-clad switchgear of the latest E.H.T. and heavy current types and, in particular, of mining equipments. A brief description of the Company's activities and works appears on page 37.

Most of the ladies elected to spend their time in studying the manufacture and use of domestic electric appliances—a highly special branch of manufacture which the Company have recently taken up with the intention of providing those features of substantial and workmanlike construction combined with safety in design which are lacking in the flimsy foreign stuff so often foisted on the non-technical public.

The guests afterwards assembled in the handsomely fitted dining room of the works and took tea.

PHOTOS BY "NEWCASTLE CHRONICLE."

The A.M.E.E. at the Seghill Collieries and Seghill Hall.

Mr. FRANK ANSLOW thanked the Company for the pleasant and useful afternoon they had enjoyed.

Mr. H. W. CLOTHIER, Managing Director, reminded the members present that it was so long ago as 1909 that Reyrolles had the pleasure of first entertaining the Association at their works. On that occasion, he recollected, the visiting members were shown examples of some of the earliest pioneer work in flame-proof construction. It was, said Mr. Clothier, the work of the mining electrical engineer, in his endeavour to secure electrical gear to withstand the arduous conditions and risks of mines usage, which had largely helped to make standard electrical gear so successful. Mining men were responsible for the best in modern switchgear, and Reyrolles freely acknowledged the help they had received from mining electrical engineers.

Continuing, Mr. Clothier congratulated the A.M.E.E. on its wonderful growth and development; he felt sure that it would continue to progress and establish the status of the electrical engineer engaged in mining. The mining industry was winning through its protracted period of trouble, and its task of regaining prosperity was largely in the hands of associations such as the A.M.E.E.

In concluding his address of welcome Mr. Clothier paid a tribute to the members of his staff and all the workers—a kindly reference which may be taken as a sure indication of one of the secrets of success held by the firm: for it was evident on every hand that good feeling and the spirit of loyal co-operation prevailed throughout the works.

Coal Owners' Dinner.

On the evening of Wednesday, July 3rd, at the invitation of the Durham and Northumberland Coal Owners' Associations, the members and their friends attended a dinner and dance kindly given by the local coal owners. The large dining hall at the Grand Assembly Rooms was beautifully decorated, and a most enjoyable evening was spent.

Mr. RIDLEY WARHAM, the well-known Northumberland coal-owner, presided, and after the Loyal Toast he proposed the toast of the "Association of Mining Electrical Engineers." Mr. Warham said it was a very pleasant duty to welcome them on behalf of the Northumberland and Durham Coalowners' Associations. They were proud of the ancient city of Newcastle and the surrounding district, which simply teemed with historical association. He cited the many places of interest: Alnwick, Bamburgh, Rothbury, and smilingly added Flodden Field to the list. Referring to the Roman Wall, he said it was a marvellous and unique possession of the North Country which had been irreverently described as the district's first serious attempt at mass production. In any case it showed that "Safeguarding" was no new thing in the North. Newcastle was not only a place rich in historical associations but, as many of them knew, it was the cradle of many inventions which have exercised a beneficent influence on our lives during the past century. They would all be very sorry that their secretary—a secretary of secretaries—Mr. Reginald Guthrie, was unable to attend owing to illness, and that the Lord Mayor would be unable to attend until later in the evening.

He offered to the Association congratulations upon entering into the year of its majority, thus completing twenty-one years of useful work: continuing throughout the period which had seen practically the whole of the development work necessary to bring the application of electric power to coal mining to the highly developed state which existed to-day. He understood that the President's year of office was about to terminate, and he congratulated him upon a period of work well done. He learnt that the President Elect was their old friend Capt. Stanley Walton-Brown. Capt. Walton-Brown was well known in the North of England, and he was sure that under his presidency the affairs of the Association would again be in capable hands. He hoped that the coming year would be one of increased interest and activity in the affairs of the Association.

As coalowners they recognised very fully the enormous importance of the work done and being done by the members of the Association in connection with mining, and of the mining of this district in particular. The electrical industry was one which was closely allied to the coal industry.

In the first place the coal trade furnished the raw material from which, in this country at any rate, practically the whole of the electric power was generated. Therefore the supply side of the industry was a valued customer of the coal trade.

In the second place they of the mining industry looked to the electrical industry, and particularly to the section represented there, to assist them in the solution of the many problems involved in the cheap production of coal at the present day.

On the North East Coast the alliance between the Coal Trade and the Electrical Supply Industry was probably closer than in any other part of England. As they were aware the supply and distribution of electric power were more highly developed in the North-East than in any other district, and a large proportion of the power distributed by the Newcastle Electric Supply Company was produced at stations belonging to, or operated in conjunction with, collieries; so that collieries were both suppliers to, and customers of, the Supply Company.

Looking back over the past 31 years Mr. Warham recalled that it was in 1898 that the first electric generators were installed by his own Company. The extent to which they had come to be dependent upon electric power was an eloquent testimony to its reliability, convenience and freedom from accidents. During all that time they had not had a pit stopped through an electrical breakdown. Considering that they had now about 900 motors in use he thought it was a record to be proud of and to be thankful that the development had been possible and typical of what had been going on all over the country.

As they knew, they had been having a very terrible time in the coal trade of this country for the last three or four years—enough to have broken up a less stout-hearted industry—but they had stuck it out together and now felt that at last the tide is turning, and he sincerely hoped it would bring an enduring prosperity to the industry. They had been living on hope a long while now and hope, they were told, was the cheapest luxury so they might continue to indulge in it to their heart's content. An optimist was a coalowner for, if he were not an optimist he would not be a coalowner.

He coupled with the toast the name of the President, Mr. Frank Anslow.

Mr. FRANK ANSLOW, President of the Association, replying, thanked the proposer of the toast for his kindly references to them. It was now 21 years since the Association was formed. At that time it was recognised that the position was not satisfactory: an energetic body got together in a spirit of co-operation and decided that alone the people interested in electricity could not carry on—that unless they carried with them the other people interested in mines such as mines managers, mines engineers, mechanical engineers, colliery engineers and everyone else who had an interest in what had become known as the mechanisation of our collieries, not much good could be done. This was clear, and was acted upon with the result that on the formation of the Association of Mining Electrical Engineers all were given the opportunity and gladly contributed their quota to the co-operative effort. Everyone had done that and the practical outcome had been a degree of safety and reliability in the electrical equipment of mines such as was never dreamed of twenty-one years ago.

He thought the organisation of the Association had had a lot to do with the success achieved: he made no apology for advertising their Association. Papers were read at the branch meetings and they had good discussions upon them: anyone could attend the meetings whether colliery managers, owners, electricians or, in fact, any who were closely interested in mining electrical matters.

As a young Association they took a step never before taken by a technical society in publishing their transactions in the form of an illustrated magazine or journal published monthly, and which he ventured to say was read by the coalowners themselves with pleasure and interest; more so he believed than they would as a rule, read the stereotyped transactions such as they received from other associations to which they belonged. He thought this was in itself no little achievement to be credited to the Association.

He wished to thank the coalowners for the support they had always given them. Each year they felt the owners' influence more beneficial to them, and he thought they could properly glean satisfaction from the knowledge that each year the owners conceded that they were more beneficial to them also. The coal owners had always encouraged and assisted them both by personal support and by becoming honorary members of their Association; but this year they, the owners, had invited them for the first time to an excellent dinner, which he was most happy to welcome as a further distinct step forward in regard to the recognition of the Association of Mining Electrical Engineers.

Mr. J. A. B. HORSLEY, H.M. Electrical Inspector of Mines, proposed "The Durham and Northumberland Coalowners' Associations," and said that much of what he had intended to say had been more ably said by Mr. Warham and their President. It was the first time the Association, in its corporate capacity, had met the coalowners of Northumberland and Durham. He detailed the original objects of the Association—which had been rigidly adhered to—and included that of giving to the mining electrician the opportunity to acquire and to add to his theoretical knowledge. The scope of the Association was very wide for its membership included not only the skilled craftsman and the working electrician; the professionally trained and skilled engineer who was to-day taking his necessary place in the organisation of the larger mines and groups of mines; the consulting engineer, such as their President, who by wide experience could give wise counsel; professors and teachers; many engineers in the employ of manufacturers; even Mines Inspectors were members and acknowledged the value of the work done by the Association.

Dealing with the statistics of mining electrical work, Mr. Horsley said that in 1912 the total horse power of electric motors installed in all the collieries of Great Britain amounted to 500,000 H.P., but to-day the number exceeded 1,700,000 H.P. Of that total the counties of Northumberland and Durham together accounted for 352,000 H.P., though Durham had the larger percentage, having two and a half times more than Northumberland.

Electricity accounted for 60 per cent. of the machine cut coal in the Northern Division but, lest they might preen themselves too much, he would remind them that across the Border nearly 98 per cent. of the machine mining was electrical.

Mr. Horsley paid a tribute to the work of the Newcastle Electric Supply Company, and added, "It is my impression that the high standard in general of the colliery electrical installation in this area is due in part, at any rate, to the example set by that great and successful organisation in the public supply of electrical energy, in sound engineering practice, and partly to early training in the essentials of good craftsmanship gained whilst in its employ."

In concluding, Mr. Horsley thanked the coalowners of the two counties for their hospitality, which they regarded as evidence of their appreciation of the value of the work of the Association.

Dr. HENRY PEILE, C.B.E., D.Sc., replying to the toast, said as coalowners' associations they welcomed them all there that night. He sympathised very much with the speaker, who said that everything he intended to say had been already said for him. He was in an even worse position. He thought it was most desirable that the coalowners and the electrical engineers should have that opportunity of meeting together and getting to know each other better. Coal owners, as they knew, were very dependent upon the electrical engineer and his work. They must have electricity and they wanted it cheap—they did not always get it as cheaply as they wanted, but they went on living in hope.

Coal owners were also closely interested in the production of electricity. He remembered when it was a common sight to see flames 30ft. or 40ft. high coming out of coke oven chimneys. That was all changed, and now these waste products were collected and converted into electricity which was produced at a low cost. The idea of having a general pool of electricity whereby waste products of mines and works could be turned into electricity was a sound and valuable asset to this country. The Newcastle Electric Supply Company had assisted greatly by enabling them to get rid of waste at all times, so that they could work their plant in a really efficient manner.

For almost every process in producing coal it was now necessary to have a good supply of electricity, which was largely used in mines for winding, hauling, cutting, and conveying coal, pumping water and many other purposes. Electricity had been of immense benefit to them and had largely reduced the cost of coal, which to-day was a most important matter when they were trying to hold their own in the markets of the world, in some parts of which labour was cheaper than here. He thought they were following the right lines in the methods of reducing their costs to enable them to sell coal abroad, which a few months ago they were unable to do.

Electricity had been of the greatest assistance to them in this way, and therefore it was obvious that it was desirable to have a close association between coal owners and mining electrical engineers. He thanked them warmly for the way they had honoured the toast.

Visit to Dunston Power Station.

The Dunston Electric Power Station of the Newcastle Electric Supply Company, Ltd., was visited in the forenoon of Thursday, July 4th. As will be gathered from the descriptive article published later in this issue there was very much of supreme interest to be seen. The steam-raising plant, in which the very latest methods of securing the full value from coal were in trial and actual day-by-day usage, formed one of the most valuable lessons for any power engineer. The lecture by Mr. Weekes, following the tour of inspection, was unique in its value as being concerned with the design and practical results of a fuel treatment plant in actual being on site. At the conclusion of the works' tour the visitors were conveyed to Newcastle by road and entertained to luncheon by the Directors of the Newcastle Electric Supply Company and associated companies.

Mr. R. P. SLOAN, Managing Director of the N.E.S. Co., and who presided, extended a hearty welcome to the guests. He said that the leading objects of the Association—safety in electrical work in mines and an improved status for the mining electrical engineer—were bound to be of great benefit to the coal industry as a whole. He particularly commended the Association in its encouragement of the young and enthusiastic workers in mines power engineering. Mr. Sloan expressed the hope that they had enjoyed the tour of the Dunston Works, and he congratulated the President, Mr. Anslow, on a successful year of office—now almost ended.

Mr. FRANK ANSLOW, in replying, sincerely thanked the Company for a most enjoyable engineering treat and the generous hospitality extended to the Association. He was particularly pleased to see along with Mr. Sloan another director of the Company, Sir George Hunter, the veteran famous shipbuilder. Sir George had been a distinguished director of the affairs of the Supply Company for upwards of thirty years—and he was the builder of the "Mauretania."

In particular, Mr. Anslow wished to thank Mr. Weekes for the valuable lecture wherein he had so fully and clearly described the notable experiments which the Company were, in an uncommonly progressive manner, proving out for themselves at Dunston in the effort to obtain the very best results possible with the latest applications of science.

Visit to Seghill Collieries.

The all-electric collieries at Seghill claimed the interest of the visitors during the Thursday afternoon. Under the guidance of Capt. Walton-Brown, managing director of the Seghill Collieries, Ltd., the advantages and efficiency of using electricity for every power and lighting service were made manifest by the clean and orderly operation of the whole works. It was difficult to realise that these collieries were not brand new, that they were old pits rejuvenated by electricity. The progressive spirit which had prompted the owners to adopt the newest plant and methods of working was evident also in the care which had been given to ensuring the welfare of the employees. Sports grounds, gymnasium, canteens, and other social amenities all showed how thoroughly the owners had been imbued with the trend of modern industrial economics—and the pits as well as the equally up-to-date brickworks were busy.

Favoured with good weather the visitors were here impressed with the fact that there need be no blackening and disfigurement of the wholesome countryside when electricity is the power agent. This was the last of the series of industrial places to be visited by the convention, and it was just about now when the first little complaint appeared. A visitor, rather tired and jaded, was heard to say that the affair was beginning to feel like a "busman's holiday." Any such impression was, however, of a surety eliminated when the party adjourned to Seghill Hall for tea. The charm of an old-world mansion with its expansive fall of velvet lawn in sylvan frame, smoothed away every trace of disaffection. In this restful old English garden of the home of Capt. Walton-Brown, in the alluring chequered shade of trees, tea was served; and the Northumbrian hospitality included too the introduction of age-old local customs ever fascinating to the stranger. A group of sturdy pitmen from Seghill, arrayed in plum velvet breeches displayed their stamina and hardihood in the amazing rhythmic intricacies of the old Northumbrian sword-dance. Seghill boy scouts rendered North Country airs on the quaint and plaintive short pipes of their border fathers. There was even the effusive welcome greeting of a very close friend of the host, his pure bred Northumbrian terrier, who added his degree of pride in the ancestral traditions.

Naturally the thanks which Mr. Anslow tendered to Capt. Walton-Brown, to his mother and his sister, were most heartily endorsed by everyone present. There was a marked tendency to linger at Seghill Hall—and to keep pace with the programme meant burning the road back to Newcastle.

The Civic Reception.

The reception on Thursday evening was again a great revelation of the wonderful hospitality of these North Country folk. The Lord Mayor and the Sheriff, with their respective ladies, and many of the leading personalities of the city and county combined to prove that the greatest dignitaries can be as free and jolly as the rest. Briefly but with whole-hearted sincerity the Lord Mayor expressed his pleasure in being able to afford the Association some practical indication of the good fellowship and welcome which his city extended to the Convention. The Sheriff similarly confirmed the generous sentiments, and Mr. Anslow as briefly and happily acknowledged them.

The dance was much more than that. Lest there should be the slightest risk of anyone tiring of monotony, the Lord Mayor in person took an obviously great delight in springing a series of rousing surprises. From the platform he directed Community Singing. The printed words were distributed, the Lady Mayoress took the piano, he himself led the singing, rendered the solo parts in a voice full, rich and strong, and conducted the chorus as a past-master of the art with an enthusiasm which carried his guests with him to a man (and a lady). Here was no stilted ceremonial function but a united party with but one aim—enjoyment. Thereafter a band of local lads, of ages ranging from 62 to 75 years, demonstrated the hardiness and agility of their stock with an exhibition of the Northumbrian sword dancing. These boys having given repeatedly of their best, in response to the plaudits of the guests, retired to cool-off and recover their normal respiration in a manner which their smiles clearly indicated would be also thoroughly in keeping with local tradition. The bagpipes followed, a full band of drummers and pipers an' a' and a'. There were sword dancers too, the Scottish style this time. Then the pipers being there all ready, the Scottish members of the Association, whose toes had been fidgetting the while the pipers skirled, got their heads together and four of them each with his lady, danced the "reel." Thus in this merry style the night passed all too quickly, and though speeches were insignificantly brief the expressions of appreciation indivually exchanged were full and profound.

The Annual Dinner of The Association.

The evening of Friday, July 5th, saw the whole of the visiting members of the Association entertaining each other and many guests at dinner. The spacious banquet hall of the Central Hotel was taxed almost to its utmost capacity with the 250 or so who took part. Capt. S. Walton-Brown, the newly elected President of the Association, presided. The loyal toast having been duly honoured

Mr. ALEX. ANDERSON, Provost of Motherwell and Wishaw, proposed prosperity to "The City and County of Newcastle-on-Tyne." He paid a fine tribute to the progressive spirit which animated the Corporation and to the great belief which Newcastle had in itself and its industrial policy as exemplified on every hand, and more noticeably to-day in regard to the new Tyne Bridge and the North East Coast Exhibition.

THE DEPUTY LORD MAYOR, Alderman R. H. Millican, J.P., responded in happy vein.

THE SHERIFF, Councillor W. A. Allan, also acknowledged the expressions of regard of Provost Anderson. He said he was pleased to learn that the Association had at one time and another visited twenty-seven

Members and Friends of the Association of Mining Electrical Engineers at Seghill Hall.

of the large works and mines in the Tyneside district. Newcastle was always glad to receive visitors with an understanding of its industries and enterprises. Councillor Allan humourously credited the members of the A.M.E.E. with a wonderful stamina: he had himself attended three of the Convention meetings. He made particular reference to the Coal Owners' Dinner and the pleasure it gave him to hear the appreciation of the record of twenty-one years' work of the Association. It revealed the A.M.E.E. as an organisation destined to continue to fill an important place in the development of national industry in future. He was a believer in associations and societies of this character: in his own business, many years ago, he had been one of the foremost in creating a trade society and the result had been altogether good: that which was mean and petty at one time had given way to an open and broad-minded cooperation.

COLONEL W. C. BLACKET, C.B.E., D.L., LL.D., submitted the toast of "The Association of Mining Electrical Engineers." Referring to his early experiences as one of the pioneers in the mechanisation of collieries, he credited the electrical engineer with remarkable progress in theory as well as in practice: he even wondered whether before very long the electrical man would not discover how to do away with coal altogether. The perfect light without heat and the natural forces of the solar system were at hand, and he feared that perhaps the coal owner might at any time be put out of business by the electrician. He proceeded to express his personal gratification that the members of the Association had honoured his esteemed friend and colleague Captain Walton-Brown by electing him their President. The choice was a very wise one.

CAPTAIN S. WALTON-BROWN, J.P., responding, paid kindly tribute to the hard-worked officials and committee of the North of England Branch of the Association, who had made the Convention so extremely successful and enjoyable. He acknowledged too the regular voluntary task which those men undertook year by year to strengthen the Association and the local branch. He particularly wished to mention the name of Mr. C. St. C. Saunders, who had been the Secretary of the Association ever since its foundation twenty-one years ago, and who had throughout so ably supported past officers and helped the Association to weather difficult periods.

Mr. A. B. MUIRHEAD, Past President of the Association, proposed the toast "Kindred Associations," and in happy terms acknowledged their assistance in co-operation with the A.M.E.E.

Mr. W. ROCHESTER, President of the National Association of Colliery Managers, responding to the toast by Mr. Muirhead, said that owners and managers of collieries had often been charged with indifference to the dictates of progress, with the lack of initiative and enterprise. Now that they have seriously and extensively adopted intensive methods and have equipped their collieries with electrical and mechanical plant to facilitate output and economise in labour, they were being criticised as being so keen on speeding up output that they were not now concerned so closely with the personal safety of the miner. Mr. Rochester wished to state emphatically that nothing could be further from the truth. The electrification of mines, in accordance with the proved principles and methods of modern practice was altogether conducive to greatly increased safety. He, for that reason, must give credit to the Association of Mining Electrical Engineers for the great work they were doing in putting the coal industry firmly on its feet and at the same time securing the greater personal safety of the mine workers. He had very great hopes for the future of the coal trade and confidence in electricity as being an essential factor in that progress. Had it not been for electricity the mines could not have made any headway.

Mr. GEORGE RAW, Past President of the A.M.E.E., continued in similar strain when proposing health to "Our Guests." He said this country was returning to the belief that the clouds of industrial depression had silver linings, and that in due course we should see not only the lining but the sunshine itself. It was the teaching of history that something like a decade of depressed trade conditions followed any such cataclysm as the great war. A full ten years had passed since the end of 1918 and it would almost appear that the economic processes which govern the delicate conditions of trade were now giving promise of brighter prospects.

It was the profound hope of everyone that this might be the case, but whether we had passed through the worst of the industrial tribulation or not, he would claim that the great mining industry with which they all had the privilege to be associated had to the very limit of its capacity been endeavouring to meet the desperate situation of the past few years by means of improved and modernised methods of production. In support of this contention Mr. Raw mentioned that the percentage of coal won by machines belowground, thus displacing the laborious work of the manual getting of coal at the working face had been doubled since the end of the war, being now 25% of the total coal produced in Great Britain. The electrical power used below ground since the close of the war had been almost doubled, the figure reaching now nearly two million horse power. He had recently reminded the colliery managers that the number of horses and ponies below ground in British mines were being replaced by mechanical methods of transit at the rate of 2000 a year. These great and comprehensive changes had been effected under the desperate financial conditions which have governed the industry during the past few years, and he claimed this progress under adversity to be an achievement of which the British coal owners and British mining men might well be proud.

These revolutionary improvements were largely due to the use of electricity below ground. It was principally owing to the unceasing efforts of British engineers and manufacturers that it was possible in this year of 1929 to use electrical plant with absolute safety under conditions below ground where ten years ago mining men would have hesitated. "And the end is not yet," said Mr. Raw. "The mining industry looks to the Mining Electrical Engineer to supply the strength and the power, and with that combination of experience and power, the British Coal Trade will speed far and true on its course. It will regain its dominating position and it will continue to lead the world in its mining practice."

Mr. E. J. GEORGE briefly acknowledged on behalf of the guests, intimating that the Illuminations of the North East Coast Exhibition as well as a Dance were awaiting the further attention of the company.

These last two affairs were duly negotiated and marked the closing hours of a Convention which will stay in the memory of participants as one of the most delightful in their experience.

The Annual Meeting of The A.M.E.E.

This was held in the Lecture Hall at the Exhibition on Friday afternoon, July 5th, following the usual Council Meeting of the morning. The publication of the Reports of these meetings has to be deferred by reason of space limitation, until next month. It is to be noted here, however, that the Principal Officers elected for the ensuing year were: President, Captain S. Walton-Brown; Vice-Presidents, Mr. J. W. Gibson and Major Ivor David; Hon. Treasurer, Mr. Roslyn Holiday.

AYRSHIRE SUB-BRANCH.

Earthing.*

Discussion.

Mr. ALEX. McPHAIL said it was with very great interest that he had listened to Mr. Wishart's very able paper and seen the very informative collection of lantern slides. He was impressed with the very fine work done in connection with testing and recording apparatus for leakage indications. One or two things occurred to him. Take first the earth continuity test. To him that seemed wrong. He had seen a case where they had continuity—perhaps not much—but when the Wheatstone Bridge was applied it was found there was a very high resistance in the earth system. In testing cables it was better to test for conductivity; in fact, in connection with mines they were compelled to do that. Take the case of a coal cutter; it might be anything like a mile from the pit bottom, and as the circuits neared the face there were a number of joint boxes, probably one every fifty yards over certain stretches. He believed the best way was to take a number of the boxes out and add longer lengths of cable as the extension went on. High conductivity of the armour of that cable was necessary and in order to get that it should be tested very often, more especially on the coal cutter, and tested from the main distributing centre to each section where the coal cutters were. Where there were a number of joint boxes the total resistance of the cores might be four, five, or six times the resistance of the cable when it was whole. To take the conductivity of the armouring there, to see if it was 50 per cent. of the conductivity of the cable was not sufficient; they could have a very high resistance of the armour circuit and still have the 50 per cent. In that case they were all the better to find the resistance of the cores and compare it with a cable without any joints; then compare the conductivity of the armouring with a cable without any joints. They should never forget that men's lives depended on the conductivity of the armouring and of the earthing system in general.

With regard to earth plates, Mr. McPhail said he had noticed that in most instances there were two plates. Now, two earth plates might be alright, but again they might not, because it would require a certain amount of testing, and very minute testing, to tell whether they would be of sufficiently low resistance to earth as to be able to keep below danger point, down to about 50 volts at least. He would like to ask Mr. Wishart what in his estimation would be the best means of testing the conductivity right from the earth plates to the end of the coal cutter lines. For himself he thought the Wheatstone Bridge was hard to beat. Personally he confessed that he did not like the continuity test.

Mr. MURRAY said it might be ridiculous to ask why armoured cable could not be supplied with earth wire similar to trailing cable, but if that could be done there would be less danger and fewer joint boxes to be properly earthed and bonded.

Mr. SOMERVILLE said that in connection with the Ayr Tramways they had steel poles set six feet into the ground. These could become alive through the insulators breaking down, yet the amount of leakage of current might be less than two amperes. So to all intents and purposes they were insulated. With reference to a remark made about the flexible leads to handlamps being earthed, would it not be better to have all the fittings of these flexible leads made of non-conducting materials?

Mr. MacCULLUM asked Mr. Wishart to say how he would know the earth-plates would carry off a short to earth of, say, 100 amps. and keep the pressure on the armouring below danger point.

Mr. McPHAIL.—With regard to supplementary bonding, we are compelled by the Mines Act to do that in mines. It is a very good thing and for this reason. In mines, and more especially in return airways, there is in many cases a good deal of moisture and also plenty of shot-firing. The gases given off set up electrolysis wherever there are two dissimilar metals in contact; it was set up on the bonding and on the armoured glands in the boxes. The better the conductivity was across the box the safer it was. Boxes thus should be very heavy; cast iron has fifty times the resistance of copper. Without the armoured glands at the end, with the glands disconnected, it was possible to carry the whole of the current across the bond, because usually the bonds were very efficient if properly made. For bonding there was one system which in his opinion beat all the others. At the end where the joint box is put in, open up the armouring of the cable about two feet; cut off a bit of the core so as to make the joint on the inside; then neatly bend the wires so that they join in the centre over the box; then a cap about 3 inches long by 1½ inches in diameter could be cut, and the whole of the wires placed in that and soldered. Where soldering cannot be done the wires can be clamped in the centre. A box should always be bonded, motors and everything should always have supplementary bonds, because they are more to be depended on than the glands. Consider the steel armouring of the cable and the iron of the box; it will often be found they are rusted up in a short time; there is not the same risk of that with the bond as with the gland.

Mr. WISHART.—Mr. McPhail has said he does not care much for the continuity test. Personally he, Mr. Wishart, had found it to be very reliable, and even in many cases to have superseded the Wheatstone Bridge method of testing. Mr. McPhail thought it was often better to test the conductivity, especially at the joint boxes. If the road were wide he thought it would be an advantage to make a special drum on which to wind a good length of cable and to carry it to the gate-end boxes. Then this drum could be unwound out to the distance required and so save a joint. Of course that method was only practicable with sufficient room to house a drum at the side of the road. But he agreed

* See *The Mining Electrical Engineer*, June, 1929, p. 414.

with Mr. McPhail that a number of joint boxes should be cut out by putting in a longer length of cable. Mr. McPhail also said of the joints in the boxes—presumably live joints—that the resistance would be four or five times higher. Mr. Wishart could not agree with him. The resistance of the joint in the box, when it has been soldered, would not be higher; it would be lower.

Mr. McPHAIL.—In colliery work there was often bad jointing done. He had mentioned that possibility specifically so that members would realise that a good joint was required. He knew of several cases where there were a number of joints on the cable and the total resistance of the conductor cores was increased from four to five times.

Mr. WISHART.—Of course, there was always the human element and its frailties to contend with in regard to bad joints, but electricians should really make good joints both for live connections and for earth connections. It was worth the trouble and might save men's lives some day. Mr. McPhail had spoken about two earth-plates and asked what was the best means of testing the conductivity of cables. Mr. Wishart said he had been asked that question when he read his paper in Glasgow, and one man present suggested testing the earthing, not by instruments but by the practical method of inserting a fuse of the capacity the cable was to be worked on. Should the cable be carrying 100 amps. he would connect the cable at the far end through a 100 amp. fuse and blow it; he called that a practical method of testing. He said if the earth connections were bad on the cable it would show in the boxes. Mr. Wishart said that might be a good method, though on heavier cables he wasn't sure that he would care to try it; it might be alright on smaller cables. The best means in his, Mr. Wishart's, opinion, was to short the ends and use an instrument to test. Unless an instrument was absolutely reliable it was not worth having, but there were reliable instruments made specially for the purpose. Home-made instruments could be used but if these were not reliable then a proper instrument for testing should be got as being essential for testing armoured cables. With regard to Mr. Murray's question, the idea propounded was quite a good one, but it added to the cost of the cable, and cost was very important.

Mr. MURRAY.—The first cost might be a little more but it might be the means of preventing a lot of disasters. The human element creeps in; all kinds of different men were set to work at a joint box and they perhaps did not realise the responsibility. In the long run would it not make for a more efficient system?

Mr. WISHART.—It would be a very good thing to have an internal earth conductor, but if the armoured cable joints were bad what would prevent the armouring becoming alive should a fault occur? Still, this extra core may be in the right direction towards a more efficient earth system.

Mr. MURRAY said that a joint box in the making was certainly liable to careless workmanship but, in his opinion, there would be fewer joints to make. With a joint box there was supplementary earthing to put on and more glands to be used. There might be more bad workmanship on the whole of those joint boxes and supplementary glands than there would be on one joint only and the coupling up of the earth wire on the inside of the cable.

Mr. WISHART said he did not think that would overcome the possibility of the armouring becoming alive. The internal core would have to be connected to the armouring at each joint box, and run as it were in parallel with the external earth conductor he, Mr. Wishart, thought it would call for more joints as the armouring would still require to be supplementary bonded to assist, as Mr. McPhail said, the conductivity of the earth glands which may be deteriorated by rust or electrolysis. Mr. Somerville had spoken about tramway poles set into the ground becoming alive. There had not been sufficient attention paid to the fixing of these poles; they were fitted not so much for an earth connection as for other duties. Often in an earthing system a pole is just driven into the ground and that is called an earth. Mr. Wishart, continuing, said his system was to start at the point of supply, whether it was on armoured or unarmoured systems, and carry through as on an armoured system, carrying all wires to that earth plate. With regard to hand-lamp holders, he did not know that these need necessarily be made of insulator materials where there were wooden floors, but he considered it might be a good idea to be carried out above concrete floors.

Mr. MacCallum had asked how one would know an earth plate was carrying 100 amps. Mr. Wishart said that he did not know how that could be arrived at unless by means of a practical test; it seemed to him that was the only certain test to see if the plate could be relied upon to dissipate the current or not. In cases where there was any doubt the only way was to put in extra plates or plates of larger area.

He agreed with Mr. McPhail that under Home Office rules supplementary bonding must be used in mines; even in factories and engineering shops where armoured cables are used, he considered it ought also to be done.

Mr. McPHAIL here mentioned that some years ago he had carried out a number of tests in connection with earth plates. His experience was that they vary exactly as lamps in parallel. He had had as many as a dozen earth plates a mile and even two miles apart. If there be need for earth plates, his advice was don't stick to two but put in as many as you can.

THE CHAIRMAN (Mr. T. M. McGlashan), in closing the discussion, said Mr. Wishart had taken great pains to give full particulars and information as to the installing of a really efficient earthing system, and while some may prefer other methods or modifications he thought they would all agree that Mr. Wishart's design was efficient, dependable, and cheap. Mr. McPhail was recognised as expert on earthing. He, Mr. Mc Glashan, would give Mr. McPhail due credit by saying that he thought his earthing methods, which he had seen, would take a lot of beating for simplicity, ease of examination, and inspection, and reliability.

Continuing, Mr. McGlashan said he had expected to have heard some reference to the inverted umbrella type of earth plate which had much to commend it. This was composed of a cup-shaped steel plate, possibly about 3 ft. 6 ins. diameter by 2 ft. deep, made of plates, say one-eighth inch thick, having a wrought iron tube about 5 feet long attached to the bottom. The cup was sunk into moist ground and filled up with gravel, coke, and stones. The vertical tube was perforated with small holes at the bottom so that, should the resistance rise during dry weather, further water could be added to keep the contents of the cup moist. The objection he saw to this type of earth plate was its liability to decay through dampness and corrosion.

On the motion of the Chairman a vote of thanks was accorded to Mr. Wishart for his interesting paper and contribution to the discussion, and to Mr. Somerville for the loan of, and manipulation of, the lantern.

WEST OF SCOTLAND BRANCH.

A meeting of this Branch was held in the Royal Technical College, Glasgow, on Wednesday, 20th March, 1929: Mr. Frank Beckett, Vice-President of the Branch, occupied the chair. The President of the Association, Mr. Frank Anslow, was also present. Mr. Andrew Wallace having been elected to membership, a paper entitled "Earthing" by Mr. John Wishart was read, and many lantern illustrations were shown. (See pages 17, 18).

Earthing.

Discussion.

Mr. FRANK BECKETT (Chairman) opened the discussion by commenting upon the great interest and value of Mr. Wishart's paper. The question of earthing was one on which there was a great divergence of opinion, and he was quite sure Mr. Wishart's views would not exactly coincide with some of the views of the members present. He would welcome a word from the President of the Association.

Mr. FRANK ANSLOW (President of the Association) thanked the Chairman for his welcome. He said he had come to the meeting as an ordinary member, and therefore had no particular message to give as President. He had listened with very great pleasure to the paper, and wished to compliment Mr. Wishart on the form in which he had put it together as well as on the manner in which he had delivered it.

Mr. Anslow said he agreed entirely with the author that the earthing system would deteriorate, and therefore no matter how good may have been the specification to which it was originally installed, it would depend entirely on the electrician at the colliery to see that the earthing system was efficiently maintained and improved as improvement could be found possible.

Was Mr. Wishart, with regard to his Table of Fatal Accidents, quite satisfied that all the accidents he had recorded as being due to bad earthing were actually proved to be due to bad earthing? Mr. Anslow did not want to say a word against proper earthing: on the contrary, good earthing was the best protection against electric shocks known up to the present, but he did wish to emphasise the fact that, even with the earthing carried out as thoroughly as it could be, and as efficiently maintained, it was still possible for a fatal accident to occur. He knew of one particular case where the earthing system was tested and found perfect a few hours before the accident occurred, and it was again tested a few hours after the accident and again found perfect: yet that man was killed. Now, that accident was recorded in the report of H.M. Electrical Inspector of Mines as being due to faulty earthing. As said, the earthing system was in perfect order and in his, Mr. Anslow's opinion, the assumption that the accident was due to faulty earthing was not correct; he submitted that it was due to other causes for which there were several theories. That such occurrences were possible was of course no excuse for an inefficient earthing system, a state of things not to be tolerated for a moment.

He entirely agreed with the author that there should be two earthplates: it was both inefficient and inconvenient to rely on a single earthplate. He also agreed with Mr. Wishart on a matter of detail in that the bolts should not be made of brass but should be made either of galvanised or otherwise protected steel, or preferably iron, because iron does not corrode to the extent that steel does: personally, he would prefer iron bolts even although they may be a little more expensive.

Mr. Wishart had mentioned that it was impossible to protect the generator: his actual words were, "It is not possible to ensure that the whole of the generator is protected as, however low the resistance may be, a certain voltage is required to pass sufficient current through the resistance to operate the generator relay; and if a fault occurs near the neutral point the voltage available may be insufficient to pass the necessary current through the resistance." With that Mr. Anslow was in agreement, but said it was quite possible to protect a generator so long as three leads were brought out from the neutral point as was shown on one of the diagrams.

Mr. O. N. HOLMES expressed his agreement with Mr. Anslow regarding the importance of efficient and adequate earthing on all systems wherever possible. Mr. Wishart had referred to a cast iron earth plate, and probably that would be as effective as one made from other metal. Mr. Holmes, however, could not agree with the author regarding the bolting of the copper connection to such plates. A method giving better results was that of the copper bond, the terminals being expanded into drilled holes in the cast iron plate. The earth conductor in that case was then connected direct to the copper bond.

In regard to joint boxes, etc., the author was quite correct in emphasising that there should be a supplementary bond on all boxes. It would generally be found that mining boxes adapted for bitumen cables have these bonds fitted externally, but in the case of boxes arranged for paper insulated cables there was an internal bond for the continuity of the lead sheathing, and the supplementary external bond for the armouring wires.

Mr. Wishart had compared the mechanical lead clamp with the ball joint: not many engineers would prefer a mechanical lead joint if a plumbed joint could be made. The effectiveness of the former joint depends upon mechanical clamping and with soft metal like lead there was always the possibility of it yielding and admitting moisture to the interior of the box.

Mr. A. NAPIER.—Mr. Wishart referred to a case in 1924 of the earthing pin not being screwed in tight to the plug; that was bad construction, because the plug should be fitted to ensure perfect contact—the pin is merely there to hold the plug from being drawn out. Mr. Wishart had shown a diagram of the bond tester but he, Mr. Napier, could not see how that bond tester could make an accurate test of the band, because the contact was only with one armour wire and neglected contact with all the other wires. To make a proper test it would be necessary to have the wires thoroughly cleaned on each side of the bond box, and a copper gland or other device clamped round the armour, thus putting all the armour wires in parallel.

Mr. A. F. STEVENSON described an experience on the point raised by Mr. Napier when he went through the test room. He had been called in on a Sunday to find a fault on a big triple concentric cable worth about 25s. a yard. He had had no experience of faulty earthing before that, so was quite content to take one wire as being a connection to the outer conductor. He made the usual localising test, but was still too inexperienced to take the test from the other end. He cut the wire and then tested both ways: then made another localising test on the faulty side and found he was about 100 yards out. He made yet another test to find what was wrong: cut again and found he was 50 yards out. He then realised what he had been doing, cleaned up all the wires, connected them together and got the fault: but the cable was pretty well ruined by that time. He thought the works manager got the idea that he, Mr. Stevenson, had done it out of spite because he had been called in on a Sunday. The actual details of that incident would not apply to this test of the bond, but it was certainly a point that, if the bonding was bad it might happen that the testing clamp be put on to a rusty wire.

He agreed with Mr. Holmes that a plumb joint was the only satisfactory means of connection on to lead, especially in a damp place. Of course that applied also to bonds which had nothing to do with collieries. It was a curious thing that nearly everything about the electric part of a colliery was put to a test of at least working conditions, and yet one practically never heard of bonding being put to that test. He once suggested to a consulting engineer that, as he was so confident of his bonding, he ought to go to the far end of the system, with the fuse in, and connect the live end with the lead or armour, but he "went up in the air"—he said it was perfectly preposterous, and he would not do it. However, Mr. Stevenson had found a contractor who had done it twice, and was perfectly satisfied. The reason for suggesting this test was that on the bond of a cable there might be a metal contact of a small area that would carry two or three amperes in the bond test without any trouble, but if subjected to 500 amperes it would blow out. That was why he believed that the bonding should be tested with the current which the bond may have to carry in practice.

Mr. Stevenson concluded by stating that in his opinion the top of the earthplate should be brought up above the ground level and should be in sight, rather than sunk, because unless the colliery is particularly well managed these things are apt to be forgotten about in any inspection work.

THE CHAIRMAN, in closing the discussion and before calling upon Mr. Wishart to reply, stressed the importance of the proper testing of earthing systems. It was not sufficient to have an earthing system properly carried out in the first instance: it must be properly tested periodically right throughout its life.

Mr. JOHN WISHART (in reply).—With regard to the Table of Fatal Accidents, the figures were taken from the reports of the Electrical Inspector of Mines. He could not say whether Mr. Anslow's actual case was due to faulty earthing or not. In connection with the question as to whether brass or iron bolts should be used, he had always maintained that iron bolts were preferable. He had an experience on a large high tension switchboard: all the bolts clamping the bus-bars together were made of brass. Before putting the current on this board he opened all the cubicles to have a last minute inspection and to see that all was right. There were about twelve bolts lying broken on the bottom of the cubicles. He could only account for that by the fact that the bolts must have been screwed up too forcibly. After that experience he recommended iron bolts, especially for earthing. He generally painted all earth bonding with red anti-sulphuric paint, to indicate that it was an earth connection.

With regard to the protecting of the generator, there were many systems, and many papers have been read dealing with that question. The subject of automatic protection would require a night to itself for discussion.

Mr. Holmes had spoken about not using a bolt for bolting the socket to the cast-iron plate. He, Mr. Wishart, had never used anything else but a bolt.

As regards the ball joint system against the clamp system, in fiery mines a plumbed joint cannot be made though it is the best joint. There are many instances, especially in fiery mines and factories, etc., where one is not allowed to use blow lamps in case of fire; then the lead clamp method of bonding has to be used.

Mr. Napier had spoken about the earthing pin: when he, Mr. Wishart, was first associated with coal-cutters, the earthing pin formed an important part of the earthing system. He remembered where there was a small copper strip on which the side of the plug made contact. He was led to believe that the earthing pin had not only to keep the plug in, but really took the use indicated by its name.

Mr. Napier had also spoken about the two pencil points on an earth testing instrument, and he agreed with him there was a liability to error due to insufficiency of the contacts. It was far better to clamp the test points to the armouring.

Mr. Wishart then briefly commented upon the full current-fuse test described by Mr. Stevenson and also on the point regarding accessibility of the earth plate connections. In conclusion he thanked Mr. Horsley, and also Messrs. Johnson & Phillips, Evershed & Vignoles, and Metropolitan-Vickers Electrical Company for information he had received from them on various points helpful in compiling the paper.

AYRSHIRE SUB-BRANCH.

Starting Switches for A.C. and D.C. Motors and how to use them.

ALEX. McPHAIL.

(*Paper read* 30*th March,* 1929).

Switches for use in coal-cutters must be electrically efficient, mechanically strong, and capable of withstanding rough usage because they are subject to the most severe strains and tests that could be imposed upon any electrical switch. Usually the operators handling electric machines in the mine are not at all careful in the way switches are turned on or off, and more especially is this so should a machine stall or stop suddenly.

D.C. Machines.

In stoppages of this kind the full voltage is thrown on to the machine, and there is a sudden rush of current through the armature in the case of D.C. machines. If the safety fuse does not melt or the circuit breaker does not trip early enough to prevent damage to the motor, and if the operator is in the process of switching off at the time, the probability is that the contact finger tips are burned and also the barrel contacts are burned by the excessive load broken when the current is switched off. There are many D.C. motors used in this district and much trouble and lost time can be saved if the operator will just look before he leaps and start his machine properly, not slowly, but quickly and regularly on to each step of the starter and not by the haphazard method of turning the controller half-way on in the first process, and then full on in the next step; an even worse method is very often used, that of giving the switch handle a full sweep right round from beginning to end in one step.

It should always be remembered that every motor when at rest has a resistance in its starter to keep down the current until the motor is started up. As the switch is being turned round the resistance is being cut out gradually and, at the same time, the back electro-motive force of the machine is rising correspondingly with the cutting out of the resistance until the motor is at full speed when all the resistance to the armature circuit is cut out and the back E.M.F. is at its full value. The object of the starting resistance is to prevent a rush of current through the armature until the back E.M.F. rises to limit the current flow into the armature. From this it will be seen that if a coal-cutting machine "stalls" great care should be exercised when starting it again, because of the cutting wheel or chain being jammed, and the possibility is that the motor will not start until it receives full current in order to get full "torque" or turning moment: even then at this point it may not move, with the result, if the fuses or circuit breakers do not cut out, the operator may switch off suddenly the very large current and do more damage to the starting gear than can be repaired in a shift—an occurrence which might mean a day's work lost to the section, and much expense to replace finger tips and probably a controller barrel.

The starting resistance is in series with the armature, and when the switch is turned on to the first step all the current to the armature passes through this resistance. The shunt current passes straight from the mains to the shunt coil so that the full magnetism to the fields is when the switch is at the starting point. As the switch is turned round the armature resistance is cut out, and when the starter is full on, no resistance is in series with the armature. The resistance coil may be of iron, eureka, manganin, or other alloy, but it must be able to carry the current for the time being without excessive heating. When an operator understands these points he will know that to hang too long on a resistance stop or stud when starting up will overheat and perhaps burn out the resistance, and that to start up too quickly will damage the motor armature. He must learn the correct time required for the starting up of every machine. He must be careful to give his motor time to start, and this can be got by practice.

In the case of motors, the back E.M.F. generated when the motor is running is opposed to the E.M.F. applied to it and, for any definite strength of field, its value is proportional to the speed at which the armature revolves. The resistance will absorb some of the voltage of the circuit and the speed of the armature will be reduced in proportion. As soon as the motor begins to revolve it generates a back E.M.F. which, acting like a resistance, reduces the current. The armature will continue to accelerate until the current has fallen to a point which will just produce sufficient "torque" to overcome the load. The current used to run the motor is usually less than is necessary to start the motor against the dead load. The slower the motor starts the higher the starting current, and it is just at the point of switching across from one contact to another that the damage is done to the starting apparatus. The back E.M.F. rises and falls with the amount of work that the coal cutter motor is called upon to do, so that it will be seen if this back E.M.F. drops too far the current flowing into the armature will rise too high and it will either trip the switches or burn out the armature.

There is a point here that is worthy of notice: where fuses are used and difficulties sometimes met with in "runs," it is not unusual for some operators to increase the size of the fuse without giving any consideration to the damage that may be done to the motor. It is generally assumed that a motor will not take more than about half a minute to run up to full speed, and starters are built on this assumption.

Coal-cutter resistances are usually strong and very efficient and the finger tips are heavy and have a good area. The great trouble is caused by what is termed "beading," that is, the formation of small round balls on the finger tips, caused by heavy currents when switching off, and when the operator tries to switch on again these "beads" or balls catch the drum segments and turn the finger out of shape.

A motor should easily withstand from 25% to 50% overload intermittently, and it often has to do so in the case of coal-cutting machines. Time lag fuses or circuit breakers, which will only give a pre-determined limited time before cutting out, are the best trips for motors working under such conditions.

An operator who is not careful in switching on may start "flats" on the commutator which in course of time will cause increasingly excessive sparking, becoming worse and worse. Once a "flat" has started, the only cure is to have the commutator turned up. Much trouble and expense can be saved by an operator studying his work and how to handle his machine. He will thereby save himself and other people much trouble and expense.

A.C. Machines.

A.C. motors are non-synchronous motors, and an induction motor is a kind of A.C. current transformer. The stator or fixed portion has the primary winding and the rotor has the secondary winding. There is usually not so much starting apparatus in A.C. work as in D.C. work: the A.C. starting apparatus having at the most two steps, a limit which does not call for so much care on the part of the operator: in the newer form of A.C. coal-cutting machines only one step, direct on to the mains is used, because nearly all the coal-cutter motors are squirrel cage motors. With a three-phase squirrel cage motor to hold the rotor so that it cannot revolve is to produce in effect a short-circuited transformer. Thus the stalled machine, if connected across the supply mains, would take a large current into the primary winding, this in turn would induce heavy currents in the rotor bars. The primary current would be not more than about from three to four times the full load current; so it is a good feature of the induction motor that the current is automatically limited, and this permits of the starting up of small motors without the use of any starting resistance. From this point of view, makers have made the rotor resistances, air-gap, and other details to permit the starting up of the coal-cutter motor directly across the mains in the first step. This prevents operators from doing so much damage and causing so much trouble by careless starting as is the case with D.C.

When a large current is taken by an induction motor at rest, it is out of proportion to the turning effort and produces a very low power factor, which gives a great variation in the line voltage. The turning point or "torque" varies as the square of the voltage, so that as the full pressure produces full load torque and there is only one-quarter load torque when the pressure is reduced to half, it will be seen that to use a starting resistance in such motors in order to keep down the starting current would reduce the voltage on the terminals of the motor and starting up could only be against very light loads, which would be no use for coal cutting machines. When a number of coal cutting machines are working there cannot be any objection to using an excessive starting current which is only momentary, because all the machines would not be starting at one time. Resistances can therefore be dispensed with and only a three-pole switch used to switch the motor directly across the mains in one step.

To get the maximum starting torque it is necessary to give the full line pressure which means that the motor will take roughly from three to five times its full load current. The greater part of this current is out of phase with the E.M.F. and serves no useful purpose at all.

Many devices have been tried to start up the squirrel cage motor under load, and the only successful way is to introduce resistance into the rotor windings. Automatic centrifugal devices have been used with a sliding short-circuiting switch worked by means of a knob on the end of the shaft which was bored out to receive the slide. Before starting the motor the knob was pulled out, which put resistance in the rotor winding, and when the motor was at full speed the knob was pushed in, which short-circuited the resistance.

Another device was step-winding but, as these devices were complicated, it was thought the best way was to use a star-delta switch which started the motor on star connections and then crossed over to delta connections: in this case the motor must be mesh-wound and provided with six terminals. In a mesh-wound motor connected up in star each phase only receives about 4/7ths of the voltage it is wound for, and the motor would start against about one quarter of the maximum torque. A star-delta switch is a three-pole cross-over switch which turns to one side for star and to the other side for delta, or as it is termed, start on the star side and run on the delta side. In most coal-cutters this switch was operated by a wheel and the switch was continually turned round in the one direction, first star, second delta, third off position. The switch being interlocked it could not be turned in the opposite direction.

To a large extent the star-delta switch has also been done away with and the more modern and simple three-pole switch adopted for switching directly on to the mains in one step. The heavy currents taken by short-circuited motors could not be objected to if the power factor was not so low.

The power factor depends on the relative value of resistance and inductance. In a circuit with inductance and no resistance the power factor is zero, and in a circuit all resistance and no inductance, the power factor is unity. It is because the resistance of a short-circuited rotor is so low and its inductance so high that the power factor at starting point is so low. The only portion of the current which is used in overcoming resistance is useful or power-current, the rest of the current is useless or wattless-current, because it is out of phase, lagging 90 degrees behind the E.M.F. When the motor is running the back E.M.F. acts as a resistance and the power factor is at its highest when the motor is at full speed. In alternating current circuits with inductance, the current lags behind the voltage. This reduces the true watts. The apparent watts are the product of volts and amperes, but the true or useful watts depend on the amount of lag and may be as low as only 15%. The ratio between the true watts and the apparent watts is the power factor, and this varies from about 95% downwards, depending on the power absorbed by the motor. Only a portion of current is usefully employed and it is that portion which is in phase with the voltage. The idle current or wattless current performs no useful function and only produces waste heat, which is not good for the machine.

It would appear that the best switchgear to start a coal-cutter under the various varying conditions met with in mines has not been devised yet. We either cannot start at all without tripping the circuit breakers or taking a heavy load, or in other instances much hard work is involved in clearing out a cutting chain before a start can be made when once it has been slightly jammed. With a good starting arrangement there would be no difficulty in starting up under any condition of normal working. What the future may bring it is not possible to say, but so far the designers have not provided the machine or gear to perform this function.

SOUTH WALES BRANCH.

At the meeting held in Cardiff on April 20th last, Mr. T. S. Thomas took the Chair; there were fifty members and visitors present. Mr. John Lewis, of Brynamman, was accepted as a member.

Mr. H. T. Gregory then read a Paper entitled, "Three-phase Induction Motors and their Control Systems", illustrated by lantern slides.

The Chairman, in opening the discussion, emphasised the importance of papers of this description being read before the Association. He was followed by Major E. Ivor David, Messrs. R. H. Morgan, W. A. Hutchings, H. Pritchard, J. F. Smith, and J. B. J. Higham, to whom Mr. Gregory suitably replied.

A vote of thanks was accorded Mr. Gregory, on the proposition of Mr. Higham, seconded by Mr. D. J. Thomas.

Three-phase Induction Motors and their Control Systems.

H. T. GREGORY.

Ordinary Squirrel Cage Motor.

The standard squirrel cage motor with its uninsulated short circuited rotor winding is the most reliable, efficient, and cheapest form of motor available. The practice of switching squirrel cage motors directly on to the supply has grown considerably, but there are still many cases where their starting performance does not permit of any, excepting small motors, to be started in this manner. As the principal limitations to the use of this motor are the heavy current drawn from the line when full voltage is applied, and the low starting torque when low starting voltages are applied, it may be of some interest to review briefly the reasons why this motor has such a poor starting performance and how it may be improved (though at the expense of good running performance).

A squirrel cage motor, at the time of starting, can be regarded as a transformer with a short circuited secondary winding, but with large magnetic leakage. The secondary is stationary and the rotating field has the same angular velocity with respect to both stator and rotor. The rotor current is equal to the rotor E.M.F. divided by the rotor impedance. This impedance is dependent upon the values of resistance and reactance. The resistance is a fixed quantity in this type of motor and is made low in order that the efficiency may be high; the reactance depends directly upon the inductance of the rotor winding and upon the frequency of the rotor current. The rotor frequency is directly proportional to the slip, and at standstill will be equal to the stator frequency.

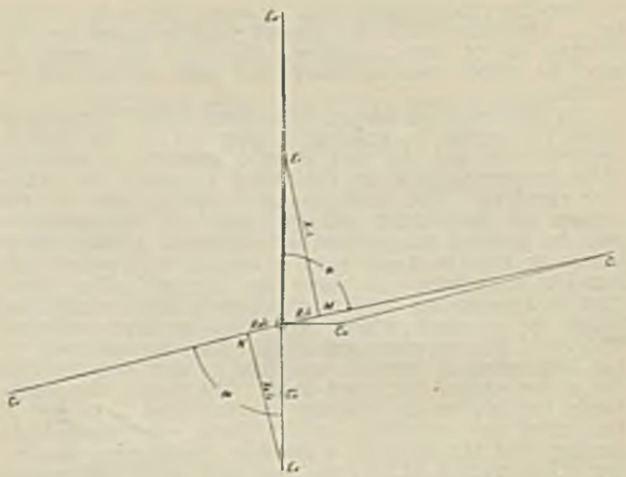


Fig. 1.

Thus it will be seen that the rotor reactance at the time of starting will be large, therefore the rotor current will lag nearly 90° behind the induced E.M.F. in the rotor. The torque being proportional to the product of the rotor current and the cosine of the angle between this current and the induced E.M.F., therefore the starting torque will be small; and the current at starting will be large as there is nothing to limit it except magnetic leakage and ohmic resistance.

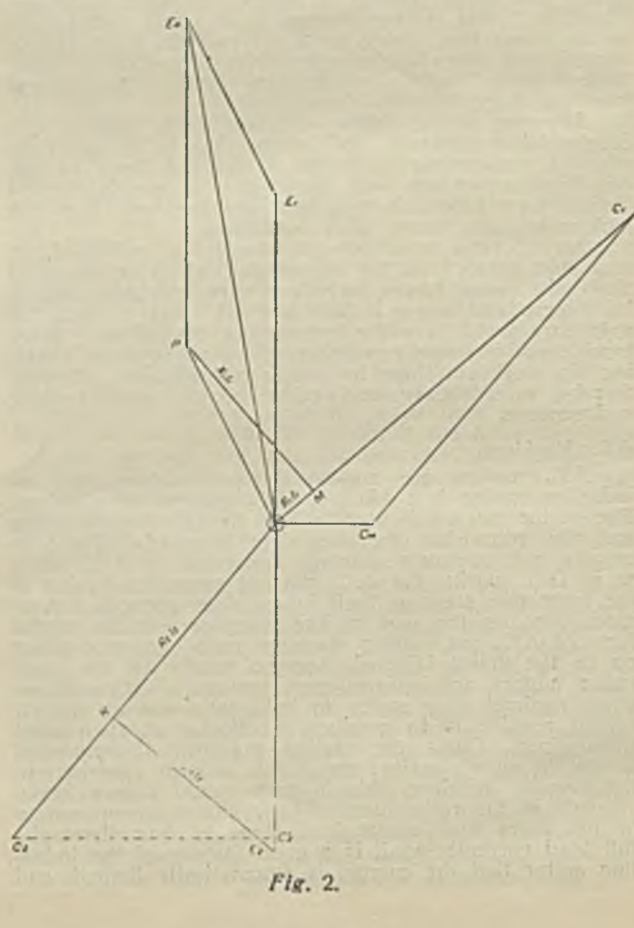


Fig. 2.

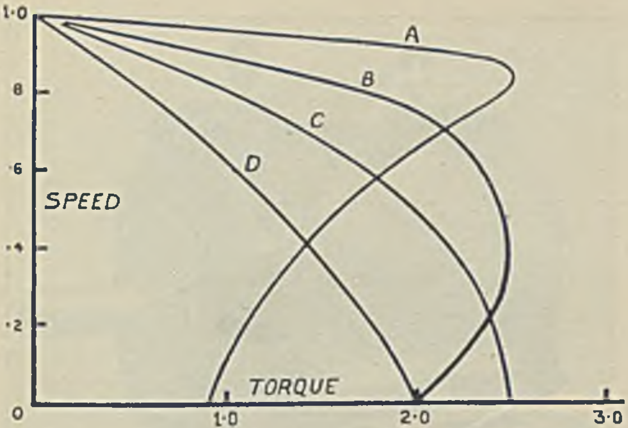


Fig. 3.

Fig. 1 shows the vector diagram of one phase of a 3-phase induction motor with short circuited rotor at the time of starting. OE_0 is the applied voltage, OE_2 is the voltage induced in the rotor, C_1 is the stator current and C_2 the rotor current. The triangle OE_1M represents the voltage drop due to the resistance and reactance of the stator, and the triangle OE_2N the voltage drop due to the resistance and reactance of the rotor. The angle of lag θ_2 of the rotor current is large; this is because the reactance of the rotor is large, being many times greater than the resistance at the time of starting. The stator current lags behind OE_0 by a very large angle θ_1, and the voltage induced in the stator is reduced to about half its normal value. The component of the rotor current in phase with OE_2 is $OC^1{}_2$, and since the torque is proportional to the product of OC_2 and cos. θ_2, its value will be small, and is represented by $OC^1{}_2$.

The starting torque and starting current of ordinary squirrel cage motors vary from 1 to $2\frac{1}{2}$ times full load torque, and from 4 to 8 times full current. These values depend upon the capacity and speed of motor. High speed motors draw a larger starting current than slow speed motors and also have a higher starting torque.

High resistance rotor squirrel cage motor.

The starting performance of the standard squirrel cage motor can be improved upon by increasing the resistance of the rotor winding. Fig. 2 is another vector diagram showing the effect of increasing the rotor resistance of the motor from which Fig. 1 is taken. The stator current OC_1 and rotor current OC_2 has slightly diminished, but the component of the rotor current in phase with OE_2 has increased to such a value that the torque has been increased to nearly four times the value in Fig. 1. Fig. 3 shows a series of torque-speed curves for squirrel cage motors with different values of rotor resistances. Curve A shows the torque-speed curve of a typical squirrel cage motor. Curve B in the figure shows the same machine with the rotor resistance increased to give nearly twice normal full load torque at starting.

Curve C relates to a further increase in rotor resistance which develops the same torque at standstill as curve B. It will be seen from the figure that increasing the rotor resistance increases the starting torque up to a limit, after which further increase in resistance reduces the torque; the starting current being reduced with increase of rotor resistance. If the resistance is made equal to the reactance, at standstill, the motor will develop its maximum torque at starting.

As the resistance will be a fixed quantity, the slip at full speed will be large and the speed regulation will be poor; as is shown by curve C in Fig. 3 any increase in load torque causes the motor to slow down, and any decrease in torque causes an increase in speed. Excessive heat will be generated in the rotor and the efficiency of the motor in general will be low.

Although possessing these disadvantages many of these motors have been applied where heavy starting conditions are encountered and running periods are intermittent and of short duration.

Double Squirrel Cage Motor.

The double squirrel cage motor, though old in invention, has only come into prominence within recent years, and is perhaps better known as the "high torque motor." It has the good starting performance of the high resistance squirrel cage motor and the good running performance of the standard squirrel cage motor. Briefly the construction and principle upon which it is based is as follows.

The rotor has two squirrel cage windings, one of high resistance material placed in slots near the surface of the core, and another cage winding of low resistance placed in slots deep in the core. With this construction, advantage is taken of the changing frequency of the rotor current from standstill to full speed. At the start the frequency of the current in the rotor of an induction motor is the same as that in the stator; the reactance of the inner low resistance cage winding being high produces a choking effect, preventing current from flowing in this winding, and the current is therefore confined to the outer higher resistance cage winding; the motor developing a starting torque depending on the value of the resistance of this winding. As the rotor accelerates and approaches synchronism the frequency of the rotor current dimishes and the choking effect of the inner winding becomes less effective until, when near synchronism, the current flows through this low resistance or inner cage winding. This provides a machine with a good starting and running performance.

The starting and running performance of double squirrel cage motors are entirely dependent upon the resistance and reactance of each cage winding. These four qualities must be so adjusted as to obtain a high starting torque, high efficiency, and high power factor. The resistance and reactance of these two cage windings can be varied to give many shapes of torque-speed curves. Fig. 4 shows a torque-speed curve for a double squirrel cage. This curve, when compared with a torque-

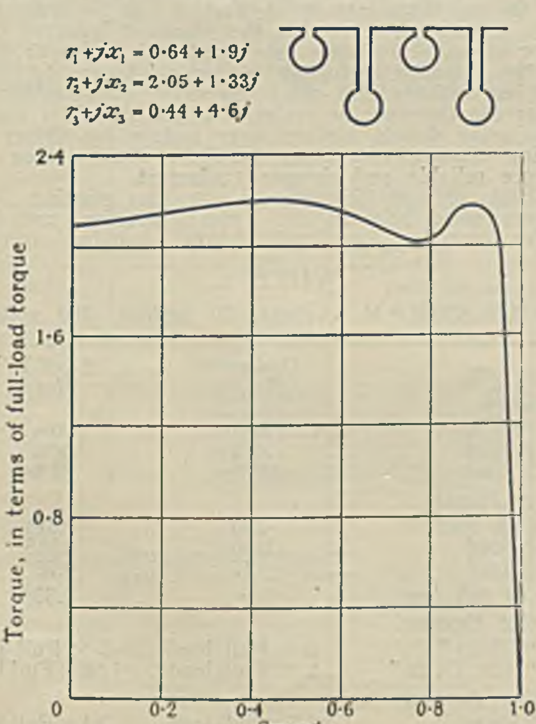


Fig. 4.

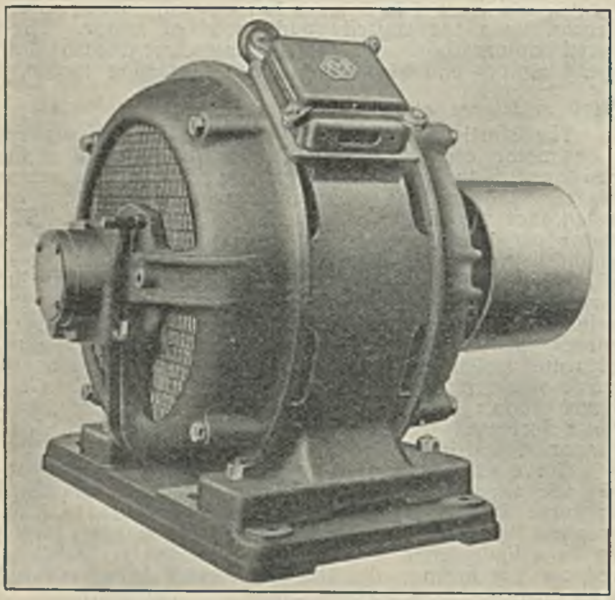


Fig. 5.

speed curve of a standard squirrel cage motor (Fig. 3) shows the superior starting and running performance of the double squirrel cage motor over the standard squirrel cage motor.

The construction of the double squirrel cage motor is to all outward appearances identical with that of an ordinary squirrel cage motor, as shown in Fig. 5. The rotor for this double squirrel cage motor is shown in Fig. 6. Fig. 7 illustrates a double squirrel cage flameproof motor for conveyor work. The performance of the standard squirrel cage motor is compared with that of the double squirrel cage motor in Table I. From this it will be seen that the rotor slip of the double squirrel cage motor is lower than that of the standard motor; a feature which indicates lower rotor losses, a cooler rotor and a machine of higher efficiency—the latter being from 0.5% to 2% higher in the double squirrel cage motor. Fig. 8 shows curves of efficiency for a slipring, standard squirrel cage and double squirrel motors. Curve (a) shows the higher efficiency of the double squirrel cage motor (C.K.B.) compared with that of the other two motors. The slight loss caused by the slightly lower power factor will be more than offset by the gain in efficiency, the gain being very marked in motors of large capacity.

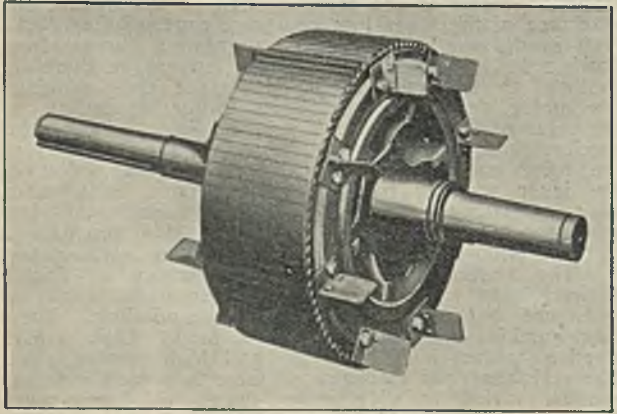


Fig. 6.

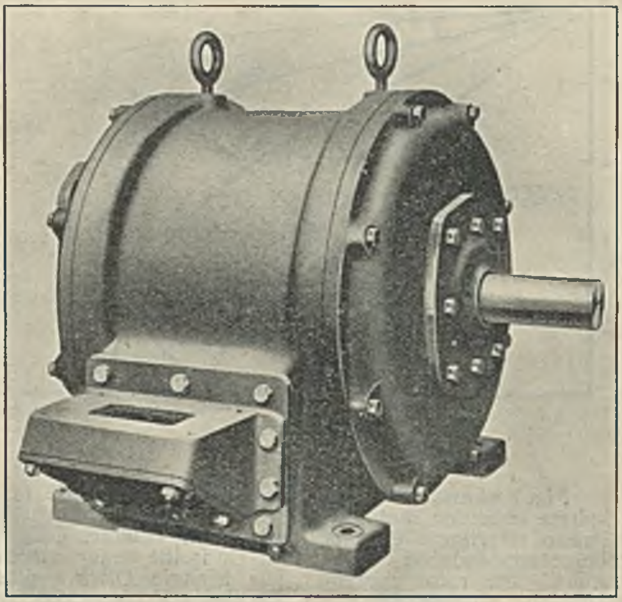


Fig. 7.

Fig. 9 shows the power factor curves for a slipring, standard and double squirrel cage motors. Curve (a) in Fig. 9 is a power factor curve for a standard squirrel cage motor (C.C.B.), curve (b) for a slip-ring motor (F.F.B.), curve (c) for a double squirrel cage motor (C.K.B.).

From Table I it can be seen that the double squirrel cage (C.K.B.) motor draws a lower starting current from the line than does a standard squirrel cage motor when switched direct on to the supply and when started up by means of a star-delta starter. This enables larger double squirrel cage motors to be switched direct on the line, and the star-delta method of starting can be applied to many drives, whereas with the standard squirrel cage motor an auto-transformer starter would be required on its 75% tapping to obtain a starting torque of 70%. The less reliable and more expensive auto-transformer starter can therefore be replaced by the star-delta starter when using double squirrel cage motors for drives requiring starting torque up to 70%; thus making for a more reliable and cheaper equipment.

Figs. 10 and 11 relate to star-delta starting. The starters were held in the "star" position until the motors ceased to accelerate before changing over to

TABLE I.

25 H.P—970 R.P.M.—3-phase, 50 periods, 400 volts.

	Ordinary Motor.	*"C.K.B." Motor.*
Efficiency.		
Full load ...	89.5%	90%
¾ load ...	89.5%	90%
½ load ...	88.5%	88.5%
Power Factor.		
Full load ...	0.90	0.875
¾ load ...	0.865	0.855
½ load ...	0.78	0.78
Slip on full load ...	3%	2.35%
Starting Current.		
"Direct" ...	6 × Full load	5 × Full load
"Star Delta" ...	2 × Full load	1.66 × Full load
Starting Torque.		
"Direct" ...	1.3 × Full load	2.1 × Full load
"Star Delta" ...	44% Full load	70% Full load

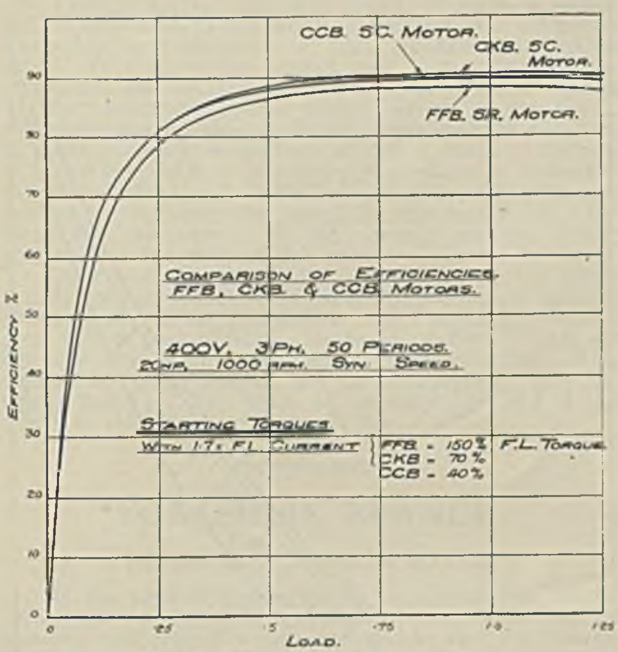


Fig. 8.

the "delta" position. It will be noticed that in both cases the maximum current peak occurs when the change over from star to delta is made. This peak is of very short duration. The ordinary motor draws a maximum peak of 3 times full load current as compared with 2.2 for the double squirrel cage motor. This is because the double squirrel cage motor will accelerate the load more nearly to synchronism before it becomes necessary to change over from star to delta. Also the power factor during the accelerating portion of the curve is higher in the case of the double squirrel cage motor than in that of the standard machine. This latter point is emphasised by the fact that when both motors have ceased to accelerate in the "star" position the ordinary motor is taking full load current while the

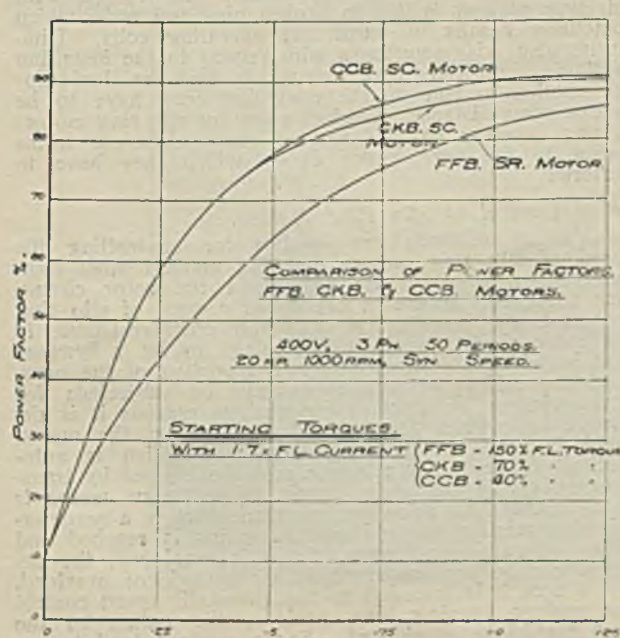


Fig. 9.

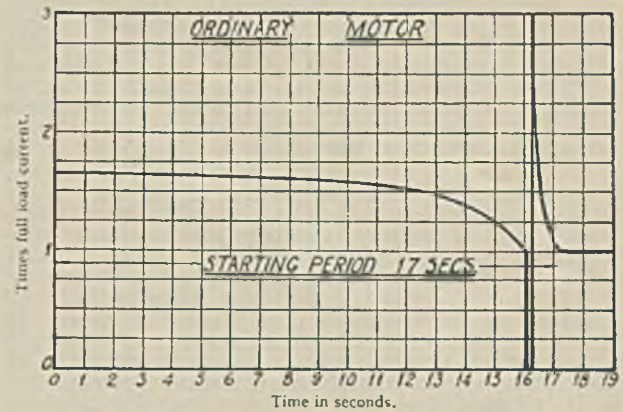


Fig. 10.

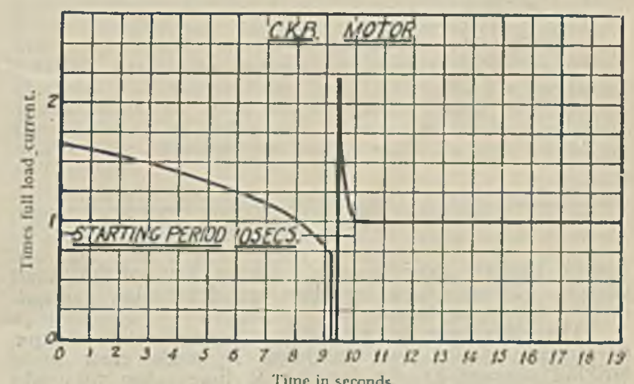


Fig. 11.

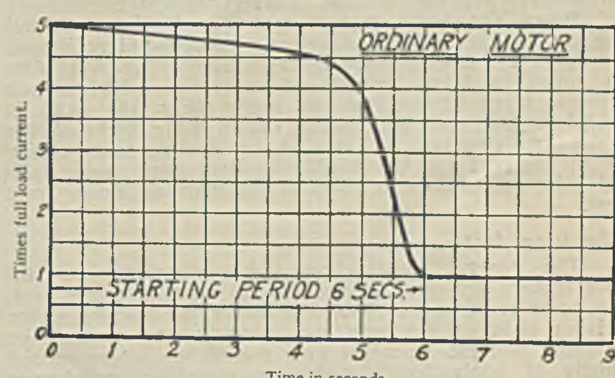


Fig. 12.

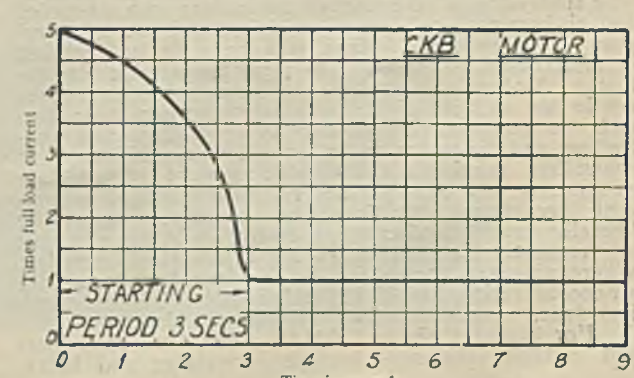


Fig. 13.

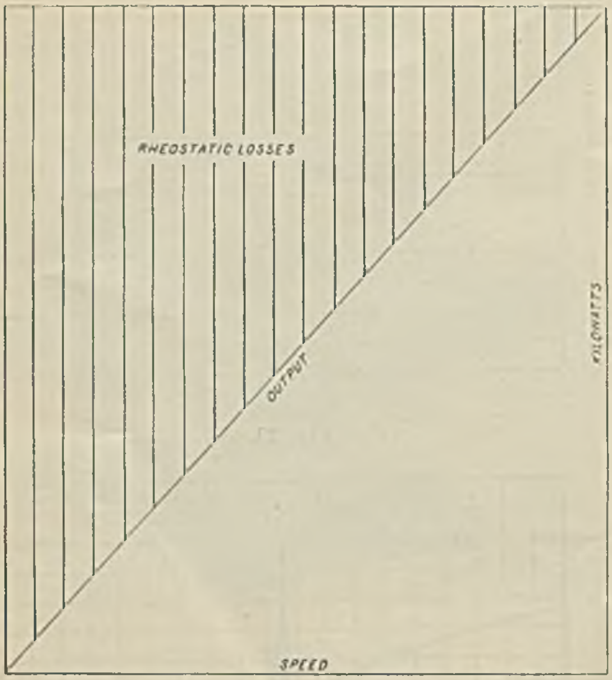


Fig. 14.

double squirrel cage motor is taking 75% of full load current, although both machines are developing approximately the same torque.

The difference in starting and accelerating torque developed by the two machines is made clear in a striking manner by the lengths of time taken to attain full speed, 17 seconds for the ordinary motor as against 10 seconds for the double squirrel cage motor.

When the same motors were used direct started the curves Figs. 12 and 13 were obtained. Here it will be noted the double squirrel cage motor (Fig. 13) is up to speed in three seconds as compared with the six seconds taken by the standard motor (Fig. 12); and, in addition, the ordinary motor draws fully 90% of the short circuit current for 75% of the starting time, whereas the current for the double squirrel cage motor falls off quite appreciably as soon as the machine moves from rest.

Slip Ring Motor.

The general construction and performance of slip ring motors are well known and call for little comment, but some remarks on control gear for the type of motor driving such as haulages and winding engines may be of some interest. Control gear for these motors consist chiefly of controllers, resistances, reversing switchgear, and liquid controllers.

For motors driving haulages up to 150 H.P., drum type air-break and oil-immersed controllers with air-cooled and oil-immersed resistances are in general use. Control gear of flame-proof designs will have to be installed in most cases underground to meet the Mining Regulations. Air-break controllers in flame-proof enclosures are in use and are giving very satisfactory results; contacts do not wear so rapidly as in oil-immersed controllers and there are fewer breakdowns. Oil-immersed controllers require a considerable amount of attention as contacts and oil must be frequently changed to prevent breakdown. Oil-immersed resistances must be liberally rated, making them costly, and the oil must be frequently changed to ensure satisfactory operation. Where air-break controllers can be installed along with air-cooled resistances of the unbreakable, jointless, rustless type, very satisfactory results will follow.

For haulages above 150 H.P., drum type controllers and metallic resistances become very large and bulky,

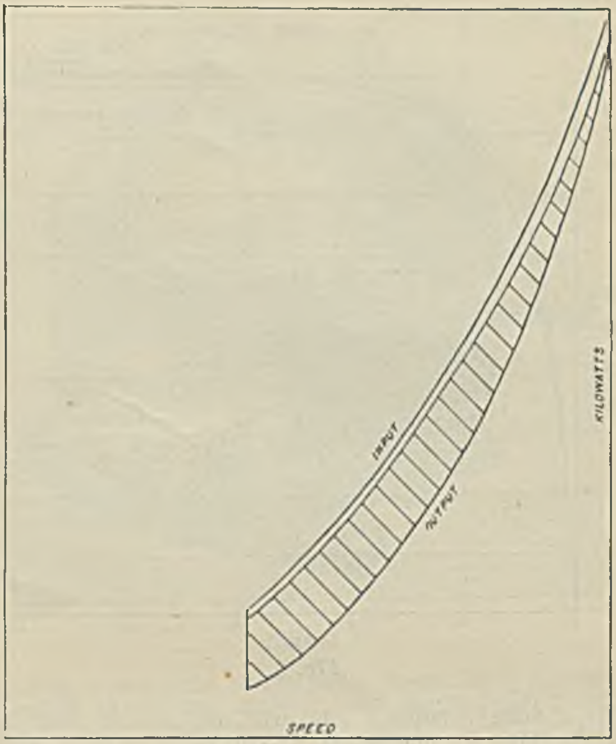


Fig. 15.

occupying considerable space and so being very difficult to house; so that at about 200 H.P. this type of control reaches its practical limit. Reversing switchgear and liquid controllers for sizes above 200 H.P. become necessary. Mechanically and automatically operated reversing switchgear, and liquid controllers of the moving electrode and the weir type are in use. Reversing switchgear of the electrically operated contactor type is also in general use.

The same remarks apply to reversing switchgear as to controllers with regard to wear of contacts and changing of oil. Occasional trouble experienced with this type of gear is due to broken pins and rods, which sometimes results in burnt out operating coils. Difficulties also arise sometimes with regard to the installing of liquid controllers underground, in that the liquid for the cooling system of the controller may have to be carried some distance. Control gears for slip ring motors driving winding engines assume more elaborate forms owing to the very heavy duties which they have to perform.

Speed Control of Slip Ring Motors.

Various methods are in use for controlling the speed of slip ring motors, but the method most commonly used is rheostatic control in the rotor circuit. One particular feature of the speed control of slip ring motors is the introduction of a permanent resistance in the rotor circuit, when it is desired to let a flywheel that is driven by the motor bear a portion of the overloads to which the equipment may be subjected; for large winders, with which for various reasons it is desirable to restrict the peak demands from the mains, there is used a liquid slip regulator which is automatically operated by a torque motor energised by transformers set in the main circuit. The torque motor is then adjusted to raise the electrodes when a predetermined maximum demand on the mains is reached and if an automatic voltage regulator is employed, the demand can be kept constant during periods of overload.

Where it is intended to use rheostatic speed control for motors running long periods, the nature of the load should be considered. For a constant load torque and variable speed, rheostatic control of speed is wasteful, as the input to the motor is constant and the power dissipated in resistances is equal to the reduction in speed. In Fig. 14 the shaded area shows the losses in resistances for constant load torque and variable speed.

For loads where the torque varies as the speed, rheostatic control may well be considered in the face of more complicated methods of speed control. In case of a machine such as a colliery fan, where it is desired to reduce the speed, advantage may be taken of this method of reducing the speed as the torque of a fan varies as the square of the speed, and the power absorbed as the cube of the speed.

Thus a small reduction in speed will bring about a considerable reduction in current, resulting in smaller losses in the rotor resistances. In Fig. 15 the shaded area shows the rheostatic losses for values of slip up to 60% for a slip ring motor driving a fan. This method of speed control has the disadvantage that the power factor of the motor is seriously impaired if the speed is reduced below about 25%.

YORKSHIRE BRANCH.

Visit to the Thoresby Colliery.

At the kind invitation of Mr. S. Evans and by the permission of the Bolsover Colliery Co., Ltd., seventy members and friends were privileged to visit the Thoresby Colliery on May 11th last. The visitors were shown over the plant by Messrs. Woodward, Wyness, Copping and the other staff assistants; Mr. A. Lucas, manager of the Sheffield office of the B.T.H. Co. was also present and answered many questions. The visit was one of great interest and it was thoroughly enjoyed by all. The Colliery Company kindly provided tea at Edwinstowe for the party, but unfortunately the officials of the colliery were not able to stay, and a letter of thanks was sent to Mr. Evans expressing gratitude to the Bolsover Company and to the officials who so generously gave up their Saturday afternoon for the benefit of the members.

The Electrical Equipment of the Thoresby Colliery.

The Bolsover Colliery Company's colliery at Thoresby, near Edwinstowe, Nottinghamshire, is an example of the latest practice in the lay-out and equipment of a modern colliery. The colliery is situated on the borders of Sherwood Forest; to preserve as far as possible the natural beauty of the surroundings, it was desirable that no steam or smoke should issue from the surface workings; also, on the other hand, commercial considerations necessitated that the colliery should be operated on the most efficient lines. Both these desiderata were achieved by the adoption of electricity for power purposes at the colliery.

A view of the surface buildings and headgears is shown in the illustration Fig. 1, from which it will be noted that the main building consists of two winder houses connected by a long building containing the plant for operating the winders, air compressors, ventilating fans and auxiliary machinery.

Power is brought to the colliery by an overhead ring main at 22,000 volts from the Company's plants at the collieries of Bolsover and Creswell to the north, and Clipstone, Mansfield and Rufford to the south, thus providing alternative supply lines and reducing to a minimum the possibility of failure. The power is stepped down at Thoresby to 2200 volts and 550 volts in transformers housed in a "lean-to" structure, shown in the illustration. At each of the generating stations mentioned B.T.H. mixed pressure turbo-alternators are installed generating three-phase current at 2200 volts, 50 cycles and stepping up to 22,000 volts for overhead transmission; the lines and switchgear being so arranged that any two collieries can interchange current without in any way affecting the supply to their own plant or to Thoresby.

The north (Bolsover and Creswell) and south (Clipstone, Mansfield, and Rufford) overhead lines terminate in 22,000 volt cellular type B.T.H. switchgear controlling two 3750 K.V.A. banks of single-phase transformers 12,720/2200 volts connected star-delta, one spare single-phase transformer being installed. The 2200 volts supply is controlled by draw-out truck type switchgear which provides for incoming feeders for the two transformer banks, and outgoing feeders to two electric winders, a 1280 H.P. air compressor, lighting motor-generator sets and two delta-star, three-phase, 625 K.V.A. step-down transformers for 2200/550 volts. The 550 volt system, which is installed to supply all the smaller surface motors, is controlled by draw-out ironclad switchgear with cubicles of the ironclad cellular type for the incoming feeders.

Two shafts, 80 yards apart, are being sunk to a depth of 2100 feet, and the winders, which will ultimately be used for winding coal, are at present employed in sinking, a duty which is much more severe

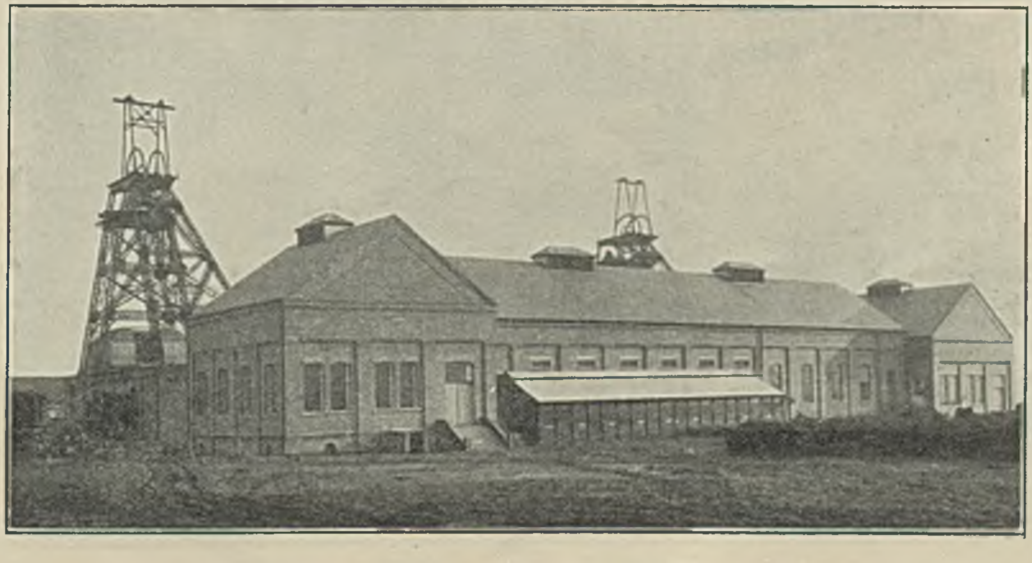


Fig. 1.—Winder Houses and Headgear at Thoresby Colliery.

than the normal coal winding duty; the out-of-balance load during the final stages of sinking will be 16 tons. The electric winders operate on the Ward-Leonard-Ilgner principle and were manufactured by the British Thomson-Houston Co., Ltd., Rugby.

Based on the sinking duty, the equivalent continuous rating of each winder motor is 2160 H.P. at 49.5 r.p.m., and for coal winding the continuous rating is 1500 H.P. at the same speed. The outside diameter of each motor magnet frame is approximately 15ft., the weight of each complete motor being 81 tons, of which 32 tons is accounted for by the armature and shaft. Each motor is direct coupled to the drum shaft, the drums being of the parallel type, 18ft. diameter by 10ft. 6ins. wide. The rope diameter is 1¾ins. and the maximum rope speed 2790 feet per minute. When winding coal balance ropes will be used and 195 tons of coal will be raised per hour, the amount raised per trip being 3.9 tons in 60 seconds net winding time. A view of one of the winders is given in the illustration Fig. 2.

The two motor generator sets which convert the 2200 volt alternating current supply to direct current at 650 volts for the 650 volts for the winder motors are shown in the illustration Fig. 3. Each motor-generator set consists of a three-phase slip-ring induction motor, 1500 H.P., 510/600 r.p.m., 2200 volts, 50 cycles; a shunt wound commutating pole compensated variable voltage D.C. generator, 1600 K.W., 650 volts; a D.C. exciter, 20 K.W., 110 volts; and a 22½ ton cast steel flywheel 11ft. 6ins. diameter mounted between the induction motor and the D.C. generator. Water-cooled brake gear is provided for acting on the rim of the flywheel to enable the set to be brought to test in a reasonably short time. The total weight of each motor generator set, including the flywheel, is 53 tons. A flywheel is provided to relieve the supply system during periods of peak loads when, by means of an automatic slip regulator, resistance is inserted in the rotor circuit of the induction motor, causing the speed of the motor-generator to stop, thus permitting the flywheel to give up a certain amount of its kinetic energy to relieve the supply system.

The automatic slip regulators, which are located against the wall near the motor ends of the motor generator sets, form a very interesting part of the equipment. Each regulator comprises a series of contactor type switches mounted on black enamelled slate panels, there being seven double pole contactors for starting purposes and twelve double pole contactors for slip regulating. The starting portion is used for running the motor generator set up to speed, and operates on the B.T.H. system of current limit control, whereby a resistance step cannot be cut out until the line current on the previous step has fallen to a predetermined value. Slip regulation is effected by means of a slip relay mounted on the front of the board. This relay is somewhat similar in appearance to a Tirrill voltage regulator; it is operated from current transformers in the 2200 volt supply line to the induction motor of the motor generator. When the current in this supply line exceeds a predetermined value the relay operates to open the first of the slip regulating contactors, thus inserting a resistance step in the induction motor rotor. Further resistance steps are thrown in automatically as required to keep the line current within the predetermined limit, the speed of the motor generator set falling lower and lower to allow the flywheel to give up some of its kinetic energy to assist in meeting the heavy demand from the supply. When the peak has passed, the slip regulating contactors close automatically in the reverse order, allowing the motor generator set to come up to speed again ready for the next peak.

A novel feature of these slip regulating contactors is the provision of auxiliary contacts on the slip regulating contactors which cut resistance out of the exciter field so as to maintain the exciter voltage practically constant as the speed of the motor generator set falls. A series of small contactors is also provided on the board for cutting resistance out of the D.C. generator field so as to maintain the generator voltage as the speed of the set drops. The resistances for insertion in the induction motor rotor circuit are mounted above the slip regulator boards. This arrangement allows free ventilation of the resistances whilst at the same time it affords easy access to the back of the boards.

In a room in the basement, between the foundation blocks of the two motor generator sets, is a change-over switchboard which permits of either winder being run from either motor generator set. The switches are fully interlocked, making it impossible for a wrong connection to be made, or for the switches to be operated whilst power is on the equipments. In this same room are solenoid operated circuit breakers for the main D.C. circuits between the generators and the winder motors; this switchgear is located in the basement between the

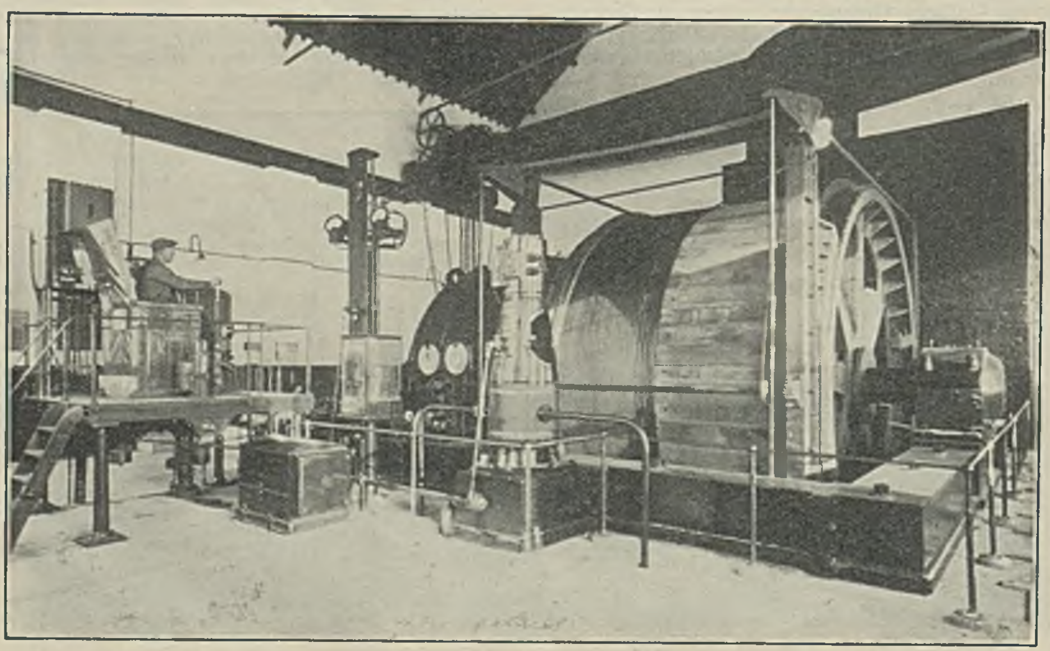


Fig. 2.—One of the Main Winders at the Thoresby Colliery.

motor generator sets so as to give the shortest possible runs for the heavy main cables.

The Ward-Leonard controllers are arranged on the floor immediately underneath the driver's platform, and are operated by hand levers on the platform. Each controller comprises a faceplate type switch for controlling the field circuit of the D.C. generator, and a drum type switch for reversing the field and effecting the various interlocks and safety connections. The D.C. generator field resistances for use with the faceplate type switch are located in the basement immediately underneath the Ward-Leonard controller.

When normal winding is commenced a cam gear, driven from the winder shaft, will be fitted; this will prevent the driver accelerating too rapidly, and will also return the control lever automatically to the "off" position towards the end of the wind. Tachographs are fitted to the winders to give a continuous record of the winding speed throughout individual winds.

A complete system of interlocks and safety devices is incorporated. Protection is given against overwind, overspeed, failure of electric supply, failure of air supply, etc. Overwind protection is given by limit switches mounted in the shaft headgear, a feature of the scheme being the B.T.H. patented system of connections whereby, after an overwind has taken place, the driver can only operate the winder in the correct direction for backing-out. The special backing-out switch by which this result is achieved is mounted on the driver's control panel on the operating platform.

The winder brakes are operated by compressed air. Two small air compressors, each of 15 H.P., are installed in the motor generator house; one compressor is of sufficient capacity to supply both winders, the other compressor acting as a standby. The air compressor, which has a capacity of 6000 cubic feet per minute at 120lb. per square inch, is of the double unit type direct coupled to a B.T.H. 1280 B.H.P. salient pole synchronous motor, one unit being connected to each end of the motor. The synchronous motor is one of the largest of its type in the country, being rated at 1280 B.H.P., 250 r.p.m., 2200 volts, and is designed to operate at 0.9 leading power factor. The 110 volt exciter is chain driven from the main shaft: the starting gear for this motor is of the B.T.H. latest design incorporating many recent improvements. It is housed in a special sheet steel cubicle and comprises a four-pole double-throw oil switch and oil immersed auto-transformer.

Two motor generator sets are provided for the lighting, etc., services, one of 100 K.W., and one of 60 K.W. at 110 volts D.C. These are controlled by a B.T.H. back of panel type switchboard so arranged that the sets can be used at will for lighting or arc welding by the "Quasi" arc process. This D.C. supply is also used for battery charging, etc.

A temporary supply at 3300 volts, three-phase, 50 cycles is provided for the sinking pumps of the "cementation" process. This is obtained by stepping up from 550 volts through a 1250 K.V.A., 550/3300 volts, three-phase transformer. This transformer is so arranged that it can be subsequently re-connected to step up or down as a link between 550/220 volt systems. Ironclad draw-out type switchgear controls the 3300 volt supply to the pump motors.

Generally the larger surface motors (50 H.P. and upwards) will be supplied at 2200 volts and those of lower rating at 550 volts.

WARWICKSHIRE & SOUTH STAFFS. BRANCH.

At the third meeting of this Branch, held in the Birmingham University on December 6th last, the paper entitled "Control Gear for Coal Face Machinery" was given by Mr. William Rea.

The Chairman, Mr. F. J. Hopley, also introduced to the Branch Mr. Frank Anslow, the President of the Association who, in addressing the meeting, stated that it was his pleasure in accepting the invitation of the Committee and to visit Birmingham, with which many happy memories were associated. Mr. Anslow's speech touched upon many problems which concerned the Association, and also upon the trend of development in the application of electricity to mining. This, he considered, was in a large measure due to the activities of the Association, through which their members became united in a common cause.

Mr. Rea's paper and the lantern illustrations were followed with keen interest. The speaker readily dealt with the many questions put to him and stated that had accommodation been suitable members would have had the opportunity of inspecting the plant he intended bringing, and satisfying themselves upon its utility and reliability.

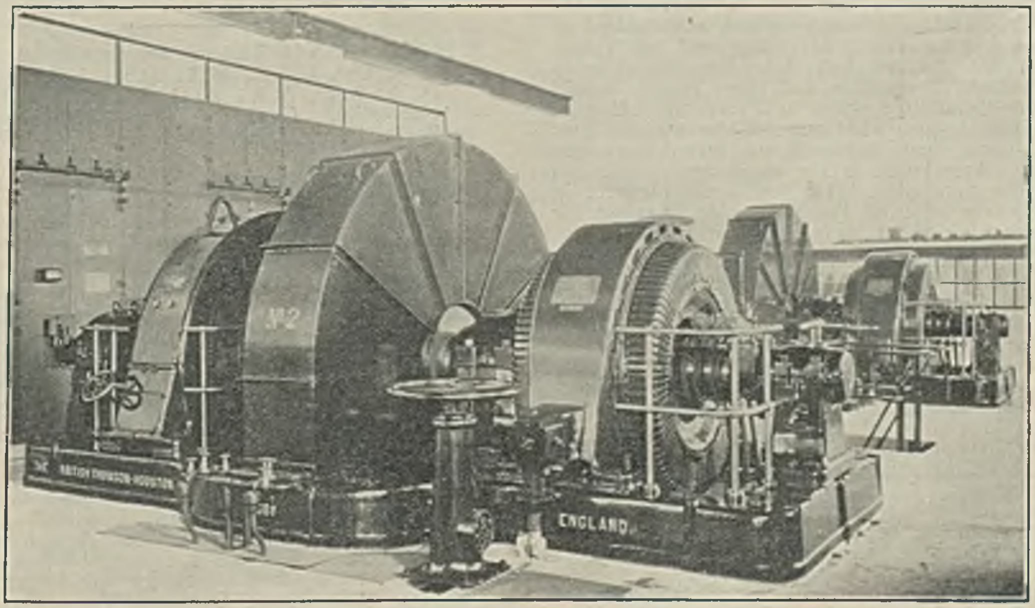


Fig. 3.—The Motor-Generator Sets for the Main Winders.

The paper was published at length in *The Mining Electrical Engineer* of January last. An abstract of the discussion which ensued is as follows.

Control Gear for Coal Face Machinery.

Discussion.

Mr. J. R. ENGLISH said there were several interesting features in this new type of gate-end switch which appealed to him. Practically all previous designs of safety switchgear for the gate-end could only be made to operate successfully on A.C. circuits, but he was pleased to see that the portable substation described by Mr. Rea could easily be applied to D.C. circuits. He thought the use of the substation might be extended to lighting at the gate-end, and possibly at the face, by making the motor generator a little larger and using low voltage lamps, say 25 volts.

The author had said that as conveyors and gate-end loaders were of a semi-portable nature, it had been found practicable to use pliable armoured cables for connecting the motors to the gate-end switch. He, Mr. English, was able to confirm this, as he had been using pliable armoured cable for this purpose for about two years and had found it very reliable and convenient. It had been recommended by H.M. Electrical Inspector of Mines. Mr. English said that in his case the pliable armoured cable was permanently connected at the conveyor end and detachable from the gate-end switch, where it could be interlocked in the usual way.

Mr. I. T. DIXON.—Is the motor generator supplying the D.C. for tripping not a weak point in the system, as small motors taking a 650 volt supply must have very fine wire windings and consequently are not very reliable, particularly on a colliery, due to conditions of operation?

Mr. G. M. HARVEY, in proposing that the thanks of the meeting be tendered to Mr. Rea for his interesting paper, said that he had been privileged to examine the working of the apparatus in the experimental state, and was greatly struck by its simplicity and positive action. This "portable substation" seemed to him to fill a long-felt want in collecting the control gear into one movable unit, while providing all the features necessary for remote control. It was, however, more adaptable in cases where a gate-end loader was employed than in conjunction with a gate road conveyor, as in the latter case space was very limited in the gate end.

Referring to the presence of the President of the Association, he was in a position to appreciate the amount of time, work and energy which a President of the Association had to give to his duties and, while they all knew that Mr. Anslow had done magnificent work on the Publications Committee and, they hoped, would return to that Committee when his term of office as President was at an end, what amazed him was the grip which Mr. Anslow had obtained on all the various activities of the Association in the short time which had elapsed since he took office. He had great pleasure in proposing a hearty vote of thanks to Mr. Anslow for attending and giving them such an inspiring address.

Mr. WILLIAM REA, replying to Mr. English, stated that it would be possible to extend the sub-station to include a low voltage supply for face lighting, but that was another case of arranging the portable sub-station to suit the particular conditions. Regarding the use of pliable armoured cables, whether they were permanently connected to the conveyor or to the gate-end switchgear was really a matter of the individual choice of the electrical engineer in charge of the plant.

In answer to the question by Mr. Dixon, Mr. Rea stated that fine wire windings were not used in the motor generator set. The smallest gauge of wire employed in the construction of the motor windings which were connected to the supply was not less than 25s S.W.G., and this could hardly be considered as being a very fine wire.

Regarding reliability, the author referred to the motor generators which were used in practically every colliery for charging the batteries of miners' lamps and also the very large number of motor generators of the type employed in the sub-station, which were in use in battery charging stations, garages and other places. Further, it was pointed out that the motor generator was only used for exciting the contactor coils, and as it had a definite work to do it could not be overloaded as was possible with machines used for battery charging purposes. The machine, as employed, carried the maker's usual guarantee and had proved itself absolutely reliable in service. The motor generator was not a toy, but a rotary machine built by a reputable firm, and although of small output it was very robustly constructed. The overall size of the motor generator was 10in. diameter by 15in. long; a machine of this size was obviously not of fragile construction.

Mr. Rea, in replying to Mr. G. M. Harvey, said the equipment was equally applicable to those conditions where gate-end conveyors were employed as in the case of gate end loaders, as it enabled the man at the discharge end of the road conveyor to have control of the face conveyors by means of control switches.

Regarding the space required to accommodate the apparatus, that would be no worse than with other types of switchgear which would not have the remote control features.

The arrangement of a portable sub-station would depend upon the disposition of the various conveyors, and no difficulties had been experienced in the application of the portable sub-station to gate road conveyor schemes.

NEW BOOKS.

H.M. STATIONERY OFFICE.

The following, printed and published by His Majesty's Stationery Office, can be purchased through any bookseller or directly from H.M. Stationery Office at the following addresses: Adastral House, Kingsway, London, W.C. 1; York Street, Manchester; 1 St. Andrew's Crescent, Cardiff; 120 George Street, Edinburgh; or 15 Donegall Square, W., Belfast.

MINES DEPARTMENT.—EIGHTH ANNUAL REPORT OF THE SECRETARY FOR MINES for the Year ended 31st December, 1928; and the

ANNUAL REPORT OF H.M. CHIEF INSPECTOR OF MINES for the same period, with a Statistical Appendix to both Reports. Price 5s. 6d. nett.

APPLIED GEOPHYSICS in the Search for Minerals, by A. S. Eve, C.B.E., M.A., D.Sc., F.R.C.S., F.R.S. and D. A. Keys, M.A., Ph.D., F.R.S.C., both of McGill University, Canada. The Cambridge University Press, Fetter Lane, London, E.C. 4. Price 12s. 6d. nett.

The authors' aim is to describe the practical and theoretical sides of the many scientific methods of mining exploration now available, and thus to enable engineers and geologists to estimate their relative merits. This book is based on actual experience in the field.

THE NEW COMPANY LAW as it affects (*a*) Private Companies and (*b*) Public Companies, by Herbert W. Jordan. London: Jordan & Sons, Ltd., Bishops Court, Chancery Lane, W.C. 2. Price 4s. post free.

This book has been prepared to show the principal changes in the law under the new Companies' Act (1929) which, by Order in Council made on July 5th, comes into force on 1st day of November, 1929.

B.I. WIRE TABLES. British Insulated Cables, Ltd., Prescot, Lancashire. Price 5s. A well-bound pocket-size book giving all the data necessary for Mains and Wiring Calculations for all classes of conductors: also Motor Currents, Voltage Drop Calculator, Fuse Currents, Capacity of Conduits, etc.

Works and Collieries Visited during the A.M.E.E. Annual Convention, 1929.

The Derwenthaugh Coking and By-Product Plant.

The Derwenthaugh Coke Works of the Consett Iron Co. are situated on the left bank of the Derwent, approximately a mile from its confluence with the River Tyne, where the Company has large shipping staiths. The site lies alongside the Company's private railway line from their collieries, so that, geographically, it leaves little to be desired. A good idea of the general arrangement of the works will be gathered from the two photographic views and the progress plan shown in the three illustrations herewith. The works affords a typical example of the way in which the collieries must be adapted to meet the economic conditions of modern times. Here the crude coal as drawn from the pits is refined into definite concentrated marketable products in the form of solid, liquid and gaseous fuels, electricity, and chemical substances. Needless to say the whole of the works is electrically equipped.

There are four incoming railway lines bringing coal from the collieries to the coke works. Eight classes of coal may have to be dealt with, and each class is delivered from the trucks into one of the eight low-level hoppers having feeder mechanism driven by 2 to 15 H.P. squirrel-cage motors so arranged that feed can be obtained from each hopper. This enables two predetermined mixtures of coal, each made up of four or fewer grades of coal, to be fed to the coking plant by two belt conveyors each of 100 tons an hour capacity. One belt delivers coal of sizes from 1½in. to 0in. direct to the coal-cleaning plant; the other belt delivers coal of any size up to 12in. to a breaker, whence, after being broken to 1½in. and under, the coal is either delivered to the coal-cleaning plant or direct to the coal-crushing plant.

From the cleaning plant the cleaned coal is delivered to the crushing plant by two conveyors, the larger coal going to the hammer mills and the fine material being delivered directly into the boot of the main incline conveyor, where it mixes with the crushed coal from the hammer mills.

An alternative route is provided in the coal-cleaning plant, which enables cleaned coal to be delivered directly into trucks for sale as a product independently of the coke works.

The material-handling conveyors are of the belt type, each of 100 tons per hour capacity, with the exception of the incline conveyor to the main bunker, which is 200 tons per hour capacity. Each conveyor is driven by a squirrel-cage motor, direct started, with the exception of the 60 H.P. incline conveyor motor, which is star-delta started.

The coal-cleaning plant follows the latest practice for pneumatically dry cleaning coal; it has a capacity of 100 tons per hour, and comprises a five-storey building, through which the division and progress of coal can be seen from the cleaning plant "flow sheet," diagram Fig. 3. The clean coal can either be delivered to trucks for direct sale, or to the crushers for the purpose of the coke works. The shale and stone is discharged into trucks for dumping, and the fine coal dust from the aspirators and dust-collecting plant is conveyed to the main coal bunker by a dust transportation system operated by two 20 H.P. squirrel-cage motors. Thirteen motors, varying from 5 to 80 H.P., operate the cleaning plant; they are all of the squirrel-cage type, controlled by a main contactor board and operated by central push buttons on the cleaning table floor. These are so arranged that on the operation of a single push button the whole of the motors successively come into service automatically with an interval of three seconds between each machine. A single "stop" push button is provided for closing the whole plant down, and there is a further "stop" push button for each motor with a safeguard effected by interlocking, so that in the event of a key motor being stopped, those motors dependent upon it also stop, thus preventing the piling up of coal at any point of the system. All motors up to 15 H.P. are direct started, and those above 15 H.P. are controlled by a single step of starting resistance in the stator circuit. A general view of the cleaning plant is seen in the first illustration.

With the alternative runs provided by the conveyors of the coal-handling plant, and with the necessity of feeding one machine from another, it was considered necessary to provide a definite system of interlocking to ensure correct working. If either of the conveyors from the track hoppers stops, the corresponding feeder hopper motor automatically stops. The alternative conveyor feed from the breaker to the cleaning plant, raw coal elevator boot, and the crushers respectively is so arranged that only one can be in operation at a time, and if it is stopped the breaker automatically stops.

The conveyors feeding the crushers from the cleaning plant and breaker respectively are arranged to shut down if the crushers are shut down; moreover, if the conveyors from the cleaning plant shut down, the cleaning plant shuts down. The latter interlock is rendered inoperative when the chute collecting clean coal inside the cleaning plant is reversed to feed the "direct sales" hopper. The stopping of the cleaning plant as a whole automatically stops the conveyors feeding it. Finally, the incline conveyor to the main coal bunker is interlocked so that in the event of its shutting down the crushers are automatically stopped. In addition to the interlocking a series of emergency "stop" buttons are provided.

The coal-crushing plant comprises two hammer mills, each of 100 tons per hour capacity and driven by a 200 H.P. slip-ring induction motor, with brush lifting and short circuiting gear and standard liquid starter control equipment. Situated in the main building is the coal handling power distribution board, with an additional feeder to the coal-cleaning plant. The whole of the mechanical side of the material-handling plant, crushers, breaker and coke-cleaning plant described later, was manufactured and installed by Fraser & Chalmers, Ltd. The hammer mills deliver their product of ⅛in. to 0in. via the incline belt conveyor of 200 tons per hour capacity to the main coal bunker, a ferro-concrete structure of 3000 tons capacity.

The ovens are of the latest quick-coking regenerative type, comprising two banks each of twenty-eight ovens, approximately 14ft. high by 18in. wide by 45ft. long. The coal from the main bunkers is filled into a coal car for the purpose of charging the oven, the charge being automatically weighed and recorded by a weighing machine operated by a 5 H.P. squirrel-cage induction motor. The car is provided with a 30 H.P. travel motor of the squirrel-cage type, stator resistance controlled by a drum-type controller in the driver's cabin and protected by a contactor-type circuit breaker with overload time limits and push button reset mounted adjacent to the driver. Power is fed to the coal car by a set of 500-volt three-phase trolley wires mounted along the length of the ovens. The operation of the ovens is carried out by the usual equipment of coke ram, coke guide and coke-quenching car drawn by an electric locomotive.

The coke ram, which is in duplicate, runs on rails at the back of the ovens and is fed by a set of 500-volt three-phase trolley wires run along the oven side and protected by sheet steel covers. The five motors are protected by a five-way protective panel with contactor-type circuit breaker and push button reset so arranged that, in order to reset, all controller handles must be brought to the "off" position. The travel motion, for moving the ram from oven to oven, is operated by a 60 H.P. slip-ring motor, with cubicle-type contactor starter, operated by a drum-type master controller in the driver's cabin. The pusher motion for pushing the coke from the ovens is operated by an 80 H.P. slip-ring motor, with cubicle-type contactor similar to the foregoing. The leveller bar for spreading the coal as it is charged into the ovens is operated by a 30 H.P. squirrel-cage induction motor, stator resistance controlled by a drum controller in the driver's cabin. The door-lift motion, for opening and lifting oven doors, is operated by a 5 H.P. squirrel-cage motor direct started by a drum controller in the driver's cabin. The door rack motion, for moving the doors to and from the oven, is operated by a further 5 H.P. squirrel-cage motor with drum controller mounted outside the cabin. The travel, pusher and leveller motions are protected by limit and interlocking switches to prevent their being operated while the ram is travelling; alternatively, to prevent the ram from being travelled while any of the other operations are being carried out.

The coke guide runs along the front of the ovens for the purpose of guiding the incandescent charge of the ovens to the coke car, and takes its feed from three-phase trolley wires running the length of the ovens, similarly to the coal car. Duplicate guides are provided—one as a standby—each with three motors; one 5 H.P. for door lifting motion; one 5 H.P. for door rack motion; and one 12 H.P. for travel motion. The two 5 H.P. motors are similar to those on the pusher machine, while the 12 H.P. travel motor is squirrel-cage, stator resistance controlled. The three motors are pro-

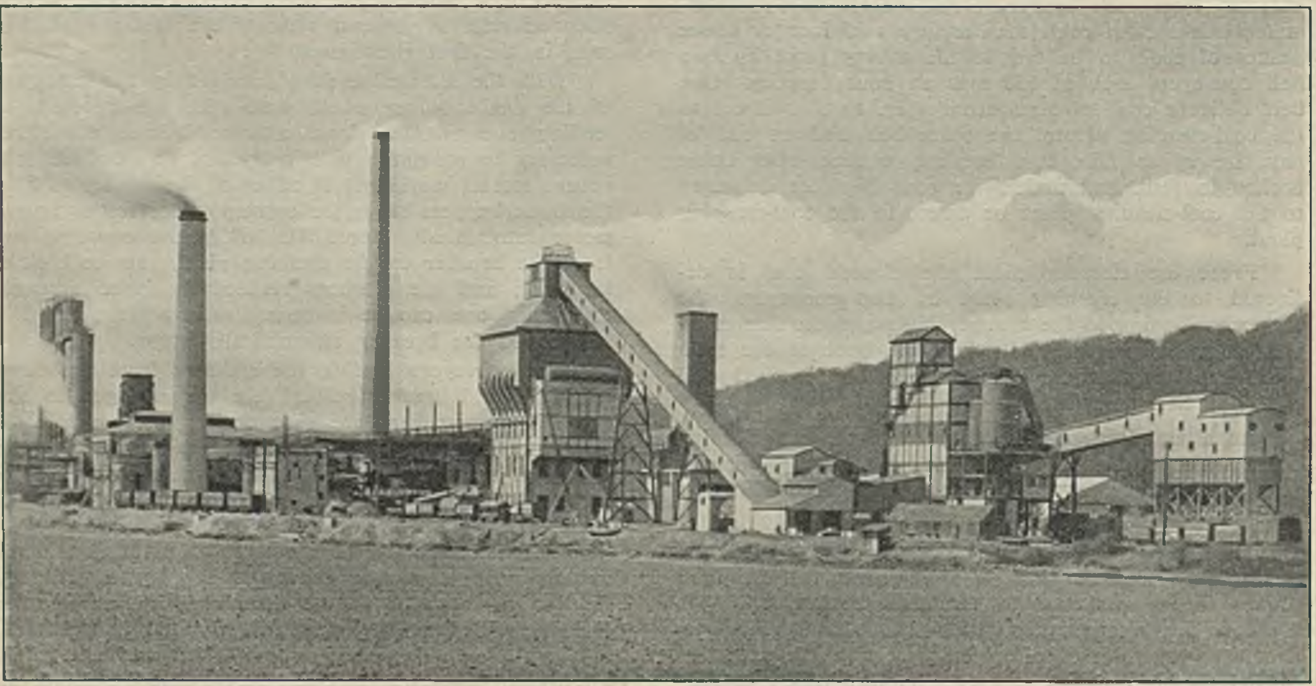


Fig. 1.—A General View of the Derwenthaugh Plant from the East.

tected by a three-way circuit breaker panel, with time limit overloads and push-button reset. The coke car into which the oven charges fall is propelled by a locomotive which takes its supply from a fourth set of three-phase trolley wires protected by sheet steel covers along the side of the battery. The locomotive electrical equipment comprises an 80 H.P. slip-ring travel motor operated by a contactor starter with automatic accelerating relays and master controller. A separate 10 H.P. motor and starter drives an air compressor for the pneumatic brakes and for the pneumatic operation of the doors of the coke car.

The coke car with its charge of incandescent coke is taken by the locomotive to the quenching tower for the purpose of cooling the burning coke. The water sprays are automatically operated by the coke car on entering and leaving the tower. Water for the sprays is fed to a water tank in the tower by means of a 20 H.P. squirrel-cage star-delta started motor, with a duplicate equipment as a standby. A derrick crane, with grab, with 12 H.P. stator resistance controlled squirrel-cage motor and drum controller are provided for removing the sludge from the settling tanks in which the water collects after quenching the coke.

For the purpose of preparing and supplying the clay for the sealing of the oven doors prior to re-charge, there is installed a clay mill driven by a 20 H.P. star-delta started squirrel-cage motor, and a clay hoist with a direct started 5 H.P. squirrel-cage motor.

It is necessary to alternate the direction of air and flue gas through the heat regenerators of the coke ovens at regular intervals of twenty or thirty minutes, which periods must be adhered to within very fine limits for the efficient service of the ovens. The gas main, the air inlet and flue gas outlet valves are mechanically operated by a special mechanism coupled to a 5 H.P. squirrel-cage motor, which has to operate first in one direction and then in the other at predetermined intervals, and to run for a sufficient period to effect the changeover. The motor is direct started by means of a reversing contactor starter with limit switch trips, the operating coils of the contactor being fed through a time switch mechanically operated by an electrically wound clock working off the lighting circuit, so arranged that the switch comes into operation every twenty or thirty minutes, energising one of two coils in turn.

The coke, after quenching, is discharged from the coke car on to a hopper wharf at the front side of the ovens and, after further cooling, is taken by means of a belt conveyor to the furnace coke screens, passing over the grizzly screen, from which the oversize passes by means of a jigger on to belt conveyors with chutes over the rail tracks for the direct delivery of furnace coke. The undersize coke passes to an incline conveyor belt, driven by a 10 H.P. squirrel-cage motor, which takes it to the small coke screens. Alternatively, the furnace coke can be diverted through a coke cutter to join the undersize from the grizzly screen for conveyance to the small coke screens. The main coke belt and the grizzly screen are driven together by a 20 H.P. squirrel-cage motor. The coke cutter, jigger, and two furnace coke belts are driven by a 15 H.P. and 2 to 5 H.P. squirrel-cage motors respectively.

At the small coke screens, the coke passes over a savage screen which takes out 1½in. to 3in. coke and discharges it to a wagon hopper. The undersize from

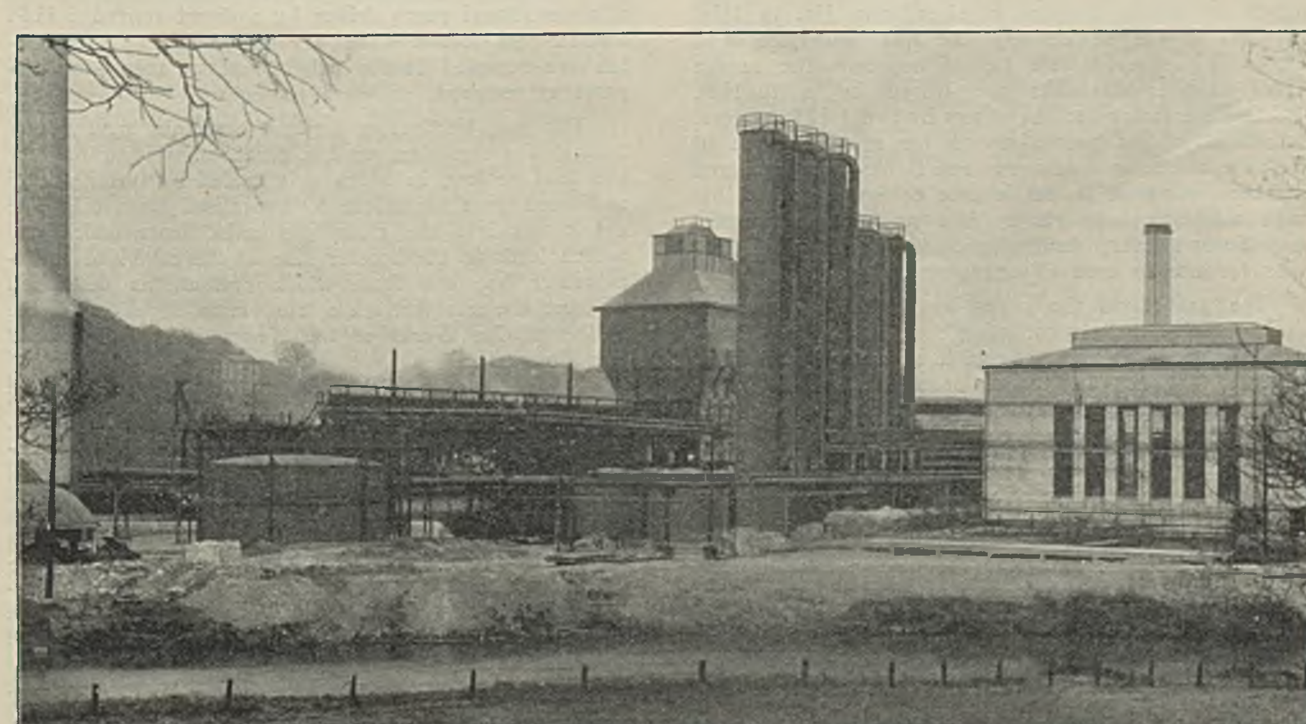


Fig. 2.—A General View of the Derwenthaugh Plant from the South.

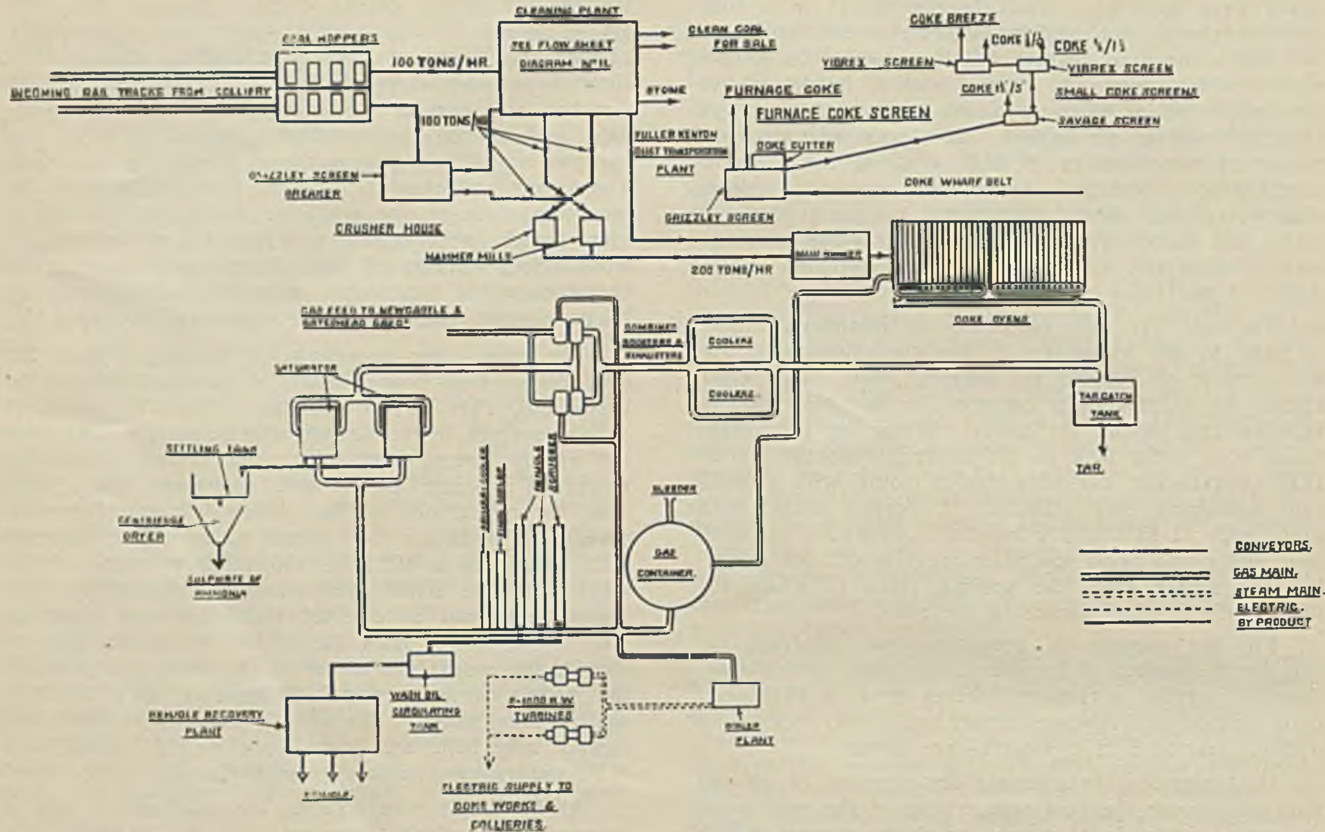


Fig. 3.—Flow Sheet showing the progress of the material through the Plant.

the savage screen passes over two other screens, which deliver to wagon hoppers in sizes from ¾in. to 1½in. and ⅜in. to ¾in. respectively, the final undersize, 0 to ⅜in. being delivered to a ballast hopper. The savage screen and countershafts are driven by a 10 H.P. squirrel-cage motor and the others by two 1 H.P. motors. Consideration has been given to the safe operation of the coke screening machinery, and it has been arranged that the equipment in the furnace coke screens and the small coke screens starts up in a predetermined order, push buttons being further provided in suitable positions for use in case of emergency.

The gas leaves the ovens by brick-lined ascension pipes, entering the gas collecting main into which ammoniacal liquor is sprayed to cool it and condense part of the tar. The gas and liquor proceed along the main, passing an outlet for the discharge of the liquor to the tar catch tank, the gas entering a serpentine cooler where the tar condenses and gravitates also to the tar catch tank. From the cooler, the gas is drawn into one of the duplicate turbo-exhausters, which are driven by back pressure turbines at 3000 r.p.m., and are situated in the power house alongside the turbo-alternators. By the centrifugal action of the exhausters, the last vestiges of tar are removed. From the exhausters the gas proceeds through the blowers to one of duplicate saturaters, containing dilute sulphuric acid which combines with the ammonia in the gas to form ammonium sulphate. The crystals of ammonium sulphate separate out and, after being raised by an ejector, are dried in a 60in. centrifugal drier. The "mother" liquor is pumped back through a preheater into the saturater by means of a centrifugal pump driven by a direct started 5 H.P. squirrel-cage motor. The dry ammonia sulphate crystals are removed to the sulphate store, ready for disposal as required.

The gas, freed from tar and ammonia, next passes through the secondary cooling plant, comprising primary and final coolers, in which it is cooled by water sprays and freed from napthalene by benzolised wash oil. The gas passes into the clean gas main, from which one branch leads to the booster side of the combined turbo-exhauster boosters, from which pressure is developed to force the gas through a 24in. main 3¾ miles to the Redheugh Gas Works of the Newcastle and Gateshead Gas Company.

A second branch leads through a gas holder back to the coke ovens to supply the heat required by them, and a third branch leads to the boilers for the generation of steam for the power station, a fourth branch taking any surplus to the "bleeder."

The centrifugal pumps for spraying the collecting main are driven by 40 H.P. squirrel-cage motors, star-delta started; those for coolng water for the serpentine cooler by 50 H.P. motors, and the pumps for the direct final cooling and high level water by 40 H.P. squirrel-cage motors respectively.

In the engine room basement are further five small pumps for dealing with the tar and ammoniacal liquor. One pair of these, the condensate pumps, driven by 7½ H.P. squirrel-cage motors, pump the mixture to decanting tanks, a second pair, driven by 5 H.P. squirrel-cage motors, raise the ammoniacal liquor after the tar has been decanted from it, to a high level tank from which it gravitates to the ammoniacal stills in the sulphate house: here it is subjected to the action of steam and milk of lime, the ammonia being driven off and finally passing into the saturators to be converted into ammonium sulphate. The fifth, driven by a 5 H.P. motor, pumps the tar which has separated out into tank wagons for shipment.

The plant for the preparation of the milk of lime is countershaft driven by a 15 H.P. squirrel-cage motor, the raw lime being raised by a motor-driven hoist similar to the clay hoist for the ovens, the controller being geared to the hoist winch and arranged so that after the winch has been started, it is automatically stopped when the bucket reaches the end of its travel.

The benzol recovery plant involves five pumps for spraying and circuiting the wash oil. These, together with a spare pump and two air compressors, are mounted in the power house behind the turbo-alternators, being belt driven from a main shaft, coupled at either end to a 100 H.P. star-delta started, squirrel-cage motor.

In all, there are about 90 electric motors aggregating over 2000 H.P., all of which are of Metropolitan-Vickers types.

The electric power generating plant consists of two turbo-generating sets each of 1250 K.V.A. capacity: turbine speed of 5000 r.p.m. geared down to 1000 r.p.m. for the three-phase, 50-period, 500/550 volt generator.

The Dunston Distillation Plant.

As in the preceding article limitations of space demanded that particular attention should be given to the processes of "refining coal" rather than to the more commonly understood details of turbo-electric generation, so in these notes concerning the Dunston Electric Power Station of the Newcastle Electric Supply Co. preference must be given to telling the reader of the most modern and valuable peruliarities of the equipment. There is probably no other instance in this country where the comparative processes of splitting coal into its useful components are so well exemplified. The following notes are based upon the Lecture which Mr. Weekes delivered to the guests who took advantage of the opportunity so kindly afforded them by the N.E.S. Co. to inspect the plant.

The Babcock Low Temperature Distillation Process has been designed primarily to treat non-coking coals such as are normally used for firing boiler furnaces, to produce low temperature coke and gas for power purposes, household fuel, and low temperature oils and spirit.

The retort installation at these works has been laid out in combination with ordinary boiler plant, and this has been done to reduce supervision costs to a minimum as the complete installation is controlled by the engineer operating the boiler plant. Thus the system is that known as the "Unit" system, as differing from the "Storage" system.

The following analysis is typical of the fuel used:

Proximate Analysis.		*Ultimate Analysis.*	
Moisture	9.29	Moisture	9.29
Volatile Matter	30.83	Ash	10.89
Fixed Carbon	48.99	Carbon	66.58
Ash	10.89	Hydrogen	4.55
		Sulphur	1.15
		Nitrogen	1.17
		Oxygen (by diff.)	6.37
	100.00		100.00

The boiler plant consists of two Babcock boilers of 30,000lbs. per hour evaporation working at 210lbs. pressure and supplying superheated steam at 730 deg. C. temperature to the steam mains of the power station, where it is used for driving turbo-alternators generating electricity for the Supply Company's mains.

One of the boilers is fitted with two Babcock hot forced draught chain grate stokers fired with low temperature coke obtained from two retorts located immediately in front of the stokers.

The other boiler is equipped with pulverised fuel plant and at present is not connected with the low temperature distillation process, but additional retort plant is being erected to produce low temperature coke which will be consumed as pulverised fuel.

When this is completed both boilers will be working with low temperature coke, one burning the coke direct on chain grate stokers while the other will burn the coke in pulverised form.

At present the pulverised fuel boiler is working on raw coal, and before describing the low temperature process it is of interest to have a brief description of this unit. The coal is fed from an overhead bunker direct into a pulveriser which grinds the coal continuously. The ground or pulverised fuel is drawn from the mill and delivered to the boiler furnace by a fuel fan through a new type of pulverised fuel burner. As has been mentioned, this method does not provide for the storage of the fuel in pulverised form.

With the type of mill in use it is not necessary to dry the coal in a separate dryer before grinding. The mill is of the Babcock Fuller Bonnot type running at 34 revolutions per minute, and it was particularly noticeable that it was extremely silent in running. The grinding is effected by the action of a large number of 1¼in. diameter steel balls contained in the mill casing which revolves at the speed of 34 r.p.m. For dealing with wet coal hot air is drawn from air heaters on the boilers through the mill and so mixed with the powdered coal and fed to the burner. It has been found possible successfully to grind coal containing 16% of moisture by using hot air at a temperature of about 400 deg. F.

An important point to note is that when grinding a coal containing pyrites, the internal construction of the mill is such that a large proportion of the pyrites is automatically rejected and delivered through a discharge opening provided for the purpose. This results in less wear on the mill and reduces the sulphur content of the boiler flue gases.

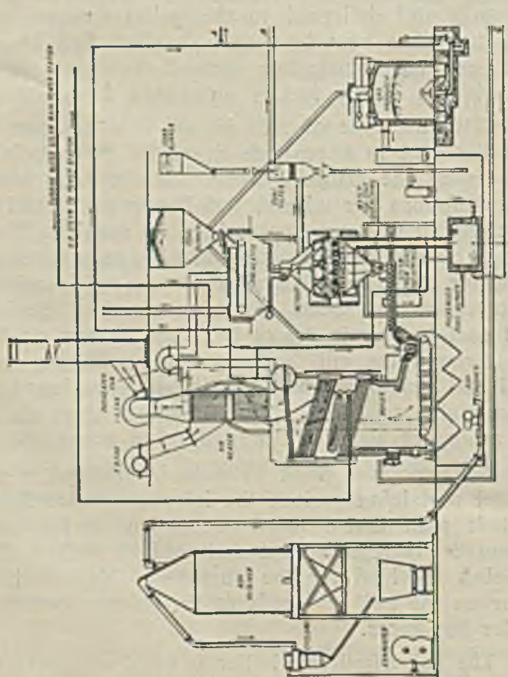
The pulverised fuel boiler is fitted with water cooled walls at the sides and back: the front wall does not require water cooling. Furnace brickwork repairs for the first year's operation have been practically *nil*: all that was required was to rebuild a small portion of the furnace wall above the cooling tubes as this part of the brickwork had not been adequately secured in place when first built.

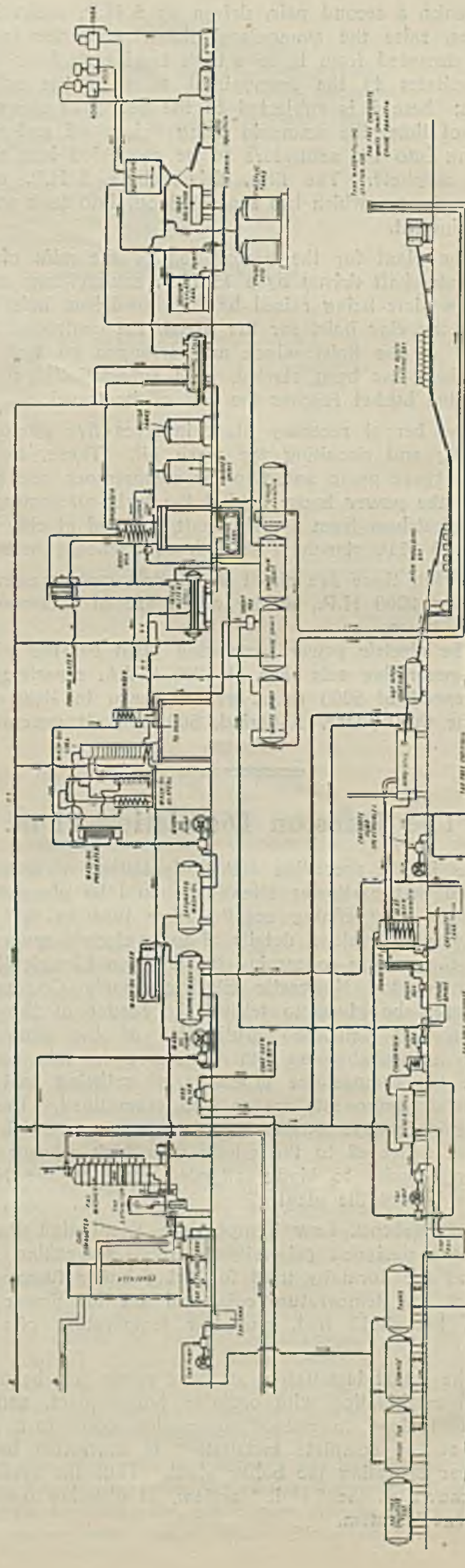
Turning now to the stoker fired boiler which is using low temperature coke from the retorts, the coke is fed direct into each stoker from a retort placed immediately in front of it. Each retort has a capacity of 30 tons per day or a total of 60 tons of coal per day. The resultant coke and gas from these two retorts are sufficient to fire the boiler continuously at about 1000 deg. C. temperature of combustion chamber.

The diagram shows the principle of the Babcok process. Raw coal is stored in the coal bunker and from there passed continuously through a dryer or preheater, where it is dried and heated before it enters the retort. This drying is effected by passing the coal in a three-inch layer on to a standard Babcock chain grate through which is passed hot waste flue gases from the adjacent boiler. The temperature and volume of the waste gases is adjusted to suit the requirements of the coal, which sometimes contains considerable moisture. In any case the temperatures obtained in the preheater are not sufficiently high to cause any distillation or loss of oils from the coal.

The use of the preheater has two main advantages: (1) the final distillation of the coal in the retort is facilitated; and (2) the partial heating of the coal by waste heat reduces the cost of supplying the heat necessary to distil the coal.

The coal leaving the preheaters is passed continuously forward into the retorts by means of screw conveyors through rotary valves which act as seals between the retorts and the preheater.





Progress Diagram of the Low Temperature Coal Distillation and By-Product Plant.

The distilling medium consists of a mixture of steam and combustion products obtained by first burning a suitable fuel in a small combustion chamber, and when combustion is completed sufficient low pressure steam is added in an attemperating chamber to produce distilling gases of the required composition at a temperature of 650 to 700 deg. C.

Means have been provided whereby the required proportion of hot products of combustion may be obtained by any of the following methods: (1) combustion of powdered fuel; (2) combustion of producer gas; (3) combustion of coke oven gas.

The combustion chambers, of which there is one to each retort, are located immediately below the retorts, and are connected thereto by a brick-lined duct, which forms the attemperating chamber referred to above.

The distilling mixture enters the retorts through an annular space which gives an even distribution of heat to the charge. The passage of the coal through the retort occupies about three hours. The rich retort gas which is distilled from the coal mixes with the distilling gases, and the whole are drawn off from the upper section of the retort by a gas exhauster and passed through a filter which cleans the gas of dust before it enters the water tube condenser in which the tar vapours are condensed, the resultant crude tar being pumped to storage tanks.

The coke extraction gear consists of rollers built up of toothed wheels assembled in helical fashion, the rollers being operated hydraulically. The hot coke is discharged continuously through coke breakers to a rotary sealing valve and thence by a screw conveyor to the stoker hopper. The screw conveyor which traverses from side to side secures an even distribution of coke in the hopper.

After leaving the condenser the gas is passed through a tar extractor to remove the final traces of tar, and then to a rotary washer where the gas is brought into intimate contact with wash oil, which obsorbs the spirit from the gas. The oil used in the washer is a light oil produced by refining the tar made in the process. The gas having been stripped of oil vapours is piped to burners at the back of the boiler furnace and combusted. The calorific value of the gas as fired is about 80 B.T.U.'s per cu. foot.

The tar refining plant has been designed for the recovery of spirit, creosote and pitch from the crude tar. The approximate yield per ton of coal is: Spirit, 2 galls.; Creosote, 7 galls.; Pitch, 5 galls. The crude tar is pumped into a steam-heated still where the water is driven off and the tar distilled for the recovery of the spirit content. The water and spirit free tar is pumped from this still to a gas-fired still where it is distilled for the production of creosote oil, the pitch residue being discharged into moulds.

The plant for spirit recovery and refining is housed in a separate building and is designed for the production of finished motor spirit, crude paraffin and an intermediate fraction, white spirit. Crude cresylic acid (about ½ gall. per ton) is also recovered from the soda liquor resulting from the washing of the crude spirit with caustic soda. The wash oil, which has been enriched by circulating through the gas washer, is pumped to a still *via* steam heaters in which the oil is preheated prior to entering the still. The still consists of a series of trays through which the rich oil successively gravitates and passes through an ascending column of steam by which the crude spirit is distilled. The wash oil after being denuded of the spirit absorbed from the gas is cooled in a tubular cooler fitted with water sprays and returned to a tank for re-circulation.

The crude spirit vapours distilled from the wash oil are condensed and run into a crude spirit storage tank, and after being mixed with crude spirit from the tar refining plant are distilled in batches of about 1500 gallons in an intermittent still. A fractioning column and dephlegmator are provided on the still for controlling the distillation range, and the distillate is run from the condenser to a "once run" spirit storage tank.

The spirit storage tanks are provided with compressed air connections by which means the "once run" spirit is blown into a lead lined washer provided with a propeller. After the addition of soda for the extraction of the tar acids, the whole is agitated and intimately mixed by the propeller and after settling, the soda liquor (sodium cresylate) is drawn off to a tank for further treatment for the recovery of the crude tar acids. The soda washed crude spirit is further treated with sulphuric acid and finally distilled for motor spirit and white spirit, the residue crude paraffin not at present being refined. The sodium cresylate is treated with sulphuric acid for the recovery of low boiling tar acids.

The Switchgear Works of A. Reyrolle & Co., Ltd.

The Hebburn-on-Tyne works of A. Reyrolle & Co., Ltd., are not only well known in their immediate North East Coast area but it is no exaggeration to say that the firm's name is a household word wherever electrical plant is used in industry, in power stations, or underground in mine workings.

The beginning of this important undertaking dates back to 1886, in which year the late Mr. A. C. Reyrolle established a small workshop in London. Fifteen years later the removal of the business to Hebburn-on-Tyne began what has proved to be one of the most notable developments in the North Eastern district of England. It is indeed claimed that this is probably the largest works in the world producing electrical switchgear as a speciality. In 1922 the original site of 5½ acres was sufficiently occupied, and a separate second works had to be built upon a new site of 4½ acres in the near neighbourhood. That again was increased later by the addition of another 5 acres for works' purposes; and an adjacent sports ground 6½ acres in extent, together with other land amounting to 3½ acres, brings up the area at the old and the new works to a total of 25 acres. Nor have extensions ceased to be necessary, and the latest additions include two large bays for electric welding, and bending and shearing machines, and a new canteen to meet the increasing meal-time demands of the Company's employees, whose number is now approaching 2,700

Messrs. Reyrolle have played a part that may rightly be called unique in making the use of electricity safe. They have achieved this by working on the principle that all electrical apparatus must be "metal-clad and earthed." Metal-clad switchgear is made up in self-contained units capable of being built together into complete switchboards, and each unit has amongst its integral parts such essential accessories as current transformers, potential transformers, compound-filled dividing boxes to take incoming and outgoing cables, and all necessary means of isolating. Interlocks are provided to make a wrong sequence of operation impossible and, generally, the construction is such as to prevent anyone from touching a live conductor accidentally or from coming within arcing distance of it.

This metal-clad principle has been developed in all Reyrolle products from the small five-ampere protected-type British Standard plugs to the super-power-station switchgear.

Special reference must be made to the adaptation of this switchgear to the almost overwhelmingly stringent requirements of work in coal mines and other places where open sparking might lead to disaster. Flame-proof joints, with wide machined flanges, were first designed and developed by this firm nearly twenty years ago; and the provision of boiler-plate switch-tanks in addition has made Reyrolle mining switchgear one of the most robust products of the industry.

Mechanical and electrical interlocking in such types of control gear as those for coal-cutters and conveyors has added still further to the excellent provision for securing the safety of underground workers; thus every credit is merited for the great share which the Company has taken in the conversion of colliery switchgear from the haphazard thing it once was to the practically undamageable and well-proportioned product it has come to be.

Typical examples of their products adapted specially for use in mines have been illustrated in these pages from time to time, and it is proposed in an early issue to give full particulars of the latest types when dealing with the exceptionally fine exhibit which the Company is making at the North East Coast Exhibition.

The visit to Reyrolle's works revealed the striking diversity of the activities and products of the Company. Stock articles made in quantities include metal-clad plugs and sockets for domestic and industrial services and those of flame-proof pattern made in accordance with British Standard Specification No. 279—1927. Other products are metal-clad distribution boxes, fuses and fuse-boxes, small air-break enclosed switches, small oil-break circuit breakers, cable sockets and fittings, and cable dividing boxes and sealing bells. Many examples of the mining gear referred to previously were to be seen. Switch fuses, with fusible cut-outs mounted in place of the usual circuit-breaking blades, illustrated another line of manufacture particularly useful in outdoor switching stations; and a department is devoted to the making of transformers and other apparatus required for protective gear.

A very complete system of automatic control has been developed both for rotary converter or motor converter sub-stations and for power stations operating on the largest supply networks; many examples of switchgear and control apparatus for this purpose were to be seen in various stages of construction. Standard metal-clad switchgear of all kinds were also seen in process of manufacture, as intended for industrial works, for single-switch sub-stations in isolated situations, and for equipments ranging in size right up to those intended for super-power-stations or for the control of high-tension overhead transmission lines, such as those of the British "grid." In particular it was gratifying to note that a large part of the work was labelled as for Colonial and foreign buyers.

This extremely advanced degree of perfection has not been done without continuous study of the technical problems bound up with the science of switchgear engineering, and the Company possesses facilities for research which are probably unsurpassed. The high tension laboratory contains, as part of its very complete equipment, a testing transformer capable of giving half-a-million volts on its secondary side; and current transformers with an output of up to 30,000 amperes are available for heat tests and protective gear stability tests. Chemical research forms a very important part also of the Company's scientific activities. As has already been indicated, the results of the many investigations that are always going on are embodied in a continual improvement of details, but it is a highly interesting and significant fact that the general lines on which Messrs. Reyrolle's designs were first laid down have proved to be so sound that the external appearance of Reyrolle standard types of switchgears has not had to be altered materially at any stage of their development.

The Seghill Colliery.

Seghill Colliery is situated about eight miles from Newcastle-upon-Tyne, and five miles from the Tyne and Blyth shipping staiths. The colliery, which is over 100 years old, is a typical example of a group of pits which, to meet the trend of the times, has been modernised by an entire reorganisation of the plant.

The most important decision put into practice was the total abolition of steam and the entire plant is now electrified, the current being taken from the Newcastle-upon-Tyne Electric Supply Company, Limited who, it may be added, cater either wholly or partly for the needs of no fewer than some 180 collieries in Northumberland and Durham.

At Seghill Colliery the whole of the surface structures, screens, heapsteads, engine houses, etc., are built in the buff bricks produced at the colliery brickworks. The effect is both pleasing and ornamental as, in addition, sufficient architectural decoration has been introduced into the design as to render the appearance attractive without incurring unnecessary increase in cost. Standing on the crest of a hill amidst the greens of an expansive rural area these buildings, almost snow-white and with no smoke or steam pall overhead, are used as an effective landmark by air-craft.

Among the plant accommodated under the one roof are two of the main winders, three hauling engines, two compressors, the main switchgear, the transformer station and the supply service apparatus. As already indicated, the colliery electrical installation is fed from the Newcastle-upon-Tyne Electric Supply Company's system. Duplicate 20,000 volt feeders are the incoming mains, while the working pressures for large and small motors are 2750 volts and 625 volts respectively. The capacity of the electric service apparatus, installed by the Power Company, is 4,000 K.V.A.

The continuous rating of the four electrically operated winding engines are 420 B.H.P., 420 B.H.P., 300 B.H.P., and 130 B.H.P. respectively, with an aggregate acceleration peak corresponding to approximately 2,500 B.H.P. Coal is drawn from different levels, three shafts being downcast and one upcast, and the winding capacity is about 4,000 tons from depths which vary between 300 feet to 900 feet.

Full use has been made of the latest electric and other devices for safeguarding the operation of winding and the prevention of accidents.

Special care has been given to the distribution of power from the control boards; complete high tension and medium tension ring mains having been provided. The cables are of the paper insulated, lead covered, armoured type, arranged on racks in a specially prepared and drained tunnel approximately 6ft. high by 5ft. wide, affording a clear passage way throughout from the main switch house to the several points at which the surface load requirements are distributed, and also providing a means of rapidly approaching and repairing any fault. Compressed air and water pipes, etc., are also accommodated in this duct.

The recently completed screening plant is of an elaborate character, and certainly is one of the most up-to-date in this country. A detailed description cannot be included here, but two interesting innovations should be mentioned. The provision of four main inspection belts enables all coal coming from the tipplers to be closely scrutinised; and to facilitate this operation the coal is graded into three sizes before it reaches the belts. Each belt is independently driven, its driving motor having automatic contactor control apparatus arranged to be operated at push button stations located at points along the length of the belt. Full, half, and quarter travelling speeds are available as required to suit the quantity and class of coal which is being handled.

The brickworks form an independent section of the activities of this colliery, and utilise material, surplus from underground, which would otherwise have to be dumped on the neighbouring land. The kiln is of the Staffordshire design, and the general arrangement of the plant is of an advanced type, provision being made for the whole of the work to be carried on under cover. The brickmaking plant is operated by means of a 100 H.P. slip-ring motor, and an interesting provision is a small electrically operated fan which supplies a cold air douche in any chamber required and so contributes to the comfort of the workers in warm weather.

No description of this colliery would be complete without reference to the Welfare Scheme which owes so much to the generosity of General Sir J. F. Laycock, K.C.M.G., D.S.O., the principal owner. Five football grounds, dressing and club rooms, cricket ground, tennis courts, bowling green, colliery institute, etc., are provided, and it is pleasing to note that the success which the various teams have attained in outside competition indicates the good use which is made of the extensive facilities available.

The North East Coast Exhibition.

The North East Coast Exhibition which, naturally, had attracted many individuals and parties during the run of the Convention was scheduled as the Official Rendezvous for Friday, 5th July. The engineering and general interests of this, the greatest exhibition since "Wembley," are so considerable and important that the descriptive account must be deferred until next month, when space can be given to the publication of such illustrations and details as will be useful and fitting for an industrial effort of this ambitious and, be it said, highly successful character.

NEW CATALOGUES.

HEYES & Co., Ltd., Water-Heyes Electrical Works, Wigan.—A colour-printed leaflet gives general particulars, certificate of test and prices of the "Wigan" 25-watt Explosion Proof Lighting Fitting, which is suitable for use either as a Hand-lamp or a Pendant.

GENERAL ELECTRIC Co., Ltd., Magnet House, Kingsway, London, W.C. 2.—A leaflet illustrates the "Dee-Bee" 15-ampere Double Pole Ironclad Switch and Fuse, which is cited as a "revelation in value." A second leaflet gives particulars, dimensions and price of the "Dee-Bee" quick make and break Splitter Switch Fuse.

ELECTRIC CONTROL, Ltd., Lewes Road, Brighton.—An attractive leaflet calls attention to the "Empire" Vertical Disconnecting Switches and other items for overhead line equipment for Rural Electrification. Standard features of these equipments are: British porcelain, sound mechanical design, ample copper section, all current carrying parts cadmium plated, steelwork hot galvanised, solderless mechanical line connectors. A complete range is available with or without fuses and choke coils for voltages up to 33 K.V.

AUTOMATIC TELEPHONE MANUFACTURING Co., Ltd., Strowger Works, Liverpool.—A description in detail and photographs of the new Beasley-Gamewell Fire Alarm equipment recently completed by the A.T.M. Co. for the Merton and Morden U.D.C.

THOR LAMPS & SUPPLIES, Ltd., Tredegar St., Cardiff.—Two leaflets deal with the latest developments in Miners' Electric Safety Lamp design. One describes two forms of lamps, both of which are approved by the Mines Department as Emergency Lamps. The other leaflet shows the well known "Thor" Lamps, which have been approved for many years, in conjunction with the new Holophane Prismatic Wellglass of which details were given in these columns a few months ago. A third leaflet illustrates the Company's standard improved form of Charging Stand.

Manufacturers' Specialities.

Electric Power for Cement Works.

Electric power for driving cement works plant offers many important advantages over older types of driving units employed. The electric motor is so suitable for individual drive that it permits of the machines used at the various stages of manufacture being grouped to better advantage than if their relative positions were determined by the driving machinery; moreover, the electric motor can often be accommodated in small spaces which otherwise would be wasted. Ease of control is another very important feature of electric driving which comes into full evidence in cement works, while, by installing ammeters as part of the control unit, the power taken by any machine can be ascertained readily: frequently, the knowledge that a machine is taking more power for driving than it should, will enable faults to be detected in an initial stage, which otherwise might lead to more serious trouble and involving the shutting down of plant for long periods.

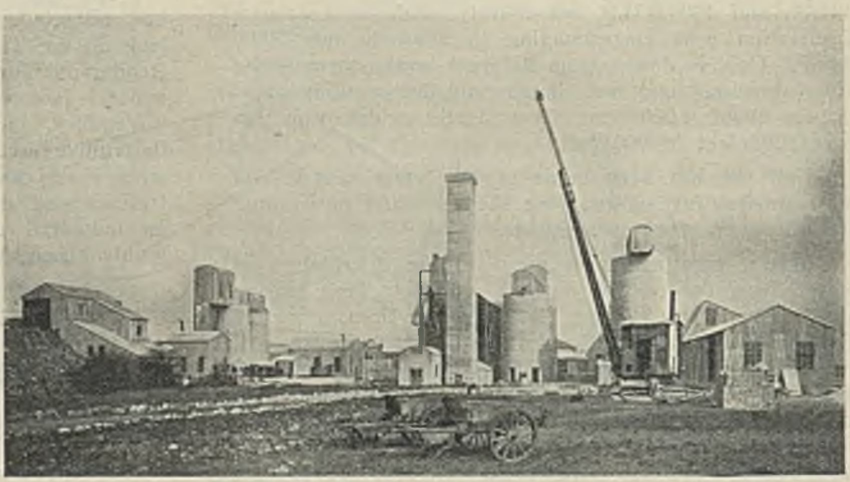


Fig. 1.—General View of Barnstone Cement Works, Nottingham.

The several illustrations herewith give an interesting insight into the general lay-out of the electrical installation at the Portland Cement Works, Barnstone, Nottinghamshire. These works have been established for many years but have recently been entirely re-fitted with modern machinery. The whole of the electrical equipment was made and supplied by the General Electric Co., Ltd.

The extent of the electrical equipment may be gauged from the fact that the total normal capacity of the motors is approximately 2,000 H.P., ranging in individual outputs from 5 H.P. to 450 H.P. Electric power is taken from the 11,000 volt mains of the Derbyshire and Nottinghamshire Electric Power Co. It is transformed down in the sub-station at the works and fed at 440 volts to the G.E.C. truck cubicle switchboard, consisting of three panels. Two of these control the low tension side of transformers, each being equipped with oil circuit breakers of maximum breaking capacity of 100,000 K.V.A., fitted with overload protection; also isolating links, measuring instruments, instrument transformers, etc. The third panel is an outgoing metering cubicle equipped with maximum demand watt hour meter, voltmeters, and the necessary instrument transformers. The outgoing cables from this cubicle are led to the feeder board shown in Fig. 2, which distributes the power to the motors through ironclad distribution boards control pillars, etc., as required. The principal equipment of each of the panels of the feeder switchboard comprises an oil circuit breaker of suitable breaking capacity fitted with overload protection, watt hour meter, ammeter, and necessary accessories.

The cement produced in these works is manufactured on the wet or thick slurry process, the burning being done in a rotary kiln. The raw materials used in the process mainly consist of the Blue Lias limestone, which is quarried on the site, with the admixture of a certain quantity of stone containing a high percentage of calcium carbonate.

These raw materials are delivered in full gauge trucks to a large jaw crusher, which reduces it in one operation to about 3in. and under. The stone is mechani-

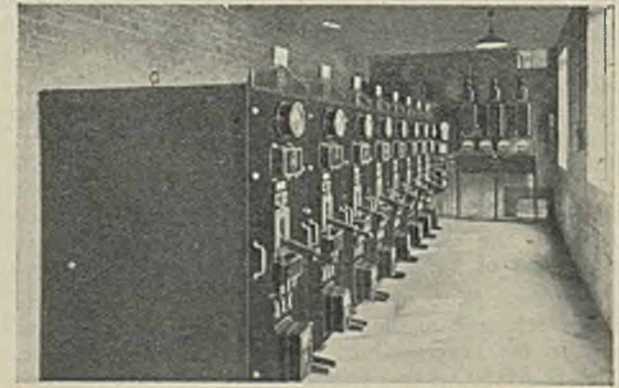


Fig. 2.—440 volt Truck Cubicle Feeder Switchboard, supplying power to the Works.

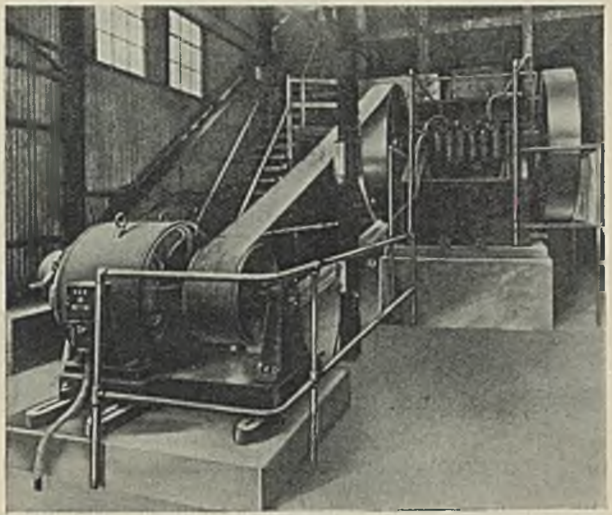


Fig. 3.—Jaw Crushers and Feeder Finger, belt driven by 125 *H.P. motor,* 580 *r.p.m.*

cally fed to the crusher by means of a finger feeder, consisting mainly of heavy grid bars with spaces between them, and arranged at a slight slope to the horizontal. Some of these bars have a rocking movement backwards and forwards given to them by a driving shaft carrying eccentrics and, by this means, the stones move forward towards the crusher jaws. This crusher and feeder are belt driven by a 125 H.P. electric motor, running at 580 r.p.m. (Fig. 3).

The crushed stone falls on to a troughed band conveyor, which is slightly inclined, and thence fed into a rotary screen, the rejects from the screen passing on to a set of medium speed crushing rolls, 30in. diameter by 20in. wide, where they are reduced to about 2in. cube and under, which is a suitable feed for the grinding mill.

The crushed stone is elevated by a continuous bucket elevator and deposited on to a steel band conveyor over two large ferro-concrete storage silos, containing the two qualities of raw stone. These silos are hoppered

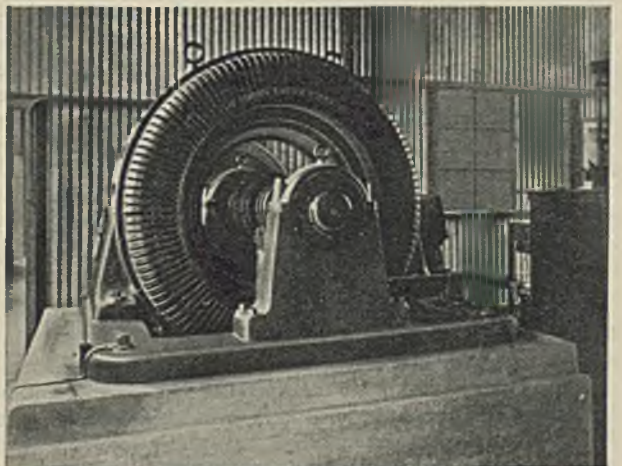


Fig. 4.—300 H.P. Three-Phase Motor driving 6ft. Ball and Tube Mill.

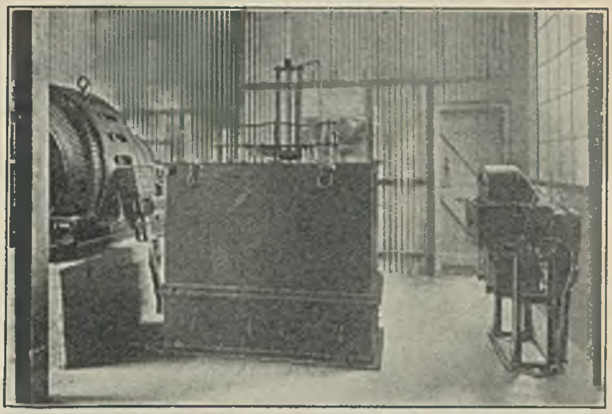


Fig. 5.—Oil Immersed Draw-out Pillar and Liquid Starter for operating 300 *H.P. motor shown in Fig.* 4.

at the bottom, and rotary table feeders are fitted at the outlets, by which means the raw stone is measured in the proportions required to give the correct chemical composition.

A band conveyor takes the raw stone to the grinding mill, which is a "Stag" combination ball and tube mill, 6ft. diameter by 32ft. 6in. long, grinding wet, the water being fed in with the stone.

The mill is of sufficient capacity to prepare the ground slurry for the plant. It is driven by a 300 H.P. electric motor running at 244 r.p.m., direct coupled to the mill countershaft. The motor is housed separately from the mill as shown in Fig. 4. The power

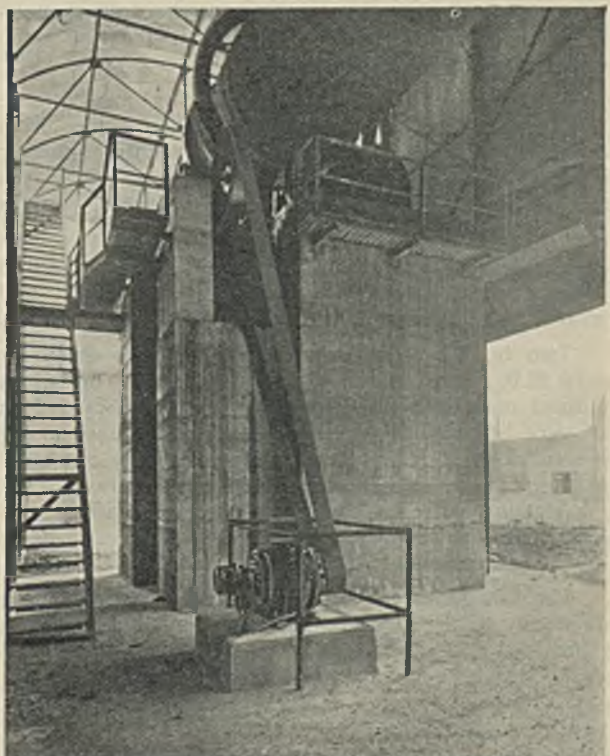


Fig. 6.—30 H.P. Three-Phase Variable Speed Motor 357/715 *r.p.m., driving Rotary Kiln.*

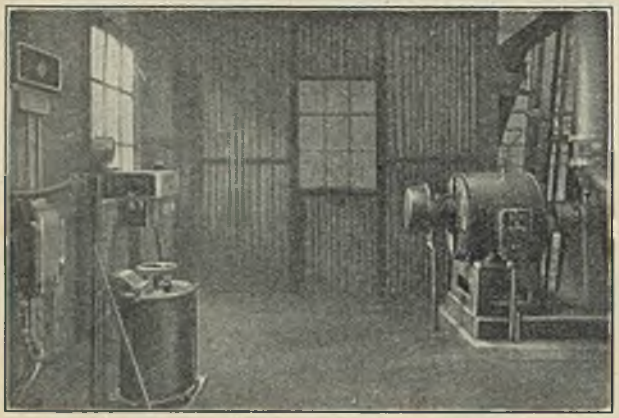


Fig. 7.—80 H.P. Three-Phase Motor driving one of the Turbo-Pulverisers direct at 1450 r.p.m.

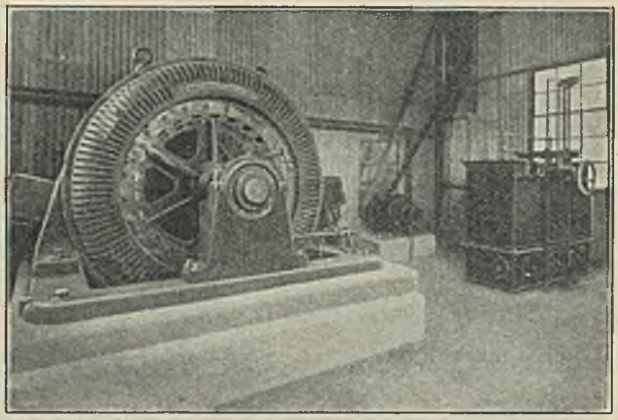


Fig. 8.—450 H.P. Three-Phase Motor driving 36ft. Combination Tube Mill.

for supplying this motor is controlled by the draw-out, oil-immersed, ironclad pillar shown to the right of Fig. 5. The draw-out features embodied in this pillar are similar to those of the truck type cubicles described. The motor is operated by the liquid controller seen to the left of Fig. 5.

The slurry as it comes from the mill is elevated by a slurry wheel, of 28ft. diameter, carrying buckets on its periphery, and runs by gravity to two triple mixers. These mixers are provided with stirrers carried on vertical shafts which keep the slurry agitated and prevent the solids from settling out. Samples are taken from these mixers at frequent intervals by the works chemist and tested, and any adjustment as to chemical composition is made at the table feeders under the raw stone silos to correct the mixture.

The finished slurry runs by gravity into a large storage mixer of the "Sun and Planet" type, from whence it is pumped by means of three-throw plunger pumps direct to the kiln, the latter being belt driven by a 30 H.P. variable speed electric motor, with a range of 357/715 r.p.m. (Fig. 6).

The kiln is fired with pulverised coal. The coal is delivered from trucks direct into a feed hopper, and elevated to a large storage hopper over the pulverisers.

Two turbo pulverisers are installed, each driven by an 80 H.P. electric motor, running at 1450 r.p.m., which is direct coupled to the pulveriser shaft, and carried on the same bedplate as the machine (Fig. 7). Each of the pulverisers is of sufficient capacity to provide powdered coal for firing the kiln, the other machine being used as a standby. The coal is pulverised, air separated, and blown into the kiln in one operation, and coal up to 10% moisture content is used.

The kiln is fitted with a patented slurry atomising equipment at the feed end, and an induced draught fan is provided for dealing with the waste gases.

The hot clinkers as they come from the kiln pass through a rotary cooler, 5ft. diameter by 55ft. long, and are handled from the cooler end by means of a swing-tray conveyor, which may either be used to deliver the clinker to the storage silos or direct to the cement grinding mill.

The cement mill consists of a "Stag" combination tube mill, 6ft. 6in. diameter by 36ft. long, driven by a 450 H.P. three-phase electric motor running at 244 r.p.m., direct coupled in a similar manner to the raw mill. This motor with its liquid starter is shown in Fig. 8, the control being also similar to that of the 350 H.P. raw mill motor.

A small plant has been provided for crushing and feeding gypsum, and automatic table feeders are used for regulating the feed of clinker and gypsum to the mill in the right proportions. The ground cement is elevated and conveyed to three large ferro-concrete silos, whence it is extracted and packed mechanically into bags for despatch.

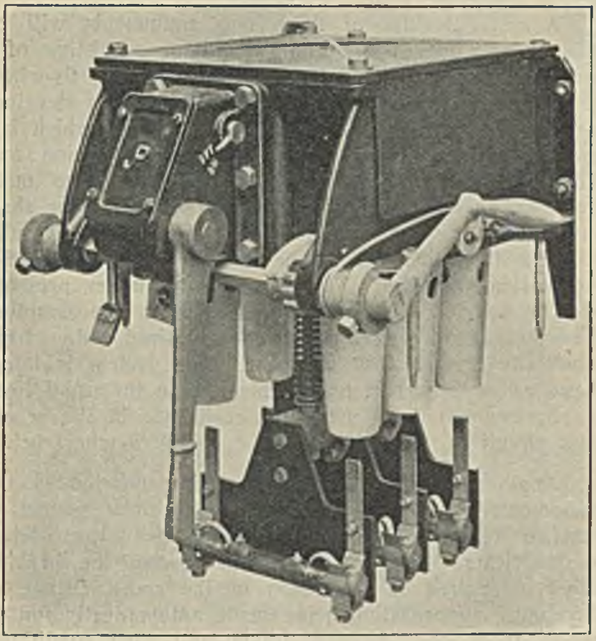
Reference has been made to the control of the 300 H.P. and 450 H.P. tube mill motors. The other motors are controlled by suitable pillars, or panels, consisting in general of an oil immersed circuit breaker with starter. In the case of motors from 30 H.P. to 125 H.P., the starter is of the oil-immersed rotor pattern, whilst for the smaller motors auto-transformer starters are employed.

The main power wiring has been carried out with paper insulated lead covered cables, single wire armoured, except between rotor starters and rotors where the cable is in flexible tubing.

The whole of the work was carried out under the direction of Mr. J. Ward, managing director of the Barnstone Cement Co., Ltd., to whom acknowledgment is due for permission to publish the information and photographs here given.

J. & P. Oil Switch-Fuses.

Oil switch-fuses provide an efficient means of controlling circuits where economic considerations will not allow the more usual complete form of automatic oil circuit breaker cubicle to be installed. The illustration herewith is of the standard type made by Johnson and Phillips, Ltd. The switch-fuse is totally enclosed and adaptable for either wall or framework mounting; it can, therefore, satisfactorily be mounted in a consumer's sub-station and occupies very little space.



An 11,000 *volt Oil Immersed Switch Fuse with Oil Tank removed.*

As will be seen from the illustration, which shows the complete mechanism of an 11,000 volt switch, the tank being removed, it embodies an oil break switch of the quick break pattern for making and breaking, and a fuse for opening the circuit under fault conditions. Therefore it provides all that is essential for controlling a transformer or consumer circuit up to about 500 or 600 K.V.A. Circuits of greater capacity could be controlled by these oil switch-fuses when there is not a large amount of generator or other supply power available to flow on a fault occurring in the system. In general such large power circuits warrant a more expensive and complete oil circuit breaker cubicle with various measuring instruments.

The design of this switch-fuse is strong and robust and in accordance with the best oil switch practice. The "On" and "Off" positions of the switch are clearly indicated and it can be padlocked in either position. Cables enter at one side and leave at the other, single or three-core cables can be accommodated and packing glands or trifurcating boxes can be fitted.

The tank is of stout sheet steel with ply-wood lining and fire-proof barriers, and a lowering device is provided to facilitate replacement of fuses. An oil gauge is fitted and a draw-off plug can be fitted if desired. The tank cannot be lowered until the switch is open. The live switch contacts are shrouded with porcelain caps, making it perfectly safe to handle the fuses when the tank is lowered.

The fuses are spring loaded so that the circuit is broken with extreme rapidity. The fuse unit is held in spring clips and can easily be renewed for re-wiring.

An outdoor pattern of similar design can be supplied which can be fitted near the base of a pole to control a cable tapping from an overhead line.

Large Electric Winders with New Features.

Five large electric winder sets are included among recent orders for mining equipment placed with the Metropolitan-Vickers Electrical Company. All five sets are to be arranged with Ward-Leonard control, three with direct coupled motors and two with geared motors. The sets represent an interesting variety of applications, two being for a deep gold mine on the Rand, two for a new copper mine in Northern Rhodesia and one for service involving exceptionally heavy output at a colliery in New South Wales, where one of the largest electric winding equipments in the world is already in service.

New features of special interest are included in two of the equipments, those for Rhodesia, one development being a hydraulic slip regulator between the motor and the flywheel of the motor generator set, and the other development an improved system of automatic braking control.

For the Rand.

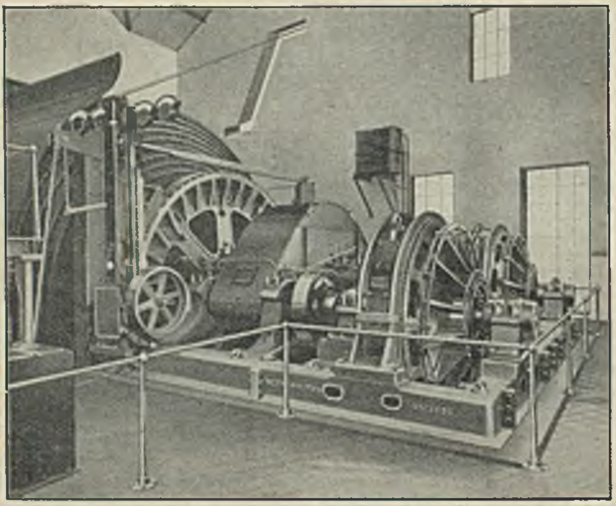
The two winders for the Rand are equipments of 2150 r.m.s. rating and 4310 H.P. working peak capacity. They were ordered by the Union Corporation, Ltd., for the East Geduld Mines, Ltd., a subsidiary company which was registered and commenced operations two years ago. The electric winders are to replace two steam engine equipments, one carrying men and the other hoisting ore, in an installation 5600 feet above sea level. The depth of the shaft is 3350 feet and the net load to be handled in the case of the ore hoist is 7 short tons (14,000lbs.), the output required being 230 tons per hour.

The two equipments will be similar, the winder motor in each case having a normal speed of 58 r.p.m. and coupled to two cylindrical drums 14ft. in diameter and 5ft. between flanges. The normal maximum winding speed will thus be 2580 feet per minute. The two motor generator sets will each consist of an 1800 H.P. 2000 volt induction motor direct coupled to a 1550 K.W. 640 volt D.C. generator. The sets will not be equipped with flywheels as the power will be taken from the large capacity distribution system of the Victoria Falls and Transvaal Power Co.

It is intended ultimately to increase the working peak capacity of the equipments to 4570 H.P. by taking out part of the permanent resistance in the generator field circuit, thereby increasing the winding speed by about 5% and the output capacity to 245 tons per hour. The Metropolitan-Vickers Company is the Main Contractor for the installation including the cable work; the sub-contract for the mechanical parts has been placed with Messrs. Blane & Co., Ltd., of Johannesburg.

For New South Wales.

Caledonian Collieries, Ltd., of New South Wales, have ordered through their managing agents, Messrs. Howard Smith, Ltd., of London and Sydney, an electric winder of 1900/4000 H.P. to replace a steam engine equipment at a shaft of Aberdare Colliery, where it is required to increase the output to 557 tons per hour.



An Electric Winder at the Harworth Colliery.

The new equipment is to do this by a schedule of 133 trips per hour with a net load of 4¼ tons. The time for the trip of 530 feet is thus only 27 seconds, of which 7 seconds is allowed for decking. The acceleration is 5.53 feet per second and the maximum winding speed 2555 feet per minute. The motor is designed for operation at 70.5 r.p.m. and will be direct coupled to a cylindrical drum 12ft. in diameter and 6½ft. wide. The motor generator set will consist of a 680 H.P. induction motor coupled, with a fly-wheel, to a 1170 K.W., D.C. generator, this equipment being housed in a separate building about 50 yards from the winder house. The Metropolitan-Vickers Company is the main contractor for the installation, including the cable work. The sub-contract for the mechanical parts has been placed with Vickers-Armstrongs, Ltd.

It is interesting to note that at another shaft of the Aberdare Colliery there is installed one of the largest colliery winders in the world, a Metrovick equipment rated at 4500/11,250 H.P. This winder raises a net load of 7½ tons from a depth of 1260 feet, and maintains an output of 490 tons per hour.

For Northern Rhodesia.

The Roan Antelope Copper Mines, Ltd., which is operating in the opening up of a large new field of copper mining concessions in Northern Rhodesia, has ordered two geared D.C. winders of 1290/2580 H.P. with Ward-Leonard control, for a new shaft 1100 feet deep. In this installation also the two winders, one for men and one for ore, will be similar. The loads to be dealt with are 12 short tons and 10 short tons respectively, and the output of ore will be 500 tons per hour. The winding drums will be cylindrical of 16¾ft. diameter for the man hoist, and 14¼ft. diameter for the ore hoist, with gear ratios to give the same winding speed, 1400 feet per minute, in each case.

Power will be supplied from the Company's own system at 3000 volts three-phase, 50 cycles, and converted by a motor generator set consisting of a 960 K.W. generator with a fly-wheel of 6½ tons.

A novel feature of these two equipments will be the use of a new type of slip regulator consisting of a hydraulic coupling between the motor and the fly-wheel of the motor generator set. The device is a development of the well known "Vulcan" coupling, which has been extensively employed for marine propulsion and industrial drives. It consists essentially of two main elements, an impeller wheel mounted on the motor shaft and a runner wheel mounted on the fly-wheel shaft, with a casing in which a controlled supply of oil provides the working medium. The oil circulates under pressure and by varying the amount admitted to the coupling the slip can be regulated to any desired value from practically zero to 100 per cent. The system is introduced as an important improvement upon the usual form of slip regulation by means of resistance in the secondary circuit of the driving motor of the flywheel set.

Another notable feature to be incorporated in the equipments for Northern Rhodesia is a new system of braking recently developed and patented by the Metropolitan-Vickers Company. In this system the braking effort is applied as a function of the speed change of the cages, compensation being made automatically for all variations of load, speed of travel, and other conditions.

The use of this new principle gives the equipment the remarkable and highly desirable characteristics that (a) any given position of the brake lever will give a definite rate of retardation under all conditions and, (b), any desired rate of retardation can be obtained without shock. The retardation under emergency conditions is also capable of accurate setting, a definite rapid rate of retardation being set for operation if the cages are approaching the end of travel and a relatively slow rate of retardation selected for operation if the cages are in an intermediate position. The system thus ensures any required stoppage in a reasonably short distance of travel while eliminating the risk of sudden stoppages, which are a cause of grave danger to passengers and plant.

Tests made in the makers' works on experimental braking apparatus of this type have given remarkable successful results, and arrangements are at present being made for tests in actual service on a large Metrovick winder in service at the Harworth Colliery of Messrs. Barber, Walker & Co., Ltd. This installation, which is shown in the accompanying illustration, is of the same type and of about the same capacity as those for the Roan Antelope Copper Mines, and is itself of interest as one of the largest electric winders in this country. The results of the tests at Harworth and the performance of the two winders for Rhodesia, on which both the new features will be incorporated, will be watched with considerable interest, since the developments promise to have a far reaching influence on future winder practice.

Bridge Score Pad.—An attractive and useful advertising novelty is the neat Bridge Score Pad issued by British Insulated Cables, Ltd. It has a hundred or more sheets each carrying various views of B.I. Cables in manufacture and laying.