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Pending C.E.B. Changes

Strong rumours have been circulating in electrical circles in the last few days of a pending resignation from the C.E.B., and consequential changes of personnel. As the news may break officially any day, but too late for inclusion in this week's issue, reference to the matter seems desirable. The central figure concerned must for the moment be nameless, but he is one of the most highly esteemed personalities of the supply industry—a Scotsman, a great engineer, a great administrator, and a great gentleman.

Blast and Counter-Blast

The hope we expressed only three weeks ago, that there would be no more reports on electricity supply reorganisation from any source for a long time, has been falsified. A new memorandum on this subject was delivered to the Minister of Fuel and Power last week; it is summarised in our later pages. This document, however, is additional and complementary to those that have already been presented, and does not in fact put forward any alternative plan. When the I.M.E.A. approved the "Brown" memorandum, setting forth the Association's views on the ownership of distribution undertakings, ownership of generating stations and a national standard bulk supply tariff, it was inevitable that the municipal selected-station owner members of the I.M.E.A., who as a body strongly disagree with the proposal that all generating stations should be taken over by the Central Electricity Board, would consider it essential the M.O.F. should have their specific views on this matter. The new memorandum, be it specially noted, together with the I.M.E.A. "Brown" document, does not invalidate the agreed recommendations of the joint "White" Report, which has the backing of 90% of the authorised distribution undertakings in the country.

Municipal Selected-Station Owners

The "Observations" of the municipal selected-station owners make two main points. First, that the majority vote of the I.M.E.A. in favour of the "Brown" Report was due to the constitution of the Association and method of voting, a case of the tail wagging the dog. Secondly, they oppose strongly the principle inherent in the proposals of centralised ownership of generation with a national bulk supply tariff, that consumers in favourable areas of supply—i.e. dense centres of population and where geographical and other advantages contribute to cheap generation and distribution—should indirectly subsidise supply to consumers in other areas. This issue is, of course, at the crux of all the major problems associated with the working of Section 13 of the 1926 Act.

A Common Denominator

In one respect the memorandum of the municipal selected-station owners and the "White" Report have a common characteristic. Both specifically impress upon the Minister of Fuel and Power the great unwisdom of forcing controversial revolutionary changes in the existing organisation of the electricity supply industry, which organisation, despite certain anomalies, has in practice functioned extremely well. Perhaps he will heed this common advice, even if it be considered that the opposed views on ownership simply cancel out.

Hydro-Electric Rating

Owing to the nature of the formula employed in assessing rateable value, the burden of local rates bears much more heavily on hydro-electric than on thermal station undertakings. The anomaly arises because whereas in respect of the latter the major financial item of generation, coal costs, is a deductible allowance, no compensating provision applies to the relatively heavy capital charges of water power development. The inequity is not disputed, but hitherto efforts to secure legislative redress for hydro undertakings have been abortive, except partially in some individual cases. There is renewed

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hope that common justice may be done, however, arising out of the Report of the McIntyre Committee just published. This is concerned specifically with the valuation and rating of hydro-electric undertakings in Scotland. But the fact that the recommendations concede the principle that some concession is justified, and that it should apply to all water power developments, greatly strengthens the general argument. The Report is reviewed on page 692. Doubtless it will not escape the notice of the cynically minded that the reasons advanced in favour of making rating concessions to hydro-electric undertakings are concerned more with promotional objects than with equity.

Not So Hot

We experienced a mild shock recently when we read in the *Electrical World* issue of April 15 that the Department of Water and Power, Los Angeles, had instituted the practice of washing 132 kV insulators " hot," and that—

> " So far as is known this is the only utility to adopt a regular schedule of washing hot equipment and insulators on steel tower structures operating at or near this high voltage."

That may be so in the U.S.A., but compared with little old backward England the progressive Department of Water and Power is nearly ten years behind the times. The following is an excerpt from the 1936 Annual Report of the C.E.B.

> " With a view to reducing insulator cleaning costs and liability to flashover, the washing of live substation insulators by means of a water jet has become routine procedure in certain of the Grid substations in Scotland, South-East England and South-West England. In other areas, permanent washing equipment is also being installed in substations which are particularly exposed to polluted or salt-laden atmospheres."

It will be noted that even eight years ago there was no suggestion of novelty in connection with the water-jet washing of live 132 kV insulators, it was already " routine " practice.

Engineers Saved Civilisation

When superior technical equipment, in the hands of our incomparable airmen it must never be forgotten, saved Britain from a fate worse than that of any of the occupied countries of Europe now under the Nazi heel, the stock of engineers rose high in popular esteem. Subsequent events during four years of mechanised warfare have consistently confirmed the predominant importance of engineers in the modern world. As for the future, are not all the hopes and plans for a better material world based on science and engineering ? Plain as these things are, it is doubtful whether the masses in general fully appreciate their significance, and the memory of the public is proverbially short. It is meet and right, therefore, that we should be reminded of them occasionally ; moreover, a well-deserved pat on the back from time to time does no one any harm. Read then these words of Sir Miles Thomas, spoken when he addressed the Engineering Industries Association in Birmingham recently.

> " Remember, it was you engineers of this country that saved it when all was at stake. You who harnessed the untapped productive potentiality of unskilled labour. You who taught the gospel and technique of sectionalising complicated operations until, individually, they could be tackled successfully by operatives who could offer as a national defence asset a little manipulative skill and a lot of bravery, but nothing else."

A fine testimony, well and truly earned. But the nation must understand that it is not enough that engineers should be acclaimed, they deserve and need also commensurate material rewards for their accomplishments.

Truth Will Out

The Ministry of Fuel and Power has appointed a committee of inquiry into the gas industry, with terms of reference :—

> " To review the structure and organisation of the gas industry, to advise what changes have now become necessary in order to develop and cheapen gas supplies to all types of consumers, and to make recommendations."

We welcome this announcement for two reasons. First, because it is in the democratic tradition that, before any changes affecting a major industry are imposed politically, there should be an impartial inquiry with evidence and recommendations made public. (We greatly distrust the " secret " report that it is understood has been made to the Government concerning the electricity supply industry.) Secondly, because the fact may now be brought to light that, by contrast, it is the gas industry rather than electricity supply that is really in a state of chaos—an inversion of common belief, but the truth.

Coal Mine Gasification

In connection with reorganisation of the coal and gas industries, references have been made recently with increasing frequency to the possibility of gasifying

coal underground in the mine, the products of this method of distillation being brought up through boreholes and pipes and utilised at the surface. It is known, of course, that at least one large plant of this nature is in operation in Russia, and others were planned before the war, but information as to the technique employed and the nature of the results obtained is at present meagre. Certainly there are not enough data available yet on which to build post-war planning visions of electric power stations sited at the pit mouth, with gas turbine prime movers fed direct from underground. That may be a possibility of the future, but at best it seems a long way off. Apart from all other considerations, a large size modern power station would probably exhaust the gas mine long before the generating plant was worn out or obsolete. The station would then have to be removed elsewhere or fuel brought to it from more distant mines. The same difficulty is present, of course, in greater or lesser degree depending on circumstances, with pit head generation in any form. The fuel appetite of large generating stations is greatly in excess of the output of the average pit shaft.

Standardisation and the B.S.I.

Standardisation is a much abused and misunderstood word. By some it is revered as the one essential means whereby order may be fashioned out of chaos; for others, it forbodes an uninspiring uniformity and stultification of progress. Of course, neither of these extreme views is correct, though both concepts enter in some degree into all standardisation, and either on occasion may be nearer the truth than the other. Much depends on what is standardised and when; the wrong form of standardisation may be applied, functional when dimensional would be preferable, or *vice versa*, and standardisation can be adopted too soon equally as it can be delayed too long. There are indeed many pitfalls in standardisation of which the unwary enthusiast knows little or nothing. For which reason British industry is particularly fortunate in that its standardisation needs are served by the British Standards Institution, which, incidentally, is a typically British organisation.

The "Standards Review"

The B.S.I. has been in existence serving industry since 1901; initially it was the Engineering Standards Committee. To-day it operates under a Royal Charter, and is the officially recognised authority for the promulgation of British Standards, terms, definitions, codes of practice and specifications for materials and methods of test, etc., of national import. The Institution does not, however, initiate standardisation; it functions only at the specific request of responsible elements in industry, Government departments or other bodies, and then only with the voluntary assistance of personnel of the interests concerned. In other words, the Institution has no legal mandate and functions through collaboration. A typically British organisation as has already been said, but one concerning the activities of which too little is known generally. For that reason the new publication *Standards Review*, No. 1 of Vol. 1 of which has just reached us, is welcome. It will appear quarterly, and present an up-to-date review of the activities of the Institution. Copies are obtainable, price 1/-, from 28, Victoria Street, S.W.1.

Boys Will Be Boys

A sidelight on the practice, rather than the technique, of grain shovelling was revealed by Mr. W. T. Partington in his prize-winning entry to the A.S.E.E. Branch Papers Competition. His subject was Static Electricity, and among other items he explained that wooden shovels are used for handling grain in malt kilns and similar situations to prevent the accumulation of static electricity. The blade of a metal shovel, if not allowed to touch the floor, becomes strongly electrified by the movement and friction of the grain, and being insulated by its dry wooden handle tends to retain the charge until contact with earth is made. The discharge spark presents a serious fire risk. There is, however, another reason why the use of metal shovels has been abandoned. More playful individuals, it appears, would work industriously until they had accumulated a fair charge on their shovels, and then apply the corner of the blade to the rear quarters of a fellow worker as he bent over his task.

METEOR

EVALUATION OF UNSYMMETRICAL FAULTS

A Direct Method

By A. A. B. Martin, B.Sc., A.M.I.E.E.

AS protective gear technique improves, greater interest focuses on the actual currents flowing at times of fault. In this article a systematic presentation of the less simple formulæ required to give these currents is attempted.

Fault current evaluation is necessarily approximate work. Amongst others, one particular approximation which may usually be made is to ignore the impedance changes which take place in generator windings when these windings are subjected to unbalanced currents. This approximation ("$Z_- = Z_+$"), when employed in the symmetrical component method of deducing the formulæ, may mean that that method is being used, sometimes with very great complication, for work which might be done more simply and directly by other means.

These other means—direct solution of simplified networks by using Kirchoff's Laws—will be referred to as the direct method. In preparing a list of formulæ, the wide applicability and uniform simplicity of this method give it a considerable advantage. In what follows, the range of circumstances which may attend a fault is discussed, and a description is given of how the direct method of solution may be applied to any particular circumstance.

Simplified Network Forms.—Fig. 1 illustrates an electrical system simplified to permit

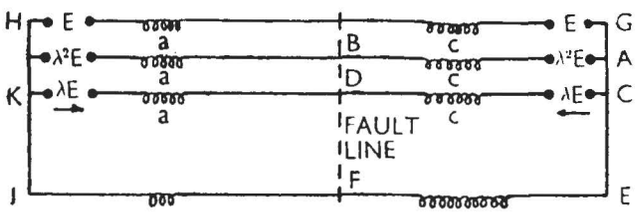

Fig. 1.—Simplified Electrical System.

direct method fault current evaluation. It is a "G-G" form of network because, as the voltages indicate, there is generating plant on both sides of the fault. Alternative forms are "G-T" and "G-O." The former denotes that, in the absence of generating plant on the right, transformer plant instead is feeding current into the fault from that side. The latter denotes that there is no source of fault current on the right. This last will not be considered any further, for it involves only very simple formulæ.

A transformer will only have to be regarded as a source of fault current if it has either an earthed star or an inter-star winding connected to the faulted network. Even so, it cannot do more than pass earth-flowing current back into the system; it acts, therefore, as a "modified generator," a generator of earth current only. Further, if it is star wound, it will not be effective unless there is an associated delta winding to permit ampere turn balance; otherwise the star winding would present an impedance too great to allow any significant flow of fault current.

Ignoring the simple "G-O" form, there are four electrically-distinct simplified network forms. These are shown in the column headings of Table 1. The first, having system earths on both sides of the fault, is as shown

TABLE 1.—ENUMERATION OF FAULT CIRCUMSTANCES.

Type of Fault		*Form of Network*				
		*	G–G E–E	G–G O–E	G–T E–E	G–T O–E
1 Phase to Earth . .	. .	—	1	2	3	4
1 Phase to Earth . .	. .	L	5		6	
1 Phase to Earth . .	. .	R		7		
2 Phase to Earth . .	. .	—	8	9	10	11
2 Phase to Earth . .	. .	L	12	13	14	15
2 Phase to Earth . .	. .	R		16		
Phase to Phase . .	. .	L	17	18	19	

* One open circuit in a faulty phase left or right of fault as denoted.

in Fig. 1. In the second there is no left-hand side system earth, so the network branch JF will be deleted. The last two are similar to the first two, except that, as there is only "modified generator" plant (i.e., transformers connected as above) on the right. The voltages there are changed, as will be explained later.

The method of reducing an extensive connected system to one of these four network forms is the same as that used in short circuit calculations. The normal voltage of the faulty section is taken as a voltage base to which all the component impedances are referred. For the two phase-impedances (marked "a" and "c" on Fig. 1), the reducing process is stopped at the second last stage so as to leave an impedance to the left, and an impedance to the right of the fault. A slight complication may arise here if there are parallel paths; this is dealt with in a

later paragraph. Similarly to "a" and "c," the earth and neutral path impedances left and right of the fault must be assessed. Usually, however, these paths are very restricted and need little or no simplifying. The form of impedances to be used is also discussed in a subsequent paragraph.

In Table 1, seven types of faults are associated with each of the four simplified network forms, but only 19 of the possible 28 resulting "fault circumstances" are numbered. The un-numbered combinations are not considered because, if any one of them be sketched out, it will be seen that either it is the same as one already numbered, or is such that fault current cannot flow freely, or is one which involves only the simple one-fault-source formulæ. In Table 2, there are 19 rows corresponding to the 19 numbered fault circumstances, and each row contains all the formulæ for all the currents at either end of the faulty section. Full explanation of Table 2 is given in the final paragraph.

Network Loops.—Considering fault circumstance No. 8, the simplified network would be as in Fig. 1 with BF joined. This entails five separate compartments or loops. Other circumstances will entail fewer loops if they involve the disappearance of one or more of the branches BD, FD, JF, KD, etc. The solution of a five-loop network would be an unduly laborious task; but, fortunately, the number of loops may always be reduced so as never to exceed three. The most complicated example may thus be solved by simple algebra, while in the two simplest cases the solution may actually be written straight down. Reducing the number of loops is effected by using a "composite phase" device, but description of this is easier if the voltages and impedances to be inserted in the various branches of the network are first settled.

Network Voltages.—These will be as shown in Fig. 1 for G-G network forms. In G-T forms there will be no 120° spaced voltages on the right; instead, there will be voltage drops in the star windings of the equivalent transformer. For network solution these voltage drops must be shown in the right-hand side phase branches. In G-T forms, if

TABLE 2.—BASIC FORMULAE FOR VARIOUS FAULT CIRCUMSTANCES.

Reference	DENOMINATOR	← CURRENT FORMULAE → NUMERATORS (* denotes formula is "composite phase" current I_c; the actual phase values being $I_c/2 \pm E'/a$ if on the left and $I_c/2 \pm E'/c$ if on the right. Other phase formulae give for phase values)				
		Sound Phase ←	Faulty Phase L →	Faulty Phase R ←	Neutral L ←	Neutral R →
1	$cdS+abS'$	$(bc-ad)E$	$(3cd+2bc+ad)E$	$(3ab+2ad+bc)E$	$3d(a+c)E$	$3b(a+c)E$
2	$cd+aS'$	cE	$2cE$	$(3a+c)E$	-	$3(a+c)E$
3	$dS+2ab$	bE	$(2b+3d)E$	bE	$3dE$	$3bE$
4	$d+2a$	E	$2E$	E	-	$3E$
5	$9cd+RS'$	$-3(d-c)E$	-	$3(R+R')E$	$-6(c-d)E$	$3(R+3c)E$
6	$9d+2R$	$3E$	-	$3E$	$-6E$	$9E$
7	$R'+9a$	$3E$	$6E$	-	-	$6E$
8	$cdR+abR'$	$(bc-ad)E$	$(3cd+2ad+bc)E$ *	$(3ab+2bc+ad)E$ *	$3d(a+c)E$	$3b(a+c)E$
9	$2cd+aR'$	cE	cE *	$(2c+3a)E$ *	-	$3(a+c)E$
10	$dR+ab$	bE	$(b+3d)E$ *	bE	$3dE$	$3bE$
11	$a+2d$	E	E *	E	-	$3E$
12	$6cdS+2aRR'$	$3(ac+bc-2ad)E+2R'(b-a)E'$	$3(3cd+2ad+bc)E+2(3R'+9cd)E'$	$6a(R+c+d+\frac{bc}{a})E$ * $-4(b-a)(d-c)E'$	$3(4ad+3cd-ac)E+6(aR'+3cd)E'$	$3(3ac+3bc+2aR)E+6c(b-a)E'$
13	$6cd+4aR'$	$3cE+2R'E'$	$3cE+2R'E'$	$6(c+2a)E-4(d-c)E'$ *	-	$3(3c+4a)E+6cE'$
14	$6dS+2aR$	$3(a+b)E+2(b-a)E'$	$3(3d+b)E+2(9d+s)E'$	$3(a+b)E+2(b-a)E'$	$3(3d+R)E+2(9d+R)E'$	$9(a+b)E+6(b-a)E'$
15	$6d+4a$	$3E+2E'$	$3E+2E'$	$3E+2E'$	-	$9E+6E'$
16	$4cR'+6aS'$	$6cE-4(d-c)E'$	$6cE-4(d-c)E'$ *	$3(3a+2c)E+2(9a+2S')E'$	-	$3(3a+4c)E+6(3a+2c)E'$
17	$3c(b+d)+2a(R+R')$	$2(b-a+d-c)E'$	$-2(s+S')E'$	$2(s+S')E'$ *	$-6(a+c)E'$	$6(a+c)E'$
18	$3c+4a$	$2E'$	$2E'$	$2E'$ *	-	-
19	$3b+3d+2a$	$2E'$	$4E'$	$2E'$	$6E'$	$6E'$

a, b - positive and zero sequence impedances to left of fault. $S = 2a+b$ $R = a+2b$
c, d - positive and zero sequence impedances to right of fault. $S' = 2c+d$ $R' = c+2d$ $E' = 10{\cdot}866E$

the lower phase is faulty and the upper two phases sound, the voltage drops in the star windings connected to the sound phases will be cause by the voltages " E " and " λ^2E " of the left side equivalent generator. Corresponding voltages will appear in the two associated delta windings, and the vector sum of these latter, reversed, will appear across the third limb of the delta. This in turn will cause a voltage, say V volts, in the star winding attached to the faulty phase. It is this voltage V which forces a current round the loop CDFE. V is easily found as is shown in the example given later.

In G-T forms, all currents on the right are in phase, since they are all drawn through the transformer neutral. Therefore, in the star windings connected to the sound phases, only the components of the voltage drops which are in phase with V are effective. By the preceding paragraph the sum of these components is $-V$; by symmetry considerations they are equal; the voltage to be inserted in each of the upper two right-hand side phase branches is therefore $-V/2$. If two phases instead of one are faulty, similar reasoning shows that in this case the sound phase voltage is $-2V$, faulted phase voltage being V as before.

Network Branch Impedances.—The impedances in the phases left and right of the fault are given the symbols " a " and " c." Symbols " e " and " f " might similarly be assigned to the impedance values of the branches JF and FE, but there is another way of handling the earth path which is analytically more correct.

On the right of a G-T network, the equivalent transformer acts as a neutral earthing compensator, and 3I A in FE are distributed as I A in each phase. If FE be looked on as consisting of three equal parallel channels, each carrying I A, then

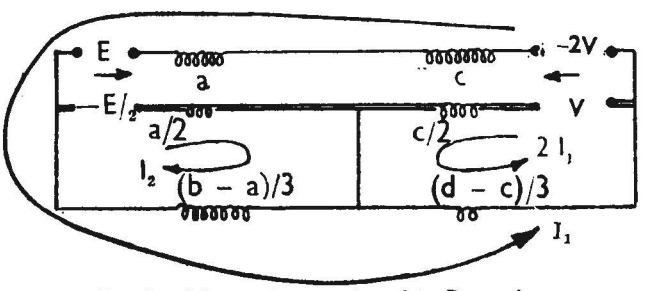

Fig. 2.—Network considered in Example.

the whole right-hand side of the network may be regarded as three separate equal circuits, all starting at F, thence to E, and back to the fault line through the phases. Let the impedance of each circuit be " d " ohms, and the corresponding impedance on the left be " b " ohms. Earth fault current in DF will divide inversely as " b " and " d," and not as "e" and "f,"for only the former represent the complete loop impedances followed by the divided currents.

In symmetrical component theory, the right-hand current system is called a " zero sequence," and " d " (the impedance offered to each current of the sequence) is called the " zero sequence impedance." In using the zero sequence impedances in preference to " e " and " f," there is the further advantage that it makes the formulæ the same as those obtained by the symmetrical component method. This is because the ordinary impedances " a " and " c " are the same as the " positive sequence impedances " of the latter method.

Considering the path followed by the " I " amps. of the lower phase on the right, the total voltage drop round the loop is dI volts. In the branch CD it is cI volts, so that in the single channel in FE, which this current uses, it must be (d-c) I volts. The total impedance value in FE is that of the three channels in parallel, or (d-c)/3 ohms. Similarly, in the branch JF it is (b-a)/3 ohms.

The " Composite Phase."—This device consists of redrawing the simplified network so as to reduce its three phases to two. If there are two sound phases, they are combined; if only one, the two faulty phases are combined. If one of the faulty phases has an open circuit, then the composite phase is formed only on that side of the fault where both phases are still active. Where combining is done, branch impedances are halved and dissimilar voltages are averaged. This is illustrated in the subsequent example.

The legitimacy of this device is obvious if it is the sound phases which are thus treated as one. In the case of faulty phases, consider first the right-hand side of a G-T network. In the branches AB and CD (Fig. 1), the voltages would be the same, and equal current sharing between the branches would not be disturbed if they were combined. On the other hand, on a side where there is a generator, the voltages in the branches are not equal, and the difference between them will drive a current round the loop (ABDC if on the right). It is perhaps obvious that the existence of this current does not invalidate the remainder of the network solution, since its effect in AB is exactly offset by the same effect, this time negative, in CD.

This may be analysed as follows: Suppose, first, there is no combining of phases, and the evaluation is done by solving various cyclic currents, including I_1, I_2, I_3 and I_4, whose paths are respectively ABFE, CDFE, ABDC and GHJE. Assume also that, in FE, an admittance 1/k is available to $I_1 + I_2$ as against the total admittance 3/ (d-c) which is available to all currents, namely, $I_1 + I_2 + I_4$. Balancing potential drops :—

$$(c + k)\, I_1 + kI_2 + cI_3 = \lambda^2 E \ldots\ldots\ldots \text{(I)}$$

$$kI_1 + (c + k)\, I_2 - cI_3 = \lambda E \ldots \text{(II)}$$

$$cI_1 - cI_2 + 2cI_3 = \lambda^2 E - \lambda E \ldots \text{(III)}$$

Adding (I) and (II) gives
$I_1 + I_2 = -E/(c + 2k)$, and hence, from considerations of symmetry, $I_1 = \lambda^2 E/(c + 2k)$ and $I_2 = \lambda E/(c + 2k)$. Substituting these values in (III) it may be shown that :—

$$I_3 = -j\sqrt{3}E/2c + j\sqrt{3}E/2(c + 2k) \quad .. \quad (IV)$$

If now the composite phase device is used, $I_1 + I_2 + I_3$ merge into one cyclic current, say I_c, which is evaluated from the equation $(c/2 + k)\, I_c = -E/2$, whence $I_c = -E/(c + 2k)$, or the same as $I_1 + I_2$. The current in the admittance 1/k is thus unchanged by using the device, and, of course, I_4 continues to use the balance of the admittance in FE, so that the remainder of the network is not affected in any way. Using equation (IV) above, the actual currents in the phases AB and CD, namely, $I_1 + I_3$ and $I_2 - I_3$, work out to be $-E/2(c + 2k) \pm j0{\cdot}866E/c$, or half the composite phase current plus or minus the current which would flow if only a phase-phase fault were present. It is thus very simple to expand the composite phase current to the actual currents.

Example.—Application of the foregoing would reduce fault circumstance No. 10 to the network shown in Fig. 2. To the right of the fault all phase currents are equal, so that only two different cyclic currents I_1 and I_2 have to be solved. Balancing potential drops :—

$$\{c/2 + (d - c)/3\}2I_1 + \{(d - c)/3\}I_1 = V \quad .....(I)$$

$$\{a/2 + (b - a)/3\}I_2 - \{(b - a)/3\}I_1 = -E/2 \quad .....(II)$$

$$-\{(b - a)/3\}I_2 + \{(d - c)/3\}2I_1 + \{c + a + (b - a)/3 + (d - c)/3\}I_1 = -2V - E \quad .....(III)$$

From (I) "V" is found to be dI_1. (This result may have already been noted in the earlier discussion of "d.") Thus eliminating "V," (II) and (III) are solved to give I_1 and I_2. The neutral currents are $I_2 - I_1$ and $3I_1$. The currents in the faulty phases on the left are $I_2/2 \pm j0{\cdot}866E/a$. All other currents are $-I_1$.

Fault circumstances Nos. 7 and 18 both reduce to one single loop. Their solutions can be written straight down. For instance, in No. 7 the sound phase current = half the fault phase current
= half the neutral current
$= E/2\{a + (d - c)/3 + c/2 + a/2\}$.

Parallel Path to Faulty Section.—This case requires special consideration. It occurs when there is another circuit between the left and the right-hand sources of fault current, as, for example, if the fault took place on one of various interconnectors between two power stations. Suppose the simplifying of the system has proceeded to the stage shown in Fig. 3. The equipment forming the parallel

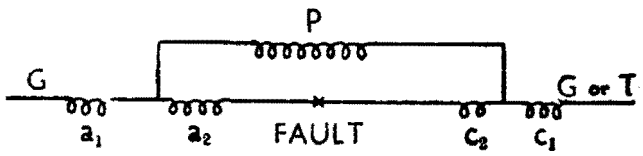

Fig. 3.—Parallel Path across Fault.

path (or paths) has been reduced to a single equivalent impedance "p." The complete simplification to the two impedances "a" and "c" of Fig. 1 may be done as follows : Let $a_1 + a_2 = a_3$, and $c_1 + c_2 = c_3$. Then "a" is obtained by multiplying "a_3" by

$$\frac{c_3p + c_1c_2 + a_1a_2(c_3/a_3)}{c_3p + c_1c_2 + a_2c_1}.$$

The right-hand conversion factor is similar with the symbols transposed. These factors may be worked out by converting the delta of Fig. 3 into a star of impedances, and then splitting the common star leg into two separate parallel impedances such that, if the left one carry the left side current, and the right one carry the right side current, the voltage drop is the same in both. In passing it may be noted that if some value of fault impedance lay in the branch DF of Fig. 1, for instance, tower footing resistance, this would have to be apportioned to "b" and "d" in the same way that the common star leg above is apportioned to "a" and "c." It will be noted that the left side phase currents given by the formulæ of Table 2 are those flowing in "a_1" and not those flowing in "a_2." The latter are the actual faulty section currents. If there is no open circuit, the latter are obtained from the former by multiplying by $p/(p + c_2 + a_2)$ for unearthed phases, and by $(p + c_2 + c_2r)/(p + c_2 + a_2)$ for earthed phases, where "r" is the ratio :—
(current in "c_1")/(current in "a_1").

An open circuit at the fault point ceases to be effective as such if there is a parallel path. On reduction to single equivalent impedances left and right of the fault, it will be seen that the impedances are not the same in all three phases, and therefore simple conversion factors from the Table 2 formulæ are not feasible. The direct method may still be used for this new condition, but, if the fault involves two phases, the composite phase device is not practicable, and the advantage of a three loop network may be lost.

Basic Formulæ.—It is of interest to note that the frequent recurrence of Table 2 abbreviated expressions S, S^1, R and R^1 is usually attributable to either the direct sum of the "sequence" impedances, or the sum of their reciprocals. (If the negative sequence impedance were a^1 and $a^1 = a$, then

$a + a^1 + b = 2a + b = S$, and
$1/a + 1/a^1 + 1/b = (a + 2b)/ab = R/ab$.

In the second column of Table 2 is an expression which is a denominator common to all the current formulæ of the fault circumstance numbered in the first column. Therefore, in the remaining columns, only the numerators of the current formulæ are given. If the two phases affected in a two-phase fault have different currents, the " composite phase " current formula is given instead. The actual phase currents are readily derived from the latter as indicated. The formulæ assume that the fault is in the " E " phase, or the "λ^2E " and the " λE " phases, depending on whether one, or two, phases are involved. Relative directions are indicated by the arrows. It is further assumed that an open circuit, if present, lies either in the " E " or the " λE " phase. In Tables 1 and 2 only faults with no open circuit or one open circuit in a faulty phase are considered, but other contingencies could be similarly evaluated by this direct method.

RATING OF SCOTTISH HYDRO-ELECTRIC UNDERTAKINGS

A LITTLE less than a year ago a committee, under the chairmanship of Mr. J. G. McIntyre, M.C., K.C., was set up to review, with reference to post-war requirements, the law and practice in Scotland in relation to the valuation and rating of hydro-electric undertakings (with special reference to the Cooper Committee recommendations) and to investigate the effect of the existing system of rating on the provision of houses and liability for rates in respect of empty premises. The first report of the Committee is now issued and it wisely separates hydro-electric rating business from the ordinary rating affairs. The Committee recommends that the Scottish hydro-electric undertakings should be permanently relieved of part of the heavy burden of local rates which they bear under the present valuation and rating system.

The report suggests that relief should be obtained by adoption of one of three methods :—(1) By the deduction of an additional 25% from the gross annual value of the generation works of the undertaking in arriving at their annual and rateable value ; or (2) by deduction from the undertaking's gross revenue, in calculating its gross annual value, of a sum equal to 3½% upon the capital expended on its generation works in excess of £30 per kW installed ; or (3) by an adjustment of the valuation of the generation works in accordance with the proportion which £30 per kW installed at the generating stations bears to the actual constructional cost per kW installed.

The Cooper Committee recommended exemption from rates, either permanently or for a prolonged period for schemes carried out by the North of Scotland Hydro-Electric Board. The McIntyre Committee does not agree that there are special conditions applying to the initial stages of the Board's operations which would justify limiting the relief from rates to that period. Until the schemes are revenue earning the revenue principle would produce nil valuations—only when they are productive and revenue comes in will rating press ; the shoe may pinch a bit in the first years, but not too tightly to be borne ; and from the start of production the C.E.B. will purchase energy which is surplus.

The Committee concludes that there is no satisfactory alternative to the " revenue principle " in rating ; and the effect of this is to bring out a higher valuation for water than for steam generating plants—as things are, for equal installed capacity the disparity in valuation is about two to one. Such burden is prejudicial and unfair to the hydro undertakings and should be lightened. The effect of the heavy rating is to retard development and prevent consumers getting the benefit of cheap electricity. The Committee rejects the view that rating and valuation concessions suggested would enable hydro undertakings to take customers from the steam undertakings, this might be so if they competed in the same limited market. As to the three methods, the second and third would provide a measure of relief directly related to the cost of carrying out a scheme.

One general principle emerged in the early stages of the Committee's inquiry—that any relief to be given should be related to generation only, and no reduction made in rates paid in respect of heritages required for distribution. The transmission lines and distribution are, it is pointed out, no different with water power than with steam generation.

As to existing works, the Committee proposes that the Galloway Company, which has concessions in its own Act, should continue as now until the concession comes up for review, when it should be brought into line with other similar undertakings ; as to the Grampian Co., any relief should be conditional on extension of the Corporation's distribution system to its maximum economic limits, with tariff reductions in view from the concession. Periodical revision by the Secretary of State for Scotland after consultation with the Electricity Commissioners, is proposed in connection with any relief granted.

OWNERSHIP & SELECTED STATIONS

The Selected-Station Owners

IT was not to be expected, and we have already said so, that the "Ownership" memorandum submitted to the Minister of Fuel and Power would go without challenge from those whose financial stake in the large capital power stations—the "selected" of the 1926 Electricity Supply Act—is very high. The Municipal Selected-Station Owners held a meeting towards the end of last month to consider the memorandum, with a view to putting the views of these much-interested authorities before the Government. Before us we have the "Observations" submitted to the Minister from the meeting, together with three resolutions.

Weakness in I.M.E.A. Constitution.—The observations begin with an explanation of the constitution of the I.M.E.A., wherein the smaller undertakings have equal individual voting power with the large ones, though the output may be minute compared with the big fellows. In such case a majority vote might well be very misleading, the number of small undertakings being large compared with the big ones. Indeed, it may be judged, from the assessment for the Electricity Commissioners' expenses, and, again, by subscriptions to the Association, that a bare majority of votes in a general meeting of the Association could be secured by undertakings representing only some 3½% of the supply industry—or, put in other fashion, the aggregate annual sales of 175 municipal members of the I.M.E.A. are less than the total annual sales of the single largest member.

At the I.M.E.A. meeting on March 6 last, an amendment expressing the opinion that the proposals in the memorandum for transfer of generating stations from the present municipal owners to the Central Electricity Board would not result in any gain to the Electricity Supply Industry or to consumers was turned down by 154 votes to 102; the 102 represented 7,570 million units, the 154 2,897 million.

Small Concerns Outweigh the Big.—The proposal to transfer the ownership of generating stations, it is pointed out, completely reverses the recommendations of the Weir Report of 1926—the Weir Committee came to the conclusion that generation should be organised and controlled on a regional basis, and that ownership and management should remain with authorised undertakings, provided the cost of the electricity required by those undertakings depended on the efforts of the owners—and in general the principle was secured in the 1926 Act, and has been successful. In fact, despite the steep rise in coal costs the estimate of average price sold (1d. or under in 1940) has been remarkably accurate—the average price per unit sold in 1939-40 was 1·009d., and consumption was 503 units *per capita* against the Weir estimate of 500.

C.E.B. Reports Prove the Case.—The Selected-Station Owners point out that there is no suggestion in any C.E.B. annual report that the present schedule of generation has been other than successful or that a change of ownership is desirable. As a matter of fact, the C.E.B. annual report for 1938 demonstrates how successful the present method has been. It is there shown (pp. 14-19) how saving has been made in spare plant production costs, fuel consumption, coupled with a large net financial gain.

Reasons for Opposition.—Nine reasons are put forward by the Selected-Station Owners for opposing the transfer of ownership. Briefly they are: high efficiency of generation is assured in present conditions; there is no evidence that any greater economy would be achieved (and the memorandum doesn't claim that it would), the proposal would require a big central organisation, lead to increased costs, the advantage of the present, expert supervision of generating stations, with long experience, would be lost; the scheme was considered and expressly rejected by the Weir Committee in 1926 and it is illogical to bring it up again unless the existing method is proved unsuccessful; the memorandum contains no statistics or information as to past results or estimates for the future; the memorandum is merely an expression of a committee which cannot claim to be expert and did not take expert evidence; if generation were divorced from distribution the authorities would suffer disadvantage. Either capital expenditure would be necessary to enable physical separation to be made, or a system of dual control would be required, adding to the operating expense; and finally, management of the 200 or so non-selected stations, now rendering useful service, would under a centralised system become difficult and unnecessarily expensive.

Why then Change?—Why then the change suggested in the Memorandum? The Selected-Station Owners say the real reason may be found in the part advocating a compulsory bulk supply tariff for all undertakings regardless of regional or local conditions. This view is supported by the fact that the proposals are backed by purely distributing authorities, though most genera-

ting authorities oppose. A standard bulk charge as suggested would be completely antagonistic to the basic principle of the 1926 Act and incentive to economical production would disappear. And anyhow the benefits of the "Grid" tariff could be extended to undertakings desiring it without wrecking what has been a provedly successful system of generation.

The resolutions passed at the meeting and mentioned earlier were :—

(1) That the statement now submitted entitled "Observations of Municipal Selected-Station Owners on the Memorandum dated January, 1944, of the Incorporated Municipal Electrical Association on the Ownership of Distribution Undertakings; Ownership of Generating Stations; and National Standard Bulk Supply Tariff" be approved and adopted.

(2) That the Secretary of this Conference be requested to forward this Statement to the Minister of Fuel and Power on behalf of the Municipal Selected-Station Owners in the event of the Incorporated Municipal Electrical Association submitting to the Minister the Memorandum dated January, 1944, to which the observations contained in the statement relate.

(3) That the Minister be informed that the "Observations" refer only to the second and third parts of the Memorandum issued by the Incorporated Municipal Electrical Association, and that the Municipal Selected-Station Owners give their full support to the first part of that Memorandum dealing with the Ownership of Distribution Undertakings and to the principle of public ownership.

IS ROUTINE MAINTENANCE JUSTIFIED?

By a Factory Maintenance Engineer

MAINTENANCE staffs in factories are rarely adequate to carry out a thorough schedule of routine tests of the type that is usually advocated in text-books and articles. In fact, by such standards most motors and electrical plant are neglected. During the war the position has become worse and maintenance has come to mean little more than repairs after trouble has developed. This was offset to some extent by the installation of new plant on a large scale which required the minimum of attention after the first teething troubles were passed. Strangely enough there was far less trouble than had been anticipated. Now this general trend requires examining quite dispassionately; indeed, it is being so examined by many statistically minded managements. If justification of a thorough schedule of routine maintenance is not possible, then we must face up to considerable revision of long-established ideas of the best maintenance practice. It is with such changes that this article is concerned.

Replacement v. Maintenance.—It has long been realised by maintenance staffs that many classes of electrical equipment will keep running satisfactorily for very long periods without any attention whatever. The cost of reconditioning such plant at the end of the period is seldom much greater than if they had been regularly serviced. The most important reason for regular servicing is the fear of failure at some inconvenient time. Therefore, there seems a strong case for selecting the best equipment, installing it carefully, and letting it run for just as long as common sense dictates, after rapid expert inspections. Standardise in every possible way, and install the plant so as to facilitate rapid replacement. When it is clear that early action is necessary to avoid failure it is better to arrange for replacement rather than attempt repairs on site in awkward situations. The faulty plant can be brought back to the shop where it can be repaired under direct supervision.

It is important to collaborate with the machine loading and production departments to avoid or reduce in some measure the vulnerability of key machines wherever possible, and to find out from them the costs and difficulties of maintaining production figures with any important machine out of action. This is not always so costly or difficult as one may be given to believe during the heated discussions after the machine has failed. But, it is certainly a deciding factor on the amount of servicing work that can be apportioned for a particular unit.

Spares.—With a carefully chosen group of spares, the cost will be far less than that of an electrician's time over long periods of elaborate maintenance ritual. It is not always advisable to accept as a matter of course the general impression that replacements cannot be effected during factory working hours. Production departments, if gently stirred up, can often be persuaded into some slight modification of their arrangements to allow of this work to be done in factory working hours.

In conclusion, then, I suggest that the idealistic viewpoint regarding maintenance routine has been given far more prominence in print than the economics of the subject can justify. Further, these servicing suggestions bear little or no relation to the practical conditions obtainable in most industrial organisations. Therefore they are misleading to students and juniors who often become discouraged to find that what they believed to be best practice has in fact very little in common with the conditions they find when entering this most interesting field of industry.—**L. E. T.**

METHODS OF STARTING A.C. MOTORS

GENERAL SUMMARY OF STARTING METHODS

METHOD	STARTING TORQUE PER CENT OF D/O VALUE	STARTING CURRENT PER CENT OF D/O VALUE	NUMBER OF STARTS/HR.	NATURE OF START	ADJUSTMENT OF TORQUE	ADVANTAGES	DISADVANTAGES	SUITABLE DRIVES
Direct on	100%	100%	Not limited	Quick starting at maximum torque	Fixed at maximum	Cheapest, simplest, most reliable	Heavy current and torque	Most small drives: pumps, fans, tools, and small machines
Primary Resistance	50% 25% 80% 64%	50% 80	Limited by resistance rating "5/starts/hr."	Smooth start at reduced torque	Adjustable by varying resistance	Easily improvised. Adjustable to suit load	Heavy starting current for small torque	Machine tools, motor generator sets, etc.
Star Delta	33⅓%	33⅓%	Not limited	Light starting, heavy running torque	Fixed	Cheap and simple: Reduced starting current	Fixed torque, 6 terminal motors. Possible heavy transient	Light starting loads, line shafting. Pumps and fans of centrifugal type
Modified Star Delta	33⅓%	33⅓%	Limited by resistance rating, " 5/starts/hr."	Light starting increased in 2 steps	Starting torque fixed increment adjustable	Smooth starting. Peaks and transients minimised	Extra resistance. Increased cost	Larger centrifugal pumps and fans, textile machines requiring continuously applied torque without heavy mechanical shock
Auto-Transformer	Tap 50% 25% 65% 42% 80% 64%	25% 42% 64%	Limited by transformer Rating " 5/starts/hr."	Light start Normal start Heavy start	Tappings adjustable to suit load	3 or 6 terminal motors. Tappings adjustable to suit load	Costly. Possible very heavy transient, particularly on ·8 tap.	Motor generator sets. Centrifugal machines and heavy fans. Laundry machinery. Mixers
Auto-Transformer Korndorfer	Tap 50% 25% 65% 42% 80% 64%	25% 42% 64%	Limited by transformer Rating " 5/starts/hr."	Light start Normal start Heavy start	Tappings adjustable to suit load	Much smoother starting. Transients and peaks reduced	Costly. Extra transformer insulation	Larger fans with heavy static friction and inertia. Ram pumps, compressors and mills
Induction regulator (60% voltage start)	36%	36%	Limited by induction regulator. Rating " 4/starts/hr."	Very smooth and gradual start	Usually designed to suit load. Torque at starting fixed	Ideally smooth and gradual starting and acceleration	Expensive	Haulage and conveyor plant. Any drive where smooth starting is of paramount importance

THE I.M.E.A. REPORT

THE annual meeting of the Incorporated Municipal Electrical Association was to have been held on June 22, but this date, in view of prevailing circumstances, has been cancelled until times are more propitious. The annual report for the year June, 1943, to May, 1944, has, however, been issued; it is the forty-ninth of the series, so it will be seen that the Association approaches its half-century jubilee.

It has been a difficult and exacting year for the Council; the consideration and issue of the electricity memoranda concerning post-war conditions and legislation would, in themselves, have kept the Council busy, and it has had other matters also with which to deal.

Senior Officers.—The tribute paid in the report to the President, Mr. F. Newey (of Lincoln) is well deserved; he has been unsparing of himself in his work for the good of the Industry. He is succeeded in office by Mr. W. P. Lilwall, borough electrical engineer of Fleetwood, who has also been a real and helpful hard worker on the Council, and as chairman of the Bulk Supply Committee of the Association. Alderman Walker, so well known and highly esteemed in the Electrical Supply Industry, makes I.M.E.A. history by being the first local authority representative to become vice-president of the Association—he, however, is a member of the I.E.E., and has wide knowledge of things electrical, is chairman of the N.J.I.C., for the Industry, and was a member of the C.E.B. until age caused his retirement therefrom. The Council has lost by retirement two Birmingham personalities during the year—Alderman Sir Percival Bower and Mr. Frank Forrest, respectively chairman of the Birmingham Electricity Committee and city electrical engineer. Their places are filled by Councillor F. Kenyon (Oldham) and Mr. J. Eccles (Liverpool).

Hon. Members.—The work done by Mr. P. J. Robinson (formerly of Liverpool) and Mr. F. Forrest (formerly of Birmingham)—both served as Presidents—is recognised now they are retired, by making them honorary members. Ald. J. W. Rayment (Lincoln) was elected an hon. member of the Council for the past year.

Membership.—The membership of the Association is 348, which is equivalent to 95% of the municipal electricity undertakings in Great Britain. In the year three engineer members—Messrs. A. Nichols Moore, C. Furness and S. R. Windle, and two local authority members—Cclr. Cassells (Barnsley) and Ald. Senington (Bristol) died.

Post War.—The report devotes no great space to the question of post-war reconstruction; it merely records the deliberations preceding the preparation and submission to the Ministry of Fuel and Power of the Joint Electricity Memorandum on Supply and the separate (I.M.E.A.) Report on Ownership of Generating Stations.

Reserve Funds.—The Council is still apprehensive, as it was last year, of the effect of rising coal prices coupled with inability in some cases of undertakings to increase charges to meet the higher cost. Financial embarrassment at the end of hostilities is feared, as reserve funds will have been depleted. The policy of utilising these reserves to meet increased costs is detrimental to the future well-being of the industry, the Council says, and it should be reviewed without delay. The general ban on price increases should be removed. There were a number of cases where serious difficulty would arise in future unless tariff increases were allowed. The 3s. a ton increase in coal resulted in the running charge, in the case of large consumers with an agreement embodying a coal clause, exceeding that of domestic consumers. There were also other anomalies which should be removed if the financial position of undertakings after the war was to be secured. Representatives are to discuss the matter with the Electricity Commissioners.

Flat-Pin Plugs and Sockets.—The Council has long urged the desirability of a revision of, or an alternative specification to, B.S.S. 546 for flat-pin plugs and sockets. The matter has again been pressed, with the support of the B.E.D.A. and the Joint Committee of Electricity Supply Organisations. The B.S.I. is still considering the matter.

Bulk Charges.—With reference to bulk charges to members in the Mid-East England area, Ilkley U.D.C. has applied to the Electricity Commission for a determination of Section 13 terms provided for in the Electricity (Supply) Act, 1926. No information as to the outcome of the application is available. The Council is assisting members in the North-West England and South Cheshire area who are negotiating with the North Wales Power Co. for adjustment of bulk supply terms.

Thermal Efficiency.—Heads of agreement between the C.E.B. and the various electricity supply associations were agreed; steps to implement the agreement by a Defence Order did not succeed, and the C.E.B. in the circumstances suggests that the Council should recommend the I.M.E.A. members to honour the agreement as a "gentleman's agreement." The members have been so informed.

(*Continued on page* 701)

BUSINESS ANNOUNCEMENTS

Official Notices ; Tenders Invited ; Situations Vacant and Wanted ; Etc.*

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City of Salford

Tenders invited by noon, Friday, 30th June, 1944, for the supply of one 200 kW. and one 125 kW. MERCURY ARC RECTIFIERS, input 400 volts, 3 phase, 50 cycles, output 230 volts, 2 wire, D.C. Copy of specification on application to the City Electrical Engineer, Electricity Department, Frederick Road, Salford, 6, Lancs.

H. H. TOMSON, Town Clerk.

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Heywood Corporation

ELECTRICITY DEPARTMENT

APPOINTMENT OF
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Applications are invited for the position of Rotary Sub-Station Attendant for shift duty in the Corporation Electricity Works. Applicants should have sound experience in the control of high and low pressure switchboards, and in the operation of rotary coverting plant.

Conditions of service and rates of pay are in accordance with District Council No. 3, N.W. Area, Capacity in K.Ws. 1001/2000. The position is *not* subject to superannuation.

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H. C. DAY,
Borough Electrical Engineer.

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RECONDITIONED MOTORS. 400/3/50. 1,425 R.P.M., 2 H.P., £10. ¾ H.P., £7. ½ H.P., £6. 230/1/50. 12-inch Exhaust Fans, £8. D/E Polisher, 2,800 R.P.M., ⅓ H.P., £10. D.C., ⅙ H.P., 230v, £4. M/G 230/1/50 input, 50v 8 amp. D.C. output, £12. C.W.O. carriage paid.—B. & P., 160 Barnsbury Road, London, N.1. MACaulay 4747.

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103 Temple Bar House, London, E.C.4

CONTRACTS OPEN

The date mentioned is the last day for the receipt of tenders or for making applications for forms of tender, etc., the name and address at the end is the person from whom or the place where forms of tender, etc., may be obtained.

June 19.—**Dunfermline T.C.**: Electrical work for 20 houses, Brucefield housing scheme. Messrs. C. R. Douglas & Son, 15 East Port, Dunfermline. Deposit £1 1s.

June 23.—**Manchester T.C.**: 33,000 volt and auxiliary pilot and telephone cables. Mr. H. C. Lamb, chief engineer and manager, Electricity Department, Town Hall, Manchester. Deposit £1 1s. Advertised June 1 issue.

June 30.—**Salford T.C.**: One 200 kW and one 125 kW mercury arc rectifier. City electrical engineer, Electricity Department, Frederick Road, Salford. Advertised this week.

July 10.—**Belfast T.C.**: Electrically-driven pump. City surveyor, City Hall, Belfast.

July 25.—**North-West Midlands Joint Electricity Authority**: Circulating water pumps. Messrs. Merz & McLellan, 32 Victoria Street, S.W. Deposit, £5 5s. Advertised May 18 issue.

COMPANY REGISTRATIONS

(Extracted from the Register issued by Jordan and Sons, 116-117 Chancery Lane, W.C.)

E. Kay (Lincoln), Ltd., 35 *Cross Street, Lincoln.*—To take over a business of dealer in wireless and electrical goods, etc., carried on in Lincoln by E. Kay. Capital £750. Directors: E. Kay and Mary Kay, both of 35 Cross Street, Lincoln; R. Blow, 6 Cranwell Street, Lincoln.

East Durham Electricals, Ltd., Middle Street, Blackhall, West Hartlepool.—Capital £500. Directors: J. Forster, Woodmans Cottage, Wingate, Co. Durham; W. Hornby, 460 Back New Road, Wingate; T. Knox, 14 Middle Street, Blackhall, West Hartlepool.

Palace Electrical Co., Ltd.—To take over business carried on at 231 St. George's Way, S.E.15, and 32 Chiltern Street, W.1, as the "Palace Neon & Electrical Co., Ltd." Capital £1,000. Directors: E. C. Camp; B. J. Piper (addresses not stated); C. F. Turner, 32 Chiltern Street, W.1.

Shorts (Lifts), Ltd., Lloyds Bank Chambers, Hustlergate, Bradford.—To take over business of a lift manufacturer carried on at Sentinel Works, Bradford, by Reuben W. Short. Capital £10,000. Director: J. R. Phillips, 3 Tarn Villas, Ilkley, Yorks.

A.B. Trading Co., Ltd., 10 *Essex Street, W.C.2.*—Manufacturers of and dealers in electrical and wireless goods, gramophones, motors, etc. Capital £100. Director: H. Reuben, 10 Essex Street, W.C.2.

Philip Salter & Son, Ltd., 26 *Cross Street, Manchester.*—To take over business of a manufacturer of and dealer in lampshades, batteries, etc., carried on as "Philip Salter" at Egyptian Mills, Wellington Street, Bury. Capital £1,000. Director: Rose G. Salter, 27 Rowley Road, St. Annes-on-Sea.

Gaydon (Worthing), Ltd.—To take over business of a manufacturer of and dealer in cycles, wireless and electrical apparatus, etc., carried on as "Gaydons," at 21 High Street and 68 Montague Street, Worthing, and at West Worthing and Storrington. Capital £2,000. Directors: A. B. Gaydon (permanent), 21 High Street, Worthing; V. B. Mitchelmore, 1 High Street, West Wickham, Kent.

Dulci Co., Ltd., Coventry House, South Place, E.C.—Manufacturers of and dealers in microphones, gramophones, dictaphones, radios, etc. Capital £10,000. Permanent director: W. Barr, 8 Balnacraig Avenue, N.W.

Tym's Electric, Ltd.—Capital £100. Subscribers: J. H. Tym, 78 Paramount Court, W.C.1; C. F. Gardiner, 17 Holborn Viaduct, E.C.1.

E. J. Munday (Electric Accumulators), Ltd., Station Road, Liss, Hants.—Subscribers: E. J. Munday, Station Road, Liss, Hants.; F. E. Smith, 38 Brompton Road, S.W.3.

Electro Medical Equipment Laboratory Co., Ltd., 2 *Gayton Road, Harrow.*—Capital £1,000. Director: R. Sproull, 28 Great Queen Street, W.C.2.

*Trafalgar Batteries, Ltd., Grand Buildings, Trafalgar Square, W.C.*2.—Manufacturers of and dealers in electric batteries, etc. Capital £1,000. Subscribers: J. Dootson, Grand Buildings, Trafalgar Square, W.C.2; F. E. Smith, 38 Brompton Road, S.W.3.

Foregate Engineering and Electrical Co., Ltd., 14*a Seller Street, Chester.*—Electric, textile, radio and general engineers, etc. Capital £1,000. Directors: J. G. Hughes, 5 Norton Drive, Irby, Wirral, Ches.; J. R. Adams, 87 Foregate Street, Chester; F. E. Somerville, 12 Bouverie Street, Chester; W. J. Bradshaw, 26 Irvings Crescent, Saltney, Ches.

Registered in Scotland

Ritchies Radio, Ltd., 43 *Ferry Road, Edinburgh*, —Capital £1,000. Radio, electrical, motor: mechanical and general engineers. First directors George Masson Ritchie, 35 Lorne Street, Edinburgh; David Neilson, 60 Broomhall Avenue, Carrick Knowe, Edinburgh; Charles Cruickshank, 13 Sloan Street, Edinburgh; Robert Lionel Rae, 52 Kekewich Avenue, Edinburgh.

Robert Shaw (Plumbers), Ltd., 116 *Byres Road, Glasgow.* Capital £2,000. Director: Robert Shaw, plumber and electrician, 9 Broomhill Gardens, Glasgow, W.

BUSINESS NOTICES

New Company.—We are informed that a new company has been formed by High Duty Alloys, Ltd., Reynolds Tube Co., Ltd., and Reynolds Rolling Mills, Ltd., to collaborate with designers and constructors in any industry to secure the best use of hiduminium alloys. Further information from Hiduminium Applications, Ltd., Farnham Road, Slough, Bucks.

E.W.F.—We are informed by the Electrical Wholesalers' Federation, Ltd., that the following firms have been elected members of the Federation, as from January 1, 1944: Kerry's (Great Britain), Ltd., Church Street, St. Ebbe's, Oxford; Bennett & Fountain, Ltd., 122 Great Titchfield Street, London, W.1.

Change of Title.—As from June 5, Ellison Insulations, Ltd., makers of Tufnol, changed their title to **Tufnol, Ltd.** There is no change in the directorate policy or addresses of the firm; the offices remain, as before, at Perry Barr, Birmingham, 22B; 36 Bennetts Hill, Birmingham 2; 121 Victoria Street, Westminster, S.W.1; Kent House, 21 Spring Gardens, Manchester 2; and 11 High Croft Avenue, Croftfoot, Glasgow, S.4.

Holidays.—Santon, Ltd., announce their works and offices will be closed from July 8 to 17 for holidays. A small staff will deal with matters of urgency.

Change of Address.—It is announced by **Batwin Electric Motors, Ltd.,** that their offices have been removed to 302 Malden Road, New Malden, Surrey. Phone: "Malden 3160." Telegrams: "Phasomota New Malden."

(*Continued on page* 711)

ELECTRICAL TIMES

Registered at the G.P.O. as a Newspaper.

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(payable in advance)

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These should be addressed to THE ELECTRICAL TIMES, Sardinia House, Sardinia Street, Kingsway, W.C.2. Tel: HOL 6016. Tele: "Equivolt, Estrand, London."

** Where applicants for posts advertised under box Numbers do not wish their letters to be forwarded to any specific advertiser (such as their own employer) and notify us to that effect, secrecy will be observed by us and the applications destroyed in this office. Applicants applying for positions should not send original testimonials.*

CONTENTS

BUSINESS ANNOUNCEMENTS

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this Journal should not be taken as an indication that they are necessarily available for export.

(*Continued from page* 696)

C.E.B. . Trading.—The committee representing the various supply associations set up to consider existing trading relations between electricity undertakings and the C.E.B. and between authorised undertakers themselves, suggested to the Electricity Commissioners that they should undertake a comprehensive investigation into tariffs and charges for supplies to authorised undertakings. The Commissioners said the time was not opportune, until the Government proposals are known; so the I.M.E.A. Council is dropping the matter for the time being.

Boiler Contracts.—Agreement has been reached between the Association and the Water Tube Boiler Makers' Association, establishing a formula for calculating price adjustments arising from variations in costs of materials and labour. The formula applies to all contracts since the war started.

Meter Standardisation.—A Joint Committee recommends that the number of standard electricity meters should be reduced. Sizes suggested are—(*a*) 40 W—5 A normal, 10 A max.; (*b*) 100 W—25 A normal, 50 A max; (*c*) 200 W—50 A normal, 100 A max.; and (d) 400 W—100 A normal, 200 A max. The wattage indicated is the current which it is recommended the meters should record accurately within the requirements of the Electricity Commissioners—it is given for guidance only. The recommendations are being considered by the manufacturers.

Other Items.—A variation in the constitution of the Council is made to ensure each centre being represented on the Council by a local authority representative; publication is still awaited of the War Damage—Public Utility Undertakings Bill; a draft Town and Country Planning (General Interim Development) Order, which provided for obtaining two consents to erection of overhead lines, etc., was found to be cumbersome. At a conference between the Electricity Supply Associations and the Ministries of Town and Country Planning, and Fuel and Power, the difficulties were pointed out. Certain amendments were suggested and the Associations offered to help the Ministry, so long as such co-operation was not inimical to the future development of public authority undertakings; the Minimum Charges Order, reducing the annual minimum charge to 10s., is mentioned, also the agreement with the Inland Revenue Authorities as to wear and tear allowances on cooling towers, generating plant and meters; the allocation of general administration charges for town clerks' and treasurers' departments, against electricity departments is still under review and should be subject of a report shortly.

Other Associations.—Following the accounts, which show an income of £13,185 against £12,772 in 1942-3, and a balance of £1,195 against £1,489, abbreviated reports are given of associations and other bodies upon which the I.M.E.A. is represented.

CANADIAN WATER POWER

THE Dominion Water and Power Bureau of the Department of Mines and Resources, Ottawa, takes an annual inventory of the developed and undeveloped water power resources of Canada. The most recent of such inventories is dated March 15 last. Water power has done remarkable things for Canada in its war effort. Among the United Nations, in spite of a population extremely small for her size, Canada starts fourth as a producer of war supplies—exceeded only by the U.S.A., Russia and Britain. Water-power is the mainspring of Canadian production, which accounts for some 80% of this being concentrated in Ontario and Quebec, in which provinces about 82½% of the water power developed is located, and natural coal deposits scanty.

Available Power.—Study shows the available water-power at ordinary minimum-flow rates, to be 25,439,400 h.p.; and for six months of the year almost 40 million h.p. is available. The total turbine installation at January this year was 10,214,573 h.p.; this figure being 180,000 h.p. greater than that stated by the Department at the end of 1943, due to a revised rating of the units in the Shipshaw development.

The figures given are of water power measured, or at least carefully estimated; many unrecorded rapids and falls of undetermined power capacity exist however. Thus the figures of available power quoted represent only the minimum water-power possibilities of the Dominion; the estimates have been calculated on the basis of 24-hour power at 80% efficiency for conditions of "ordinary minimum flow" and "ordinary six months flow."

Estimates on the basis of ordinary six months flow are made upon the assumption that it is good commercial practice to provide installation up to an amount, the continuous operation of which can be assured during six months of the year, with power deficiency during the remainder of the year made up from storage, interconnection, or installation of auxiliary fuel plants. Analysis shows the average machine installation to be 30% greater than the ordinary six months flow power; so that the present recorded resources will permit of a turbine installation of more than 51,350,000 h.p.; the 10,214,513 h.p. installed represents slightly less than 20% of this.

NOTES ON WIRING

VARIETY IN CONDUIT BOXES

STANDARDISATION has two main objects: interchangeability and quality. More recently mass production has become almost of equal importance. The standards for conduit boxes offer good examples of the original objects. The most essential dimensions are laid down, including internal diameter and depth, size, centres and threads of the lugs, and the screw-thread of the spouts. Three different qualities are provided for: malleable, sheet steel and grey cast iron. For each quality there are 13 different methods of entry if we include back entry outlets, and a choice of three different patterns of cover. Then there is the standard small circular box and the large circular box to which these variations in design apply equally. But the installation trade and the manufacturers are not content with these few dozen patterns. Other patterns have been developed and a large number of these are very useful and some, in fact, essential, from the point of view of easy fitting while others have been developed for the purpose of reducing cost.

The spoutless box is used almost as much as the B.S. spout box. I have always been in doubt whether the economy in using these is as great as is sometimes thought. One pattern of the spoutless box has threaded bosses to take the conduit and necessitates that the conduit be cut accurately to length and that a female bush and back-nut be added at each entry. The other pattern has clearance holes and requires a male smooth-bore bush and coupler. If the contact surfaces are clean this makes an equally good job, with quite as good continuity as spout entry, fitting is easy, but there is the disadvantage of a reduced wiring space. Next we have such things as "branch" spout boxes, with two spouts on one side and one on the other, and "twin through-way" with two tangent spouts facing one another. The ordinary terminal box is available in two patterns, back entry and side entry, and there are other variations such as two, three and four-way with additional back entry. A "raised back" box brings the spout in line with the conduit if spacing saddles are used. Then there are specially deep circular boxes and circular extension boxes to extend sunk work with surface tubing. All of the simpler boxes have also to be repeated for those who use grip-conduit. And I have not mentioned the B.S. oblong spout boxes nor the adaptable box with plain sides.

But even this does not complete the tale, as boxes for switches and socket-outlets have to be included—some circular and some square or rectangular. The shallow switch-box, popular for surface work on account of its small projection, is used when this consideration can be allowed to outweigh the restriction of wiring space, and akin to this is the special box to take a semi-recessed switch. The deep box for switches and socket-outlets is made with both spout and clearance hole entry, with fixed grid, and also in two main types of adjustable grid which pay their way as labour-saving devices in addition to improving the appearance of the installation. Some of us, too, have a definite dislike to neck-ring fixing, so boxes with corner fixing have to be provided.

It is seen that the number of different boxes mounts up to several hundreds. From the points of view of the contractor, the consumer and his advisers, the large variety is advantageous, and it is to be added that there is sufficient standardisation of depth and fixing centres to enable most of them to take standard accessories. So if the manufacturer is content, let us retain them all. But with the growing appreciation of the virtues of mass production, will the manufacturer remain content with the position, particularly in view of a continued limitation of material and the difficulties that will arise in holding stocks? Proposals for "rationalisation" and a reduction of patterns, if they are to be made should, however, certainly come from the manufacturer rather than the user, but I should regret to see an extension of British Standard patterns which might have the ultimate effect of reducing the numerous useful non-standard varieties.

Drawing-in P.V.C. Cables.—I mentioned some time ago that contractors were remarkably slow in their appreciation of p.v.c. cables. At the time I thought it was mainly due to the higher price as compared with war-emergency v.r.i. and an inherent disinclination to adopt new methods. I now learn that another reason is involved. In spite of the smaller external diameter of the p.v.c. cable, there is some quality in its surface which makes the draw into conduit more sticky, and there are sometimes real difficulties in pulling in with the hitherto recognised sizes of conduits in proportion to the number and size of the cables. I hope that manufacturers will find a way of remedying this, and would remind them once again that for ordinary wiring in buildings a departure should be admissible from the standard Government specification which provides for a material suitable for very low temperature not experienced in usual building interiors. I am not a thermo-plastic chemist, but I gather from the recent discussion at the I.E.E. the cause of the trouble might be an unnecessary excess in the proportion of the plasticiser included.

MEGOHM

CHARGE ENGINEERS' NOTES

WELDING AIDS INSTALLATION WORK

THE installation of industrial electrical equipment nearly always necessitates a good deal of time being spent on drilling, sawing, and erecting ironwork for switchgear, transformers and other gear. Especially is this so in such places as steel works and foundries, where woodwork is rare. On such jobs an oxy-acetylene welding plant is invaluable to the electrical constructor, and the time taken on the initial erection can be cut very often to less than a half. Cable racks, saddles or any part which is required in large numbers can be made on a jig. Any class of framework necessary may be mapped out on the floor and erected *en bloc*. Mild steel of the five standard cross sections are generally easily obtainable in various sizes covering most of the requirements of the installation engineer. Mild steel plate of $\frac{1}{16}$ in. and $\frac{1}{8}$ in. gauge is useful for making boxes, and is best stocked in strips from $1\frac{1}{2}$ in. wide upwards.

All sizes of boxes can easily be made to take any number of tubes or cables, the welding being simple, but care must be taken to avoid distortion. The four sides and the base having been cut, they are welded together with the run horizontally downward. By using as little metal as possible a neater job is obtained and cleaning reduced. Care should be taken to see that the sides are at right angles before being allowed to cool, and the base can then be welded in after "spotting" each corner. Various sizes of clamps are useful for box-making. Four nuts necessary to receive the screws fastening the box-lid are welded on at each corner, and finally the lid cut and drilled to suit. Care should also be taken in the cutting of the pieces, as otherwise distortion takes place. Another method is to cut the four sides and base out of one piece, the only welding then necessary being at each corner. After the holes have been drilled or cut to the sizes required the couplings or glands can be spot-welded or brazed into position.

Where a number of tubes of different sizes are to be run along the same route, saddles of a very simple design can be made out of 2 in. by $\frac{1}{8}$ in. gauge steel if $1\frac{1}{4}$ in. tube is the maximum size to be run. If larger tubes are to be used a wider strip is necessary. The spacing between tubes is kept standard, say $\frac{1}{2}$ in., and the strip cut off in suitable lengths. The distance from the base need only be about $\frac{3}{8}$ in., holes for fixing being drilled in the base at each end. The tubing is slid into the saddles and a very neat-looking job is the result with the minimum of drilling and wall-plugging, etc. The biggest job is cutting the holes to take the tubing, but after marking the plate out and putting a small drill through for each, it is soon completed with a ratchet drill.

Brazing of broken parts is also another useful feature of the welding plant, and very often saves a lot of time spent in obtaining spares and replacements. Care should be taken to use the correct fluxes and filling rods, and in the case of a broken casting the two parts should be cut to form a V to receive the metal and provide a larger brazing surface. With brazing, only a red heat is necessary. Of course, it is essential that at least one man receives tuition in the various uses of the welding plant, and the same man can also be held responsible for the care and maintenance of the equipment and material.—**A.G.**

SYNCHRONOUS CLOCKS

The British Synchronous Clock Conference has been established many years and, by the collaboration thus afforded, it has been possible to maintain a considerable measure of order in an industry which, without the existence of such a body, might easily have run riot to the detriment of all concerned. The Conference has consistently set out to help all who have active interest in the sale of electric clocks by maintaining fair trading conditions and a properly organised system of distribution. War-time conditions have, of course, for the time being greatly reduced manufacturing possibilities; nevertheless, the Conference has continued to be active in the effort to maintain equilibrium on the market with the reduced supplies that have been available during the past two or three years. Fruitful discussions have also taken place from time to time with the spring-wound clock industry for the advancement of a better future in the Clock Industry generally and, in common with other associations, the Conference is devoting considerable attention to post-war rehabilitation needs. At the annual meeting of the Conference recently, **Mr. H. M. Harris** (T.M.C. Harwell (Sales), Ltd.) was unanimously re-elected chairman of the Conference for 1944, with **Mr. D. W. Barrett** (Smith's English Clocks, Ltd.) as vice-chairman. It may be noted that the members include: British Vacuum Cleaner & Engineering Co., Ltd. (Magneta Time Co., Ltd.); Ferranti, Ltd.; General Electric Co., Ltd.; Smith's English Clocks, Ltd.; Synchronome Co., Ltd.; and T. M. C. Harwell (Sales), Ltd. The secretary is **Mr. Felix A. Rogers,** 36 Kingsway, W.C.2.

TO THE READER.—If you do not file your copies, why not pass them on to one of your electrical friends in the Services?

COOKING AND HEATING NOTES

INFRA-RED PAINT DRYING

THE use of infra-red as a medium of industrial heating has undoubtedly come to stay. It is finding an increasing number of uses such as the drying of foundry moulds, drying of plastic powders for moulding and the softening of thermoplastic sheet. It is, however, in the drying of paints and varnishes that infra-red heating continues to find its greatest scope.

A typical installation is shown in Fig. 1, and is for drying paint on the insides and outsides of metal canisters. These canisters are component parts of important war equipment and are pressed from 0·048 gauge sheet steel. The canisters are placed in wire containers and completely immersed in a bath containing shellac-base paint. From there they are carried through the infra-red lamp heating unit on another conveyor and, in not more than two minutes, emerge perfectly dry, inside and outside, and ready to be packed for despatch. The drying time of the air-drying process originally employed occupied 45 minutes.

This paint-drying unit incorporates six trough reflectors, each containing nine Osram infra-red industrial lamps, and has a total power consumption of 13·5 kW. Each group of troughs on either side of the unit is "hinged" on a common spindle (Fig. 1) to facilitate cleaning of the reflectors and to provide easy access.

The infra-red plant shown in Fig. 2 is a part of a much larger G.E.C. installation specifically designed for drying paint inside and outside petrol containers. It consists of two plants and has a total loading of 504 kW and employs more than 2,000 lamps. The containers are first painted inside, placed on a conveyor and transported to spray booths situated at the entrance of the plant. The containers are then painted outside whilst still on the travelling conveyor and pass through the infra-red plants, which are 42 ft. long, and out at the other end, dry and ready for inspection. Compared with drying by convection oven, this represents a saving in time of about 22 minutes, and when one considers that some thousands of petrol containers pass through this plant every week, it will be appreciated what a considerable amount of time and space is saved.

Fig. 2. Large 504 kW Infra-Red Plant.

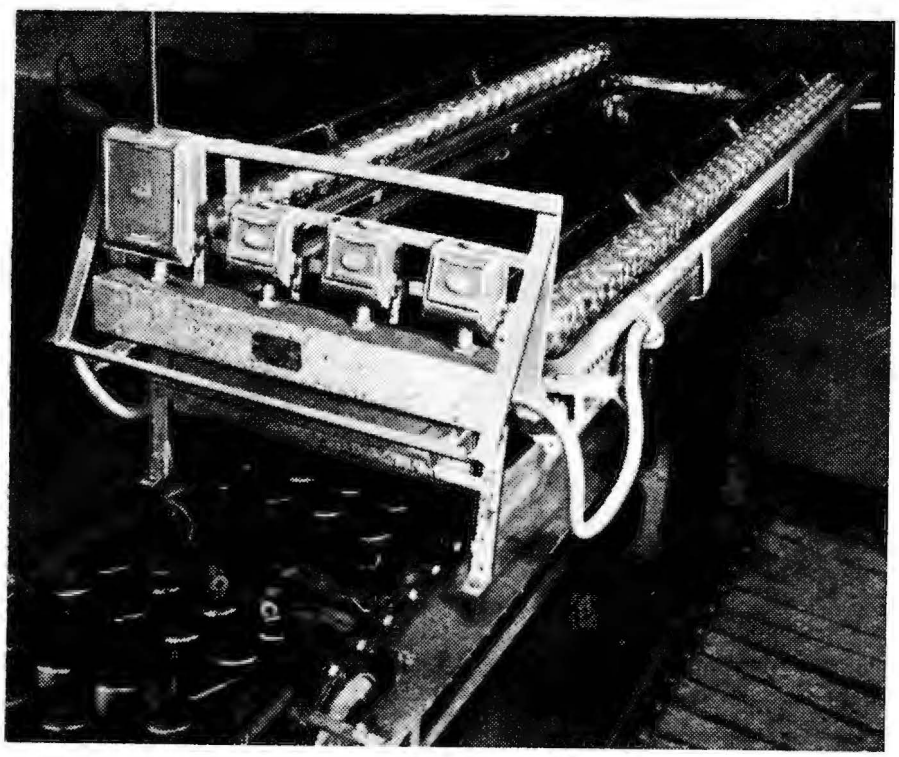

Fig. 1. Trough Reflectors are Hinged to Facilitate Adjustment.

In both installations, the trough type reflectors are rhodium plated, and the Osram infra-red industrial lamps are rated at 250 W. By using troughs an unbroken reflecting surface is provided and maximum efficiency is thus achieved.

HOTSPOT

LETTERS TO THE EDITOR

We cannot be responsible for the opinions and expressions of our Correspondents

Two-Part Tariff Revision

SIR,—The article on the above subject in your June 1 issue, by Installation Superintendent, was of interest as an illustration of a point of view held by many in the industry, and more particularly by those who are not themselves responsible for introducing or administering tariffs. Although a reduction in the number of tariffs in force would simplify the administration of our business, and might also bring certain limited advantages, I do not think it would increase the sales of electricity, and might quite conceivably have the reverse effect. Many of the tariffs now in existence were introduced to meet special needs by the more enterprising managements, and have contributed to the present satisfactory state of development of the industry.

In the first group of amended tariffs, your contributor brackets cooking, heating and motors. Surely he does not suggest that the same flat rate should apply to heating which may have a load factor well under 1%, and will almost certainly coincide with the undertaker's peak load, as the other types of load, whose characteristics are altogether more desirable?

I do not consider that he has been quite fair to the rateable value tariff, and has not regarded it in a sufficiently broad manner. This tariff has stood the test of time, having been in use nearly forty years, and probably 80% of municipal domestic consumers have elected, of their own free will, to be charged on this rate in preference to flat rates.*

It is conceded by most of those people who are acknowledged to be experts in tariff matters that it is not practicable to operate a domestic tariff which reflects with complete accuracy in all cases the actual costs of supply. The example cited by your contributor is not particularly well chosen, as a fixed charge of 12s. per annum is quite inadequate to cover the fixed costs incurred. This is an example of bad application, and the minimum fixed charge should, depending on costs, seldom be less than 30s. per annum. He cites the consumer with a £6 rateable value, and the same electrical consumption, as identical with that of a £35 rateable value consumer. In the first case the house frontage might be five yards, whereas in the second it would probably be 25 yards. It is obvious that the capital costs of a distribution system for a given number of large houses will be greater than for the same number of cottages built probably in rows.

If Installation Superintendent will give further thought to this problem he may come to the conclusion that the older generation of supply engineers had a greater degree of wisdom and business ability than his article would appear to indicate.

June 5. C. CAMERON KIRBY,
Engineer and Manager.
Alderley Edge and Wilmslow
Electricity Board.

* In our issue March 18, 1943, Mr. C. Cameron Kirby contributed an article, "The R.V. Tariff, M.D. and Equity," in which evidence was presented supporting the view that, in general, there is a definite relationship between rateable value of a house and costs of supply.—ED.

SIR,—The article under the above title in your issue of June 1 suggests a simple way of solving the tariff problem, but if an easy solution was possible on an M.D. basis, then it is a certainty that such a solution would have been found before now.

The example of a lighting consumer, which Installation Superintendent gives, with a declared minimum of 1 kVA demand, would pay 10s. annual charge plus a unit charge. Suppose 200 units were used at ½d. per unit, this consumer would pay a total of 18s. 4d. in a year. Such a small annual charge cannot be regarded as a sound business proposition.

Some difficulty would be found in convincing this lighting consumer that it would be to his advantage to install additional apparatus. What would Installation Superintendent use as an argument to try to hire out a cooker of 5 kVA loading? It would cost the consumer 50s. a year in fixed charge alone which, in most cases, would be considerably more than the hire charge.

Human nature being what it is, a consumer would try to keep his declared M.D. at a minimum, and problems would arise with the all-electric domestic consumer. What would Mrs. Brown have to say when she found that, through drawing a little hot water from the water heater, the thermostat had operated and increased the load, tripped the circuit-breaker and spoilt the family meal? A slight rise in volts might cause similar results. There would be many complaints from all types of consumers. We are still afraid of the maximum demand bogey.

June 5. B. CROWSLEY.
16 Longcroft Lane, Welwyn Garden City.

PHILIPS' DRAMATICS

The Accounts and Administrative sections of Philips Lamps, Ltd., located at Oxted, Surrey, since the beginning of the war, recently formed a Dramatic and Operatic Society. For their first performance they presented "Merrie England," and scored a success notable for the high level of the acting and singing revealed by the cast. The British Red Cross Fund benefited to the extent of £31.

PERSONAL

It is announced that **Mr. C. W. Salt,** the city electrical engineer of Carlisle for the past 25 years, is retiring.

Sir Felix J. C. Pole has been appointed a director of Power Securities Corporation to fill the vacancy caused by the death of Mr. William C. Lusk.

Mr. C. H. Downing and **Mr. H. A. O'Brien** have been appointed directors of British Electric Meters, Ltd.

Mr. D. C. Brook has been appointed a director of Balfour, Beatty & Co.

Cable & Wireless announce that **Mr. Albert Harry Ginman,** general manager in Canada, and president of the Canadian Marconi Company, has been elected a member of the Courts of Directors of the Company and of Cable & Wireless (Holding) Ltd., with the title of director resident in Canada.

Birthday Honours.—Among the Birthday Honours announced last week we note the following :—*Knight Bachelor,* **Hubert Stanley Houldsworth, K.C.,** Controller-General, Ministry of Fuel and Power; *Privy Councillor,* **James Chuter Ede,** Parliamentary Secretary, Board of Education, Past President of British Electrical Development Association and member of the London and Home Counties J.B.A.; *K.B.E.,* **Sir Purshottamdas Thakurdas,** chairman, Cotton Association, Bombay, and of Bombay Electric Supply & Tramways Co., and director of Tata Power Co. and associated companies; *C.B.E.,* **Frank Forrest,** lately chief engineer and manager, City of Birmingham Electricity Supply Department; **H. M. Mathews,** Electrical Commissioner, India; **James Kenneth Weir,** director G. & J. Weir, Ltd. **Lady Reading,** who is made G.B.E., was a former president of the E.A.W. *O.B.E.,* **Lt.-Col. C. R. Cooke,** Director, Line Construction Posts and Telegraphs, New Delhi; **A. Patterson,** manager, Bombay Suburban Electric Supply; **J. M. Dodds,** head of Research Department, Metropolitan-Vickers Electrical Co.; **G. S. C. Lucas,** head of electrical development section, B.T.-H. Co.; **Mr. F. T. Nurrish,** director, George Bray & Co., Ltd., Leeds. *M.B.E.* : **A. B. Cape,** engineering test superintendent, General Electric Co.; **R. E. Cox,** liaison officer, General Electric Co.; **G. W. Giffen,** works manager, Siemens Bros. & Co.; **J. G. Gillespie,** first electrician, M.V.; **R. H. Hacker,** managing director, Dynatron Radio, Ltd.; **F. Hall,** works manager, Superheater Co., Ltd.; **R. G. P. Helbing,** works manager, Standard Telephones & Cables, Ltd.; **C. J. Jones,** materials officer, electrical industry export groups; **E. J. H. Jones,** works manager, Associated Equipment Co.; **J. B. Kealinge,** manager, Clyde district, Chadburn's Ship Telegraph Co.; **T. H. Kinman,** head of radio section, British Thomson-Houston Co.; **I. Lipman,** manager, E. K. Cole, Ltd.; **F. C. Robinson,** manager A. C. Cossor, Ltd.; **F. Scott,** air raid precautions officer, North Eastern Electric Supply Co., Newcastle-upon-Tyne; **E. S. Blench,** superintendent welding and fabricating department, A. Reyrolle & Co.

Following the election of **Mr. Chas. W. Bridgen** to the board of Directors, the following appointments have been made on the Ferranti sales staff: **Mr. O. M. Robson** becomes general sales manager; **Mr. G. B. Proctor,** transformer sales manager; and **Mr. A. E. Prophet,** meter sales manager. Mr. Robson was educated at Clifton and Gonville and Caius College, Cambridge, where he graduated in the Mechanical Sciences in 1925. Since that date he has been a member of the Ferranti staff. Mr. Proctor joined the staff of the Ferranti Transformer Department in 1929 upon his having graduated B.Sc.Tech.(Hons.) at the Manchester College of Technology. Mr. Prophet had sea-going experience before he joined Ferranti's in 1920.

At the Rugby establishment of the English Electric Company, Ltd., **Mr. E. H. Vyse,** a member of the drawing office staff, on June 2 retired on pension at the age of nearly 74, after 59 years of service with the Company and its predecessor, Willans & Robinson, Ltd. In recognition of this exceptional achievement, Mr. Vyse was presented with a framed illuminated certificate expressing the appreciation and gratitude of the management and directors of the Company. It may be noted that a few weeks earlier, on the occasion of his golden wedding, Mr. Vyse was presented with a cheque subscribed by friends and colleagues in the Company. Mr. Vyse commenced an apprenticeship with Willans & Robinson, Ltd., at Thames Ditton in 1885, and was transferred to the Drawing Office some three years later. He moved to Rugby with the firm in 1897, and from that time has been responsible for handling all the Spares and Repairs orders passing through the Drawing Office.

Recently the British Electrical and Allied Industries Research Association advertised for a new director. We understand that it has been decided to make no permanent appointment at the present time, but **Mr. E. B. Wedmore** will be retiring about the end of December next. For twenty-four years, covering the entire period of the activities of the E.R.A., Mr. Wedmore has been its director. He has seen it grow

from the smallest beginnings, with a staff of two persons; to its present stage, with a personnel numbering 175 and an income of over £100,000 per annum. Those, who like ourselves, have watched the growth of the Association with close interest, know how largely its rise in importance is due to the remarkable fitness of Mr. Wedmore for the job and it will be difficult to imagine the E.R.A. without him; his successor will not find it easy to attain to the high standard he has set. It is regrettable that his retirement is due to health reasons. As from January 1, 1945, **Dr. Whitehead,** who has been assistant director of the Laboratories, will take up the duties of acting director of the Association, *pro tem.*; and **Mr. McMahon,** who has been assistant secretary, will, from July 1, take the position of secretary, and will be in general charge of the business side of the organisation under the director. In Mr. Wedmore has been seen the unusual combination of exceptional administrative ability and thorough scientific and practical knowledge; this has enabled him to keep a guiding hand on 22 research committees, with over 80 sub-committees—no mean feat. The field covered thus is very wide; research is undertaken for the manufacturing and supply sides of the industry, and through representative sub-committees is kept in close touch with the needs of the electrical and allied industries, with full pooling of knowledge and resources. As we all know, results of the first importance have been obtained, and in all Mr. Wedmore has been closely concerned.

Mr. T. H. Relton, who was Editor of *B.T.H. Activities* since its inception, and other B.T.H. publications, issued from time to time, retired at the end of May, after 33 years' service with the Company. Mr. Relton has been succeeded by **Mr. G. W. P. Page,** who has been connected with the advertising side of the Company for many years.

Obituary.—Briefly, last week, we announced the sudden death, on May 29, at the age of 41, of **Mr. Stephen Farmer,** Birmingham manager of Foster Transformers & Switchgear, Ltd. Mr. Farmer had many friends, among whom he was affectionately known as "Mick;" they may like to have his picture which we here reproduce, Mr. Farmer joined Foster's as branch manager in 1932; he will be much missed.

Mr. Stephen Farmer.

ELECTRIC SUPPLY NEWS

Londonderry.—The Derry Chamber of Commerce has instructed its secretary to convey to the Corporation "an expression of alarm" at the proposal of the Government to absorb the city's electricity undertaking in a proposed amalgamation scheme, and to point out that the Chamber, as representing the citizens, will support the Corporation in any steps deemed necessary to resist the proposal. The mayor (Senator Simmons) said it was proposed to reduce the Derry undertaking's status from a generating station to a distribution centre. The Corporation was much concerned at the proposal and had a committee dealing with it, and he thought it would take them all their time to retain the station's status. Another speaker said the Government was inclined to force amalgamation for the reason that it had landed itself with a white elephant in the shape of a huge generating plant, and in order to give it the appearance of a paying concern was going to try to wipe out all local centres of generation. The proposed lowering of the station's status would mean a serious loss not only to the rates direct but would also reduce local employment.

Merthyr Tydfil.—At present the electricity supply here is carried out by the Merthyr Electric Traction & Lighting Co. Councillor O'Driscoll, at a recent meeting of the Town Council's Public Works Committee, suggested that the Council should own the local electricity undertaking; he objected to the Company having sole right to supply electricity in the area; he thought Merthyr would get electricity cheaper if it ran its own undertaking. Ultimately it was agreed that the town clerk should submit a report showing the legal position of supply in the town.

Penrith.—The clerk to the Penrith Council has heard from the Mid-Cumberland Electricity Co. that electric light and power in the parishes of Ousby and Matterdale has been included in the Company's post-war development schemes.

Ulster.—A statement by the Northern Ireland Ministry of Finance shows that the principal and interest of a loan for £900,000 raised by the Electricity Board for Northern Ireland has been guaranteed by the Ministry. Guarantees amounting to £850,000 expired in the year ended March 31 last. Of the guarantees amounting to £2,400,000 in respect of loans raised by the Board £1,958,634 was outstanding at March 31.

TRAINING THE P.O. ENGINEER

IN April last year the P.M.G. appointed a committee to examine the question of the training of Post Office manipulative and engineering staff and to make recommendations. The Committee took evidence and amongst those who expressed their views were the Post Office Engineering Union. As this union represents some 47,000 workers in the minor non-clerical grades of the Engineering, Stores and Factories Departments of the Post Office, its evidence had a good deal of weight; the evidence submitted by this body is reproduced in a booklet now before us.

It is emphasised that there are dangers inherent in a system of training of which the sole aim is to provide a sufficiency of highly skilled technicians but stimulates no interest in wider fields of human activity. Therefore every encouragement should be given to further general education.

Recent advances in tele-communications have created a demand for entrants with a higher standard of knowledge than hitherto. Other points are: young workers should take part in the industrial, social and political life of the community; an accepted standard of attainment for entrants is required, temperamental fitness is desirable, pay and status of instructors is too low, training is too intensive for growing lads—a 40 hour week and no evening study should be introduced. Training in administration should be given, and a Departmental Training Committee set up; it should also be concerned in youth welfare.

SPENBOROUGH C.D. COMMUNICATION VAN

SINCE the outbreak of war, Spenborough, like many another place, has found that a weak link in its organisation is the vulnerability of communications. Councillor Ben Bentley, M.B.E., of the Spenborough Urban District Council, put his thinking cap on to overcome this difficulty. The result was the view that, with a communication van, with a trained crew, existing services could be either supplemented or in emergency essential communication be restored without delay. He approached several local business men as to funds for such vehicle, and the result was highly successful. A 1½-ton lorry was presented by S. Law & Sons and adapted for the purpose; it has also a special trailer. The Electricity Committee of the Council naturally played its part—it installed the special equipment necessary to turn a very efficient van and trailer into a complete communications unit—the apparatus for this purpose was put in under the direction of the Council's electrical engineer and manager, Mr. C. Booth, and his staff. They did a good job, for the van provides a complete telephone exchange system in miniature, communication by portable telephones wired for point-to-point operation, inter-communication with the G.P.O. system, medium and long wave broadcast reception and short wave radio transmission, loudspeaker amplification.

PARLIAMENTARY

Fuel Restrictions.—Commander Locker-Lampson, on June 6, asked the **Minister of Fuel and Power** whether the recent cut of 10% in electricity and 25% in gas applied to publications and their printing; and why printers of Government papers and city circulars bore this burden alone. **Major Lloyd George** replied that the cuts in industrial consumption of electricity and gas were not being applied to the printing of newspapers. They were being applied to all other printing but, on application by firms concerned, were relaxed to such extent as to enable the production of periodicals to be substantially maintained, and to safeguard essential Government printing.

Domestic Electricity Supplies.—On June 6 also, **Sir W. Smithers** asked the Minister of Fuel and Power why electricity for all domestic purposes, and especially for the new houses, was not being made available to all at reasonable cost. **Major Lloyd George,** replying, said electricity charges in new houses could not be considered apart from charges to domestic consumers generally. Revision of such domestic tariffs raised very important questions affecting the finances and organisation of the whole of the Electricity Supply Industry, and could only be undertaken as part of a reorganisation of the industry in the post-war period. The question how far such reorganisation was necessary was at present before the Government.

Colonial Radio and Telephones.—Speaking in the debate on Colonial Affairs on June 6, **Capt. Peter Macdonald** (I. of W.) expressed the hope that every encouragement would be given to private enterprise in our Colonies. The radio development in the Colonies was at present deplorable; radio was not getting into touch with the people at all; those who had the money were able to get programmes from S. American, German and Spanish sources, but not from home. Then there was cable and wireless development—what was being done for the development of the Colonies? There was also widespread need for the development of the telephone. All these things must be got on with soon, and we should have a Colonial Development Council or board sitting permanently to survey these schemes, co-ordinate them, sift them, and make sure they were carried out and that there was continuity of policy, whether or not there was a change of Government. Another speaker urged the need for technical training of men to carry out Colonial public works.

D.I.E.E.—Sir H. Williams asked the Minister of Supply whether Mr. S. F. Steward, the director of industrial electrical equipment, was resigning that position in view of his appointment as a director of E. R. & F. Turner, Ltd. **The Minister of Supply (Sir Andrew Duncan)** said No. Mr. Steward's connection with E. R. & F. Turner was not incompatible with his official duties, and the Ministry would continue to have his full-time services.

Public Utility Accounts.—Mr. Alfred Edwards asked the **Minister of Fuel and Power** whether he would remove the ban on the publication of accounts of electricity and gas companies; and, if not, what were the reasons for continuing the ban. **Major Lloyd George** said the ban was imposed for reasons of security, which he was advised still existed.

NOTES AND NOTICES

"Salute the Soldier"

During the Woking "Salute the Soldier" week which ended on June 5, the Woking Electric Supply Co. staged in its extensive showrooms, Chobham Road, Woking, a fine display of military equipment and A.A and field guns, part of a "Valentine" tank, a predictor, with all its instruments, scientific apparatus for gun and aircraft location, field and tank wireless, and a number of original moving side shows made by the Company's staff were the means of raising a considerable sum of money, to be handed over to Army charities. Many thousands visited the exhibition.

Boston also has been enthusiastic in pushing the "Salute the Soldier" Campaign. Amongst those who have been particularly helpful is Mr. Harry Payne, manager of the Boston Electric Supply Co. The local press calls him a real live wire, and so he is, as former electricity development campaigns have proved.

Lighting Reconstruction

The fourth of a series of pamphlets issued by the Illuminating Engineering Society on lighting reconstruction topics has just made an appearance. Its title is "Natural Lighting," and this pamphlet, like the preceding ones, should prove of service to Government departments, local authorities, borough engineers, architects and others concerned with lighting problems of the future. Lighting Reconstruction Pamphlets Nos. 1 to 3 deal respectively with "Principles of Good Lighting," "The Lighting of Public Buildings" and "The Lighting of Schools"—all of them are obtainable at a uniform price of 1s. each, or special prices for quantities.

Women Welders Build Bridges

In the B.B.C. North American Service are British-American "bridge of understanding" programmes. In one such programme lately, women welders from a South of England works (whose name, were we sufficiently indiscreet to mention it, would be known to all electrical men) took part. They went to the studio straight from the factory—in their overalls and head-protective caps which they wear at work. Their names were Mrs. E. Seymour, Mrs. G. Roles, Miss D. Nason, Mrs. I. Perkin and Miss A. Taylor—the compère, Mr. N. Stuart.

Welding the Bridge.

Transformers Order

The Board of Trade has published an Order (S.R. & O., 1944, No. 643—price 1d., H.M. Stationery Office) which, as from June 7, 1944, revokes the Electrical Transformers Order, 1943 (S.R. & O., 1943, No. 1353), and thus removes the restrictions imposed on the manufacture of certain descriptions of electrical transformers.

A.S.E.E. Prize Papers

At the meeting of the Association of Supervising Electrical Engineers this week the three winning entries of the Branch Papers Competition were read by their authors. **Mr. J. S. Smith** dealt with the high frequency furnace as applied to the manufacture of steel. The special problems which arise were described and the principal advantages were listed. Static electricity gives rise to difficulties in many different classes of industry and these were referred to by **Mr. W. T. Partington** in his paper. Precautions that have to be taken under different circumstances were described. A paper of wider interest was that by **Mr. S. H. Harding,** giving a comparison of starting methods for three-phase squirrel-cage motors. This discussed the effect of the different methods on starting characteristics, and a useful summary was given in tabular form, which is reproduced on p. 695. The first prize was awarded to Mr. Harding, the second to Mr. Smith and the third prize went to Mr. Partington.

Well Shot, Everett Edgcumbe !

The results of the third annual competition organised by the Society of Miniature Rifle Clubs and open to all Home Guard platoons in the country, were recently announced; the winning team is one composed entirely of employees of Everett, Edgcumbe & Co., Ltd., and is from the Works Platoon. It is of interest that the same platoon were runners-up in the same competition last year, and this year, as winners, made a score of 982 out of a possible 1,000. As last year, the number of teams entered for the competition was upwards of 2,500.

W.E.S., Manchester

The annual meeting of the Manchester Branch of the Women's Engineering Society is to be held to-day (June 15); after the formal business there will be a discussion on "Household Equipment—the Engineers' Point of View," and Mrs. Crispin (A.I.D.) will give an introductory talk on "Electrical Equipment." At the meeting of the Society on May 15, Mr. G. L. Leighton, of the Met-Vickers Meter Department, spoke on the subject of "Electric Circuits—Faults and Protection."

Limitation of Supplies

The Board of Trade calls attention to the fact that supplies of second-hand lighting fittings and re-covered lampshades are subject to the quota restrictions imposed by the Limitation of Supplies (Miscellaneous) (No. 22) Order, 1944, S.R. & O., 1944, No. 60, Lighting Fittings, on persons registered in Class 9b. Moreover, the re-covering of lampshades is considered to be a process of manufacture, and accordingly an authorised unregistered manufacturer must include the value of shades re-covered and supplied by him in his permitted total of £100 per month; an unregistered person who was not, on December 1, 1941, carrying on a business of supplying controlled goods of Class 9b manufactured by him may not supply shades re-covered by him.

I.E.S., Birmingham Centre

At the general meeting of the Birmingham Centre of the Illuminating Engineering Society, on June 2, officers elected for the next session were:—*Chairman,* **Mr. J. G. Holmes, A.R.C.S., D.I.C.**; *vice-chairman,* **Mr. C. F. Partridge, M.I.E.E.**; *treasurer,* **Mr. F. F. Middleton**; *hon. secretary,* **Mr. C. J. Allderidge.** On this occasion the Hon. Secretary of the Society, **Mr. J. S. Dow,** attended and gave an interesting address on the "History and Aims of the Illuminating Engineering Society."

ELECTRICAL COMPANIES

Dividends.—*Bridgwater & District Electric Supply & Traction Co.*—Dividend of 6% on ordinary shares for 1943.

Electric & General Investment Co.—Final dividend of 7%, less tax, making 10% for the year ended May, 1944.

R. A. Lister & Co.—Interim dividend of 5%.

Ever-Ready Company (Great Britain).—At this meeting Mr. Magnus Goodfellow's statement (circulated with the report) said there was a small increase in profit after providing for E.P.T. and deferred repairs to the factories. Two important matters have been settled during the year—the ascertainment of the depreciation on buildings, plant, etc., under war conditions, and to the settlement of E.P.T. The settlements had depleted the reserves by £368,000 ; to meet the charge £178,000 had been transferred from the year's profits, contingencies reserve reduced £130,000, and the balance from general reserve £60,000. These transactions enabled them to go forward with a clear knowledge of the financial position. It should be noted that the expenditure of £992,000 on buildings, plant and establishments referred to in the report had been provided entirely out of their own resources, and that the liquid financial strength improved during the year, net current assets having risen from £1,000,000 to £1,220,000. The business again achieved a substantial increase in production, but this increase was not available for civilian consumption, supplies so available being approximately the same in quantity and price as in the previous year. Post-war prospects were favourable ; the change-over to peace-time requirements would not take any considerable time. Renovation of plants would be a costly matter, but service to the public should be quickly available in increased quantity and many improvements in design.

BUSINESS ANNOUNCEMENTS

Continued from page 700

COMMERCIAL INTELLIGENCE

LONDON GAZETTE

Intended Dividends

Brighton and Lewes.—Casselden, Horace Charles, 67 London Road, Brighton, trading as Edwards & Son, radio, electrical and musical instrument dealer. Last day for receiving proofs, June 20. Trustee, Mr. A. E. Orbell, 6 and 7 Old Steine, Brighton.

Adjudication

Liverpool.—Taylor, Frank, 4 Mercer Court and 46 Fenwick Street, Liverpool, electrical and general contractor. Date of order, June 7.

Application for Discharge

High Court of Justice.—Berners, Irene Florence, and Berners, Charles Joseph, trading as Major Manufacturing Co., at 98 Great Tower Street, E.C., battery manufacturers. Date of hearing, June 27.

Bankruptcies

Michael Skulnick, 83 Wellesley Court, Maida Vale, W.1, battery manufacturerer. The first meeting of creditors was held recently. The only proof of debt was for £219 claimed by Mr. L. Fabian, the petitioning creditor. That was stated to be the only liability, and no assets were disclosed. Debtor started business on his own account in 1938, as Hydrolux Manufacturing Co., dealing in water softeners, and in December, 1940, he added a battery business at Stanhope Street, N.W. He sold that business in July, 1943, to a company, for £1,200. He attributed failure to the adverse result of a law action. Mr. Percy Phillips, accountant, London, W., was elected trustee to wind up the estate.

Princely Battery Co., Ltd., 99-103 Fonthill Road, N.4. First meetings of creditors and contributories under this compulsory liquidation were held recently. The company was formed in April, 1941, to make and deal in electrical batteries and accumulators. The issued capital was £95. The only director was Mr. Shri Paul Chandra Jaina, who had carried on business as a merchant in electric batteries for some time before the formation of the company. Most of his purchases had been made from the Victor Battery Co., Ltd. He stated that he formed the company as he experienced difficulty in trading as an individual, and he gave it the name of Princely, by which his batteries were known to the public. In September, 1943, he purchased the undertaking of the Victor Battery Co. for £15,000, and an arrangement was made for the Victor Co. to supply this company with batteries at a special discount of 25% until the purchase price was satisfied. The failure of the Princely Battery Co., Ltd., was attributed to the fact that the Victor Co. was unable to carry through the arrangement. No particulars transpired regarding the liabilities or assets, and the liquidation was left in the hands of the Official Receiver.

CONTRACTS CLOSED OR RECOMMENDED

Where it is stated that tenders are accepted by a Committee it will be understood that this is subject to confirmation.

WEST HAM.—Accepted by Social Services Committee: **Lancashire Dynamo & Crypto Co.,** electric mixing machine, £160.

PRESTON.—Accepted by Electricity Committee: **British Insulated Cables, Ltd.,** 33 kV cable.

HULL.—Accepted by Telephone Committee: **Bullers, Ltd.,** insulators, £299 16s. 3d. Accepted by Electricity Committee: **Aiton, Ltd.,** renewal of condensate balance mains; **Metropolitan-Vickers Electrical Co.,** reactors, £7,800.

PETERBOROUGH: Accepted by Electricity Committee: **British Electric Transformer Co.,** transformers, £333.

WOOLWICH.—Accepted by Electricity Committee: **Babcock & Wilcox,** stoker links, £168.

PROSPECTIVE BUSINESS

The information given below is compiled from various sources, and while every care is taken to see that it is accurate no responsibility is taken.

Accrington.—Conversion of two shops, Water Street, to houses for Co-operative Society.

Coventry.—Temporary school for T.C. Builder, J. Daniels, Coventry.

Devizes.—Dining-room and kitchen, Secondary School.

Dutton.—Nurses' quarters at P.A. Institution for Cheshire C.C.

Ealing.—Conversion of 15-17 Culmington Road for day nursery.

Hampton.—Canteen kitchen at Grammar School.

Hastings.—Reconstruction of Priory Road senior boys' school.

Heston and Isleworth.—Reconstruction of premises, Williams (Hounslow), Ltd.

Huntingdon.—School meals kitchen at Ramsey Forty Foot, for County E.C.

Kimberley.—Central kitchen, for Notts C.C.

Liverpool.—Extensions to nurses' home, Fazakerley Sanatorium.

Macclesfield.—Conversion of "Sutton Oaks" to home for aged persons for Cheshire C.C.

Market Drayton.—Ward block at Sanatorium for Cheshire Joint Sanatorium Board. Builders, A. V. Shenton, Ltd., Longton.

Middlesbrough.—Kitchens at eleven schools.

Newcastle-on-Tyne.—Conversion of shops and houses for dwellings, for T.C.

Salford.—Prefabricated hut at Grammar School. Builders, E. B. Jones & Rawlinson, Ltd., Salford.

Scarborough.—Adaptation of premises, Melrose Street, for school kitchen.

South Shields.—Rebuilding Laygate Lane infant school.

Twickenham.—Canteen kitchen, etc., County School for Girls.

Widnes.—Conversion of shop premises, Ann Street West, to dwellinghouses for J. Laveric.

Wisbech.—Boiler house at Institution, for Isle of Ely C.C.

TRADE MARK APPLICATIONS

Amongst recent applications for British trade marks are the following. This information is extracted from the Official Journal by permission of the Controller.

R. & T. (in circle). 627424. Class 9. Scientific, electrical, etc., apparatus and instruments. Ronald Trist & Co., Ltd., Bath Road, Slough.

Cemdu. 627962. Class 9. Electrical instruments and apparatus. Carlisle Electrical Manufacturing Co., Bentcliffe Works, Salters Lane, Eccles.

Latralok. 627963. Class 9. Electrical instruments and apparatus. Carlisle Electrical Manufacturing Co., Bentcliffe Works, Salters Lane, Eccles.

Plastalux. 627859. Class 11. Electric lamps and lamp fittings. E. K. Cole, Ltd., Green Park Hotel, Aston Clinton, Bucks.

MEETINGS TO NOTE

June 17.—Association of Mining Electrical and Mechanical Engineers, Yorkshire North-West Branch. — "Colliery Cables — Manufacture, Maintenance and Performance," R. F. D. Milner and J. R. Cox.—Wakefield Technical College.—3 p.m.

June 21.—Institution of Heating and Ventilating Engineers.—"Vertical Temperature Gradients in Factory Buildings Heated by Unit Heaters" (Discussion).—Institution of Mechanical Engineers, Storey's Gate, S.W.—6 p.m.

June 22.—I.M.E.A.—The annual general meeting, which was to have been held on this date, is postponed, *sine die.*

June 22.—I.E.E. Formal meeting to submit candidates for election and transfer.—Savoy Place, W.C.2.—2.30 p.m. Ballot meeting on July 6, 2.30 p.m.

June 22.—I.E.E., Devon and Cornwall Sub-Centre.—"Standardisation of Motor Dimensions," H. Marryat.—Royal Clarence Hotel, Exeter.—3 p.m.

June 24.—Commercial Travellers' Benevolent Institution.—Half-yearly Court of Governors.—4b Frederick's Place, Old Jewry, E.C.2.

NOTES AND QUERIES

We are constantly receiving inquiries from readers on all sorts of matters. Technical questions are dealt with in Electrical Plant Problems and by Megohm. Most questions we are able to answer right away by letter or telephone, but occasionally we are at a loss. We shall be pleased to insert questions of this kind under the above heading in the hope that readers possessing the information will assist in the solution. Publishers' names are in brackets. Where samples are sent which it is desired should be returned the cost of postage must be prepaid.

(13466) **"Spartovac" vacuum cleaners,** address for repairs? W.S.C.—Solectric, Ltd., 13 Oakington Parade, Wembley.

(13467) **"Davenset" battery chargers, etc.,** makers of? G.S.P.—Partridge, Wilson & Co., Ltd., Davenset Works, Evington Valley Road, Leicester.

(13468) **"Mary Ann" vacuum cleaner,** address for repairs? W.K.R.—Thorn Electrical Industries, Ltd., 64 Jersey Street, Ancoats, Manchester.

(13469) **"Reliance" electric steriliser,** makers of? G.—Surgical Manufacturing Co., Ltd., 9 New Cavendish Street, W.1.

(13470) **Incinerators, electric,** makers of? B.—Jackson Electric Stove Co., Ltd., 143 Sloane Street, S.W.1; Archibald Low Electrics, Ltd., Newarthill, Motherwell.

(13471) **"Abney" pocket level,** suppliers of? L.D.—E. R. Watts & Son, Ltd., 123 Camberwell Road, S.E.5.

(13472) **"Moffat" cooker,** makers of? S.E.—W.—Moffats, Ltd., Blackburn, and 1 Beaufort Gardens, N.W.4.

(13473) **"Thermaglo" immersion heater,** makers of? S.E.—W.—British Quain Sunlight, Ltd., 3 Woodhouse Road, North Finchley, N.12.

(13474) **Institute of Physics,** address of? W.—Temporary address: The University, Reading.

(13475) **Burgess Products Co., Ltd.,** address of? M.A.P.—B.—Hinckley, Leics.

(13476) **"Kenray" fire,** makers of? N.E.L. & P.—Archibald Kenrick & Sons, Ltd., 65 Newman Street, W.1.

(13477) **"Catterex" fires,** makers of? C.W.—S. P. Catterson & Sons (1935), Ltd., Globe House, Duke Street, Liverpool.

Further Answers

(13436) and (13442) **"Abney" pocket level,** name of suppliers? We understand the firm that we gave in our previous answers are unable to supply. Try E. R. Watts & Son, Ltd., 123 Camberwell Road, S.E.5, or J. Halden & Co., 8 Albert Square, Manchester.