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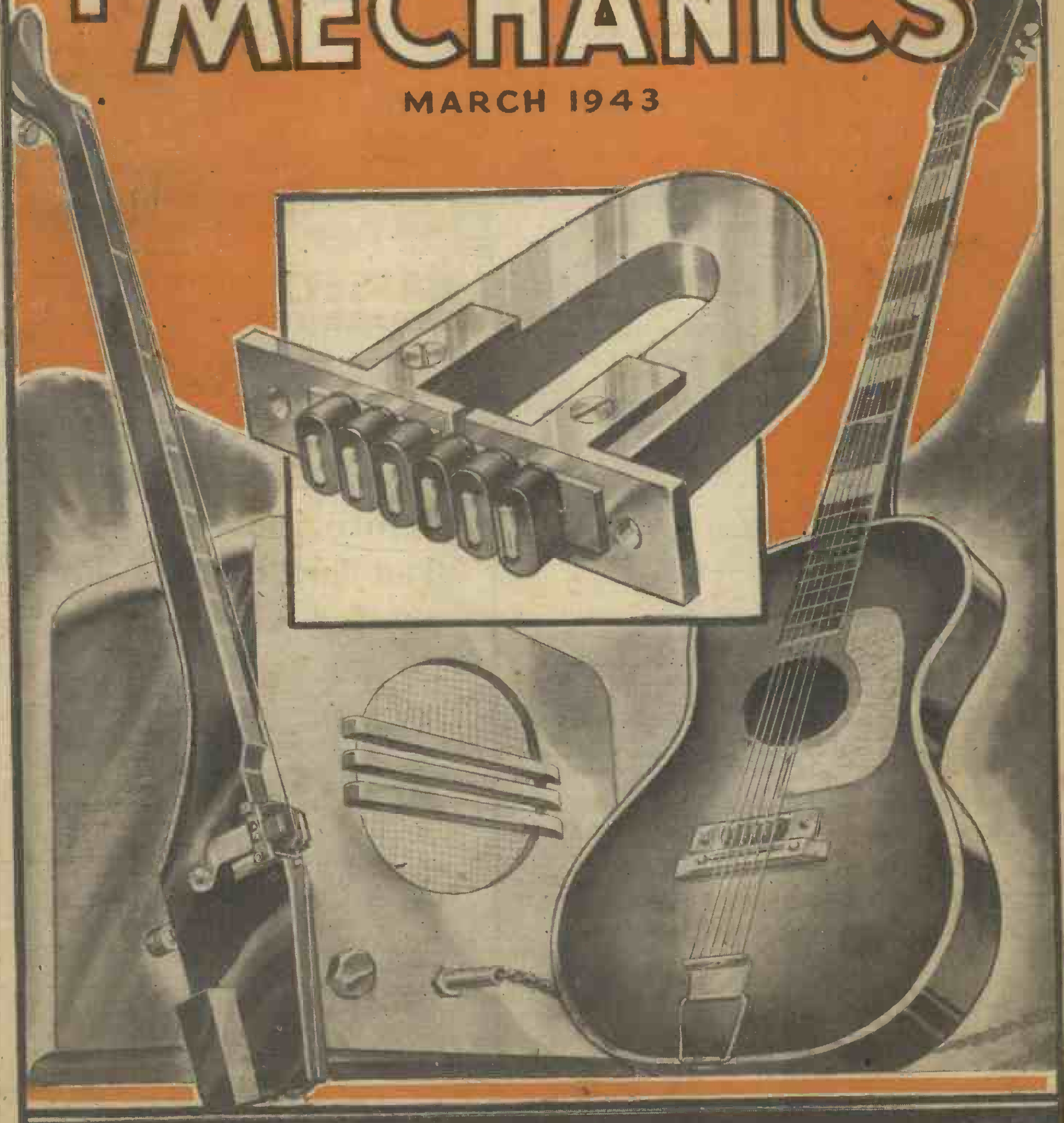

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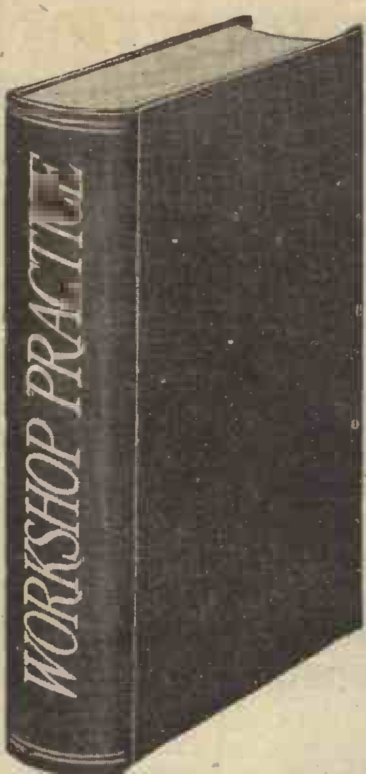

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Owing to the paper shortage "The Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

Editor : F. J. CAMM

VOL. X. MARCH, 1943 No. 114

FAIR COMMENT——BY THE EDITOR

Office Aid to the Factory

THE office worker does not always feel that he is a part of the war effort, yet he is just as essential as the machine operative, the designer, and the draughtsman. His job is to see that the factory works smoothly, that documents are available without waste of time, that tools are returned to the stores, and the factory records generally accurately kept, and accurately analysed. His job is to present in a visual form a cross-section of the position of the factory at a given moment, so that bottlenecks can be spotted and remedial measures adopted. There are so many office systems, however, that a skilled clerical assistant used to one system finds when he takes on a new job elsewhere that he has to start again, because most factories adopt their own system. Some of these systems are evolved by the accountants.

Numerous books and articles have been written on the subject of system, and the organisation of office routine, but no one has yet standardised a system which would be acceptable to all factories. Engineers have standardised everything but routine. I am glad, therefore, to note that the British Standards Institution are tackling the problem, in conjunction with the Ministry of Production. They have published a booklet which deals with the work of the Institution, and with various aspects of the ways in which factory offices can assist production. Considerable importance is ascribed to the efficient organisation of the offices and factories engaged on war production. The vast change in the volume and nature of the country's industrial production during the war has brought with it many problems. One which bears heavily upon factory output is that of obtaining from the clerical administration the greatest possible aid to factory production, a problem rendered more acute by the depleting of staff as well as by the increased work occasioned by the filling in of forms and documents necessary to meet the requirements of a number of Government departments.

Recommendations

In view of its close association with industry, the British Standards Institution was requested to inquire into this matter, although the problems involved were somewhat outside its usual sphere. Accordingly, the Institution held a conference, at which it was decided to set up a committee which would make recommendations on the most appropiate procedure, designed to promote simplification and greater efficiency in the clerical side of works production and organisation. The committee, through expert sub-committees, has, in course of preparation, a number of booklets; the following are among the subjects which will be dealt with in them: Factory production control methods, costing systems, industrial purchasing, store-keeping, receiving, despatching, invoicing, pay roll methods, and office practice and organisation.

The principles set out in these booklets will be familiar to large and well-organised firms, but the majority of the works in this country are small units, and it is to assist these in particular that the booklets are being issued. Their object is to bring to the attention of those engaged in the management of productive engineering enterprises, those methods which are generally considered to be the most efficient in dealing with the clerical side of works production and organisation.

Principles

It might at first appear difficult to make proposals which would be equally applicable to large and small establishments, but the principles involved are the same. Principles are therefore defined and a choice of practices given to suit varying needs. The object is towards simplification of the work involved. It will be demonstrated how the introduction of an efficient system tends to remove obstacles to smooth and efficient working. The essence of efficient manufacture is orderly administration, which has given rise to the science of production control. Muddle is the fifth column in the factory. Experience has shown that inadequate planning and organisation in factories results in delaying, confusion and consequent inability to deliver by the promised dates. Other results springing from the same cause are the overloading of some machines while others stand idle, as well as the sudden discovery of shortage of stock. Ways will be suggested of eliminating the overlapping of effort, and inaccuracies and inadequacies of clerical records.

In regard to costing it is recognised that no uniform system would be suitable for all factories. Identical principles should, however, be generally applicable. It is essential in every efficient factory that the raw materials required shall be available at the right time, in the right quantity and quality. Methods will be suggested indicating how practices recommended for small firms may be amplified for adoption by larger ones. In any well-managed factory it is essential to ensure that proper provision is made for the receipt of goods ordered as well as for the prompt payment for them. When goods have been produced and orders fulfilled they should be promptly despatched and invoiced, and the whole transaction from order to delivery completed as expeditiously as possible.

The information essential to put into operation any system of production control should be prepared in a form which makes comparison easy and rectification comparatively simple. For example, recommendations are to be made for the recording of machine utilisation, to show how many hours each machine is kept working, how many hours it is idle, and the number of hours lost through breakdown. This and similar essential information, and the method in which it can be most effectively recorded, are to be disclosed.

Of course, the most perfect system in the world breaks down if it is operated by unskilled or lazy office staff. Whatever system is introduced should, therefore, be simple, so that it requires little skill, and may be operated by the unskilled office staff which is now replacing the skilled, and will go on replacing it until the war is over. We must avoid system for the sake of system. Some firms have large staffs employed in keeping the system going—filling in unnecessary forms and compiling unwanted statistics. Some of these so-called "office systems" are costly to buy.

Pay Rolls

The wages of the whole labour force of the country have to be paid every week, promptly and accurately. The method of preparing pay rolls varies according to the size of the factory, and the degree to which office machinery is installed. One of the factors which complicates the preparation of a pay roll is the large number of deductions which have to be made from wages every week. On an average about 14 deductions, compulsory or voluntary, are made from industrial workers' wages every week. In one large undertaking it is known that there are 73 possible deductions from gross wages. Many companies engaged in engineering production appreciate the importance of the clerical sections of their organisations. They are not regarded as necessary evils or dispensable necessities. As a result methods have been developed which are likely to produce the best results from the point of view of economy in labour and the ready availability of required information. It is suggested that in every factory there should be, depending on its size, either an individual or a committee whose duty it would be to study the whole subject of organisation and methods in the light of the information which will be gathered from these booklets. The booklets will be on sale at 6d. each, post free. Remittances should not be sent until their publication is announced, but the address of the British Standards Institution is 28, Victoria Street, London, S.W.1.

A Synchronous Electric Clock Motor

Construction Details of an Interesting Clock Conversion

By L. F. ROWE

Fig. 1.—The original motor compared in size with a penny.

THE clock motor forming the subject of this article was originated through the desire to build a unit suitable for operation direct from the mains, and comparable with the commercial article in accuracy of timekeeping, dimensions, and current consumption, but at the same time capable of being constructed with a few simple tools such as are found in the kit of any handyman, plus a reasonable amount of skill and patience.

The motor is described exactly as built, although it is not suggested that the design or method of making are perfect or most suited in every detail to "home production," but no doubt the reader attempting construction of the motor will effect such modifications as will tend to simplify construction, according to the equipment at his disposal.

An important difference between clocks of the synchronous motor type and those of the spring-driven type, which is of distinct advantage, lies in the fact that in the latter the clock drives the regulating mechanism, i.e., pendulum or balance wheel, whereas in the former the regulating mechanism (in this case the motor) drives the clock. The spring-driven clock has the motive force—capable of exerting considerable torque—applied at the beginning, i.e., the "slow" end of the gear train. The resultant motion is then geared up and regulated to the correct speed by an escapement mechanism of one form or another at the "fast" end of the train. Due to the high ratio between the ends of the train the torque available for operating the escapement is extremely small, and in order to avoid errors in the timekeeping of the clock it is essential that the escapement be constructed with a high degree of precision. Fortunately, the synchronous motor type of clock is free from this advantage as the regulator, i.e., the motor, supplies its own driving torque, the power necessary for this being available in virtually unlimited quantities and hence accuracy of workmanship is not such a vital factor.

Small Torque

Actually, due to the high ratio of the gear train, the torque required from the motor is extremely minute and may be ignored, the main load consisting of its own friction. The one accurate feature required is a truly uniform speed of rotation, which in the type of motor described, is fixed by the design and happily is not dependent on the precision with which it is constructed; in fact, a surprising amount of latitude is permissible without any marked ill-effect on the operation of the motor. In electric clocks of this type the really accurate part of the job is, of course, supplied ready for use by the electricity undertaking in the shape of time-controlled alternating current mains (the clock motor merely serving as a means of keeping the clock in step with the supply alternators), a fact for which the home mechanic, lacking the facilities to produce precision work, may be duly grateful.

Fig. 2.—Showing how the motor is mounted in the clock case.

The original motor is shown in Fig. 1, which illustrates the diminutive size of the unit. Although it was made entirely without the use of a lathe its performance came fully up to expectations, the speed being absolutely constant and the current consumption, on 230-volt mains, less than half a watt. The dimensions were kept as small as practicable so that it could be conveniently accommodated in the case of an existing clock of the spring-driven type, the "works" of which had ceased to function with any degree of reliability. This was accomplished simply by removing the spring and its associated gears and pinions, together with the balance wheel and escapement mechanism, leaving a continuous train of wheels between the hands and the wheel immediately preceding the escapement wheel. The escapement wheel having specially shaped teeth is useless as a gear wheel. It is, of course, essential to have the correct ratio between the rotor of the driving unit and the spindle driving the hands, and it was found necessary to increase the ratio of the existing train by the addition of two further stages of reduction.

The motor was mounted on a simple bracket screwed to the side of the clock frame, in such a position that correct meshing was obtained between the pinion on the rotor spindle and the last wheel of the train. The arrangement is shown in Fig. 2, which illustration also shows the additional gearing which is mounted between brass extension brackets screwed to the existing side plates. The clock thus converted keeps perfect time and is highly satisfactory. The pinions carrying the hands are driven via the usual friction device, and due to the high torque (as compared with that normally available to an escapement) and the higher gear ratio, the clock now possesses the advantage that the position of the hands can be adjusted either forwards or backwards by the normal adjusting knob without stopping the motor. This feature is of great assistance when setting the clock to a time signal. For the benefit of readers wishing to fit the unit to an existing clock on the lines described above, details are given later concerning the selection of suitable wheels for the additional gearing.

Principle of Operation

For those who are not familiar with the principle on which this type of motor works this may be briefly explained as follows. The motor is of the "phonic wheel" type, one of the earliest and most simple types of synchronous motor devised. It consists of a toothed soft iron disc, or rotor, free to rotate between soft iron pole pieces, each having teeth similar in size and spacing to those on the rotor. The pole pieces form part of the stationary magnetic circuit, or stator, at the centre of which is a coil for supplying the necessary energy. On energising the coil from an alternating current supply, an alternating magnetic flux is set up in the iron circuit, and flows from one pole to the other via the rotor, reversing its direction in sympathy with the frequency of the supply. If at the instant of switching on the current the teeth of the rotor and pole pieces are not exactly opposite, the magnetic flux, by virtue of the fact that it always takes the path of least resistance, decreases the air gap between poles and rotor by pulling the teeth into line.

A torque is thus set up in the rotor which, however, is reduced to zero immediately the two sets exactly coincide, since any further movement of the rotor beyond this point would, of course, increase the air gap, resulting in a torque being set up in the opposite direction. In consequence, once the rotor has been pulled into line with the pole teeth it is retained in this position. If, however, the rotor is caused to revolve by an externally applied torque, at such a speed that between each of the magnetic impulses caused by the alternating current the rotor is able to move exactly one tooth forward, it will continue to revolve at this speed when the externally applied torque is removed. This is due to the

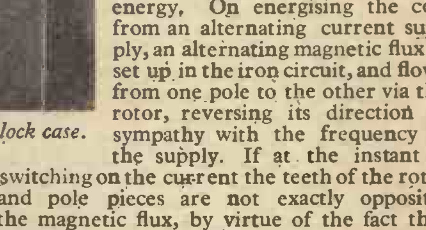


Fig. 3.—Modification to gear train.

fact that at this particular speed, i.e., the synchronous speed, the period when the rotor teeth are midway between the pole teeth coincides with the period when the magnetic flux is zero and thus no torque is exerted on the rotor at this point and its inertia is allowed to carry it towards the next tooth. As the mid-position is passed and the next tooth is approached the magnetic flux is growing in strength, the resulting torque imparting further energy to the rotor. The flux strength reaches its maximum when the teeth are again in line, and as it begins to diminish the rotor is again carried forward by its inertia to the next midway position, the process then being repeated. This cycle of events is continued so long as the alternating current supply is connected to the coil and affects simultaneously as many teeth on the rotor as there are on the pole pieces. Thus the rotor continues to revolve in step with the magnetic impulses at the rate of one tooth per impulse.

A few moments' consideration will show that it is impossible for the rotor to revolve at any other than the synchronous speed. If the speed were less than synchronous the magnetic impulse would be increasing in strength *before* the rotor teeth had reached the midway position and there would be a tendency for them to be attracted back to the pole teeth they had just left, i.e., the torque would act in the reverse direction. This effect increases with each impulse, as the lag of the rotor behind the impulses is cumulative and within the space of a few impulses the reverse torque is sufficient to stop the rotor. Similarly, if the speed is greater than synchronous the rotor teeth pass the pole teeth before the magnetic impulse attains its maximum strength and are attracted back, setting up a reverse torque and eventually stopping the rotor as before. Theoretically it should be possible for the rotor to revolve at a multiple of the synchronous speed, but this can only occur if the field is sufficiently intense to give the necessary torque, and can be avoided by the use of a suitable energising coil.

Speed of Rotor

From the foregoing it will be appreciated that the synchronous speed in revolutions per second is equal to the number of magnetic impulses per second divided by the number of teeth on the rotor. The number of teeth on the pole pieces does not affect the speed. One complete cycle in an alternating current system has two points of maximum value, one positive and one negative, separated by a point of zero value. Since the rotor and pole pieces are of soft iron, and not polarised, the negative and positive maximums have the same effect and attraction between poles and rotor occurs in both instances, thus giving two magnetic impulses per cycle. The rotor of the motor described has 25 teeth, and, therefore, when connected to a supply having a frequency of 50 cycles (100 impulses) per second has a synchronous speed of four revolutions per second. This speed was chosen, firstly, because it is convenient for working in the gear ratios, and, secondly, because 25 teeth was the greatest number that it was practicable to accommodate on the rotor without increasing its dimensions beyond the proportions required.

From the principle of its operation it will be appreciated that a motor of this type will run equally well in either direction, depending on the direction of the initial starting torque.

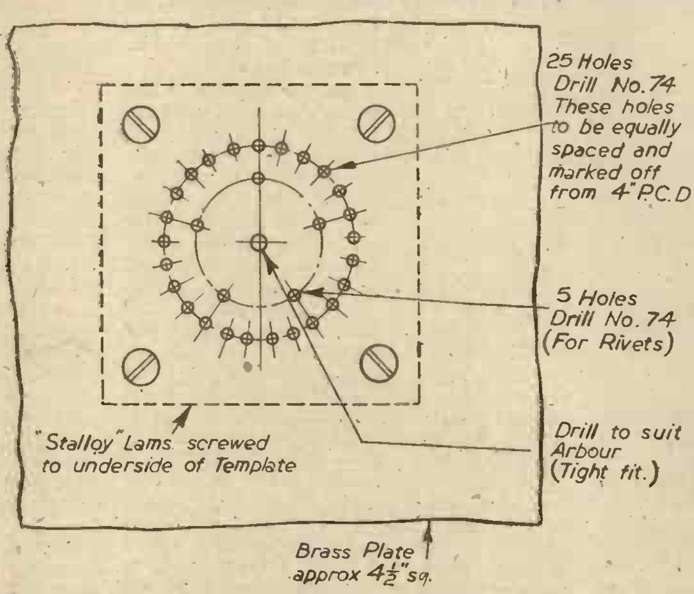


Fig. 5.—Details of the rotor drilling template.

It is therefore essential to see that it is always started in the right direction, and this can be effected by a simple starting mechanism described later.

The motor is not self-starting, which is actually an advantage, as it prevents any possibility of the clock restarting itself after a break in the supply and indicating incorrect time.

Arranging the Gearing

Obviously, no definite instructions can be given regarding the fitting of additional gearing, since this will vary in every case, depending on the type and size of clock, and

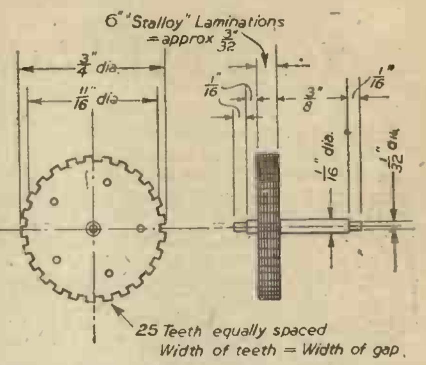


Fig. 4.—Front and side views of the rotor.

the wheels and pinions available for forming the additional reduction stages. The final details are, therefore, left to the ingenuity of the individual, but the following notes may prove helpful in this direction. Once having fixed the speed of the motor it is a simple matter to find the gear ratio required between the rotor and the pinion of the minute hand (if an existing clock train is being used the 12 : 1 ratio between the minute and hour hands will already be provided). Since the minute hand makes one revolution per hour the ratio must be equal to the number of revolutions per hour of the rotor, and in the case of a motor having a speed of four revolutions per second will be 14,400 : 1. The "going" train of a normal clock has a ratio considerably less than this, and it will be necessary to increase it by the addition of further stages of reduction gearing.

Before it can be decided what increase in ratio is required it is, of course, necessary to determine the exact ratio of the existing train after removing the escapement wheel. The only safe method of doing this to ensure accuracy is to carefully count the number of teeth on each wheel and pinion throughout the train, carefully noting which are drivers and which are driven, and work out the ratio from the figures obtained. It must be remembered that an error of only one tooth in the counting will cause the clock to steadily gain or lose according to the direction of the error. When the existing ratio is known the number and ratios of the additional steps can be arranged. These will naturally depend on the size and types of wheels and pinions available, although generally two or three stages will be sufficient, provided there is room to accommodate fairly large wheels. It is necessary to provide a pinion on the rotor spindle, and this must be taken into account when working out the ratios.

In the usual clock train the diameter of the wheels decreases with each successive stage, and due to this it may be found that the first wheel of the additional stages has to be of such small diameter (to obtain clearance between it and the arbor of the last wheel of the existing train) that it is impossible to obtain the final ratio required.

This difficulty may be overcome by modifying the last stage of the existing train, as shown in Fig. 3. The arbor is shortened and fitted with a new bearing in the form of a bracket attached to the side frame in a convenient position. This allows the next wheel to overlap, thus permitting a considerable increase in diameter. Almost any clock type of gearwheels are suitable for making up the extra stages, and those used in the clock described were obtained from the counting train of an

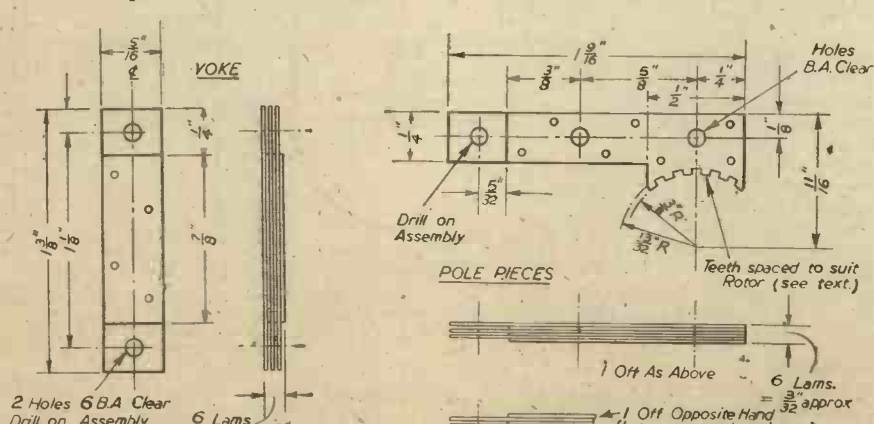


Fig. 6.—Method of forming yoke and pole pieces.

electricity meter of the house service pattern, the complete train being bought for a few coppers from a junk stall. These were ideal for the job, giving up to 10 : 1 ratios and possessing the advantage of having bosses fitted with grubscrews, making for easy assembly and convenient adjustment. If the wheels used are not suitable for meshing with the last wheel of the existing train, the latter can be replaced by a wheel of similar type to those used for the added stages, the existing arbor and pinion being retained. To ensure smooth running the wheel and pinion teeth should mesh by an amount equal to one-third of their depth. If the extension plates forming the bearings for the additional arbors are made in one piece accurate drilling will be required to obtain correct meshing. This can be avoided by the use of independent bearings for each arbor, these being provided with ample clearance in the fixing holes to permit of individual adjustment.

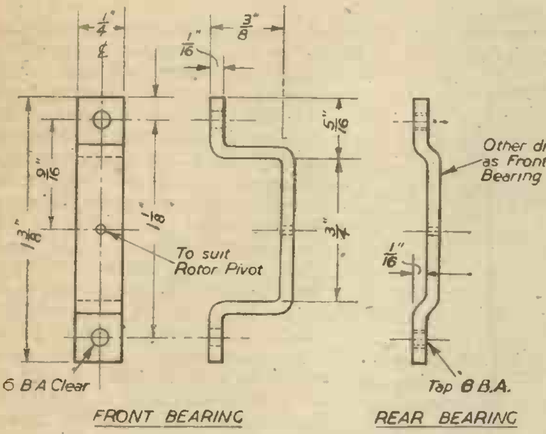


Fig. 7.—Front and rear bearings.

In Fig. 2 the added wheels and bearing plates can be plainly seen. In this case only two stages were added, although, in effect, a third stage is provided by the reduction between the pinion on the rotor spindle and the last wheel of the extended train.

Should the ratio required to be provided by the additional gearing work out to some odd value which is found difficult, or even impossible, to obtain with the wheels and pinions available, it should be borne in mind that this may possibly be overcome by arranging the number of teeth in the rotor to give a speed which will suit the gearing, and it is as well to consider this in the light of the gears available before deciding on the number of teeth on the rotor. As regards calculations, the energising current can be considered as a driving wheel having a hundred teeth (on a 50-cycle supply), and the rotor as a driven wheel, the number of teeth being arranged to give the ratio required.

The possibility of using worm drives should not be ruled out, since these give a high reduction ratio, and the worms can be easily made by winding wire round an arbor. The diameter of the wire and spacing of the turns being arranged to suit the teeth of the wheel which it drives.

Apart from being suitable for embodiment in the frame of an existing clock, the unit can, of course, be used as the basis of an entirely new clock, in which case many of the snags mentioned above would not arise, since the constructor, having a free hand, would naturally build the clock to suit the gearing.

The Rotor

This, being the heart of the job, was the first part to receive attention. It was made of "Stalloy" soft iron laminations obtained from an old transformer. The dimensions are given in Fig. 4. Six laminations make up the thickness of approximately $^3/_{32}$in., these being firmly riveted together before drilling or cutting to shape. Due to the hard scale on the surface of the laminations it is difficult to mark out or drill them accurately, and a drilling template was made from a piece of brass sheet large enough to allow a circle of 4in. diameter to be described centrally on one side. A second circle of $\frac{7}{8}$in. diameter was struck from the same centre. The circumference of the larger circle was divided into 25 equal parts to give the spacing required for the rotor teeth. This was effected by stepping round a pair of dividers, adjusting the span by trial and error until the correct distance was found. It was first divided into five equal sections, each section then being divided again into five equal parts. A straightedge was then carefully adjusted to line up with the centre of the circle, and each of the 25 points in turn, a line being carefully scribed where the straightedge intersected the circumference of the $\frac{7}{8}$in. diameter circle.

The six pieces of stalloy were cut into approximately $1\frac{1}{2}$ squares and screwed to the underside of the template (see Fig. 5) and five holes drilled with a No. 74 drill for rivets, one on each of the five main dividing lines on a $\frac{1}{2}$in. diameter circle. The laminations were then removed from the template and riveted together with iron wire, the outside laminations being slightly countersunk and the rivets filed flush. The assembly was again screwed to the template and the 25 holes drilled for the teeth, again using a No. 74 drill. The central hole was also drilled at this stage, the diameter being a tight fit for the arbor. It was found essential to rivet up the laminations before drilling these holes as a small relative movement between the laminations is bound to occur when riveting, with the result that if the holes are drilled first they take up an angular direction with respect to the face of the assembled laminations. This is particularly serious in the case of the central hole, as it causes the rotor to run badly out of truth with the arbor.

After removing from the template the surplus material was trimmed away until the diameter was $\frac{7}{8}$in., thus leaving a ring of "half-holes" the spaces between which form the teeth of the rotor. These were trimmed square by means of a thin file. The rotor was next filed until it was round and true. For this purpose it was fitted with a spindle and temporarily mounted on two bearing brackets, a stop adjustable to lie close to the edge being arranged to detect the "high spots" as it was rotated. These were successively removed by filing until the rotor ran true. This is a rather tedious process, but time spent on this part of the job is amply repaid by the increased efficiency of the completed motor.

The rotor was fitted with an arbor (from the meter-counting train mentioned earlier on), which had to be shortened to suit the motor and re-shouldered. Although it hardly seems a practicable method of doing it, the new shoulder was formed by filing, a small fretwork file being used for the job. A square was first formed by removing an equal amount from each side, this in turn being formed into an octagon by removing the corners. Successive series of corners were then removed until the arbor again assumed a circular shape; finally it was polished with fine emery and burnished whilst held in a revolving drill chuck. Strange to say, this ran almost dead true.

A simpler arrangement would be to leave the arbor unshouldered and drill the bearing bracket to suit the full diameter. In this case it would be necessary to provide a stop to prevent lateral movement of the arbor, unless the bearing bracket is drilled with a blind hole. An objection to using the full diameter of the arbor is that it considerably increases the friction unless the diameter is very small. On the arbor of the rotor was also fitted a small pinion (from the same source) to suit the gear train, and a small brass disc about $\frac{5}{8}$in. diameter by $^3/_{32}$in. thick. This latter item is to give a flywheel effect by increasing the inertia, thus assisting in starting and giving smoother running.

Pole Pieces and Yoke

Details of these are given in Fig. 6 and, like the rotor, they consist of six stalloy laminations riveted together. It will be noted that the ends are arranged to interleave. This, however, is not essential, although it makes a neater job when assembled. If preferred, both yoke and pole pieces can be made with solid ends and overlapped without affecting anything but the appearance. If they are interleaved it is, of course, necessary to cut back alternate laminations before riveting up and also to arrange them to be right- and left-handed, as shown in the sketch.

It should be noted that as the pole pieces are exactly opposite when assembled, and the rotor has an odd number of teeth, there will have to be a difference in the relative position of the teeth on each pole piece equal to half the width of a tooth. To ensure that the correct position was obtained, the pole pieces were finished off with the exception of the teeth, which were marked off from the rotor when assembled, the rotor being moved along its arbor to allow it to overlap the pole pieces. The teeth of the pole pieces were then carefully filed to shape and re-

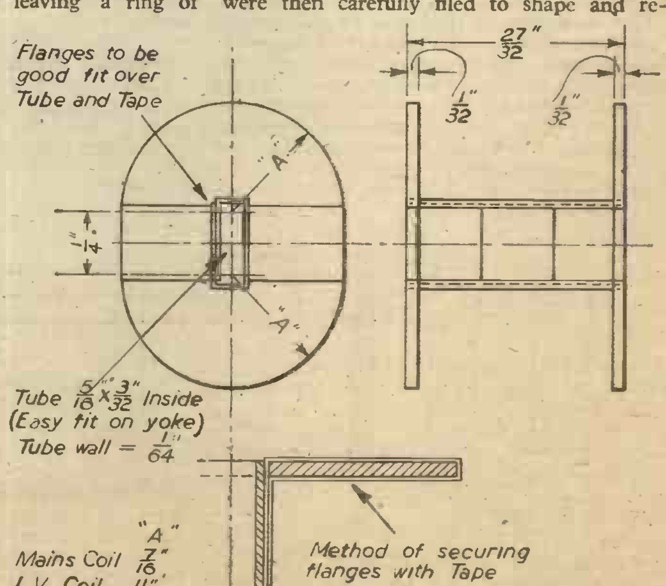


Fig. 8.—Details of bobbin construction.

assembled, the rotor being moved back into its correct position between them. Final touching up of the pole pieces with a file enabled quite a small air-gap to be obtained between them and the rotor. To allow for any irregularities the air-gap was made adjustable by allowing ample clearance round the fixing screws of the bearing brackets, where they passed through the pole pieces.

Bearing Brackets

These are shown in Fig. 7, and are made from brass strip. Care should be taken in drilling the holes for the arbor: these should be a good bearing fit and if possible finished with a watchmaker's brooch. If this is not available, however, a piece of wire and a little fine grinding paste may be used to obtain the required fit. The holes should be slightly countersunk each side for retaining lubricating oil.

The Bobbin

This was made from scraps of sheet bakelite, the flanges being 1/32in. thick and the tube 1/64in. thick (see Fig. 8). The tube was formed by bending up from sheet, the overlap being secured with seccotine. It is necessary to heat the bakelite before it can be bent. This was effected by means of a heated piece of hacksaw blade, the edge being applied to the bakelite along the line of bend. The blade should not be too hot; just short of red heat is sufficient, as if hotter than this the bakelite will blister. Alternatively the tube can be formed round a strip of metal having the same section as the yoke. This ensures obtaining the right shape and size, but due to the greater area in contact is more likely to blister the bakelite unless carefully handled.

The flanges were secured to the tube by two strips of black silk tape glued to the sides of the tube, the ends being passed through the aperture, round the flanges and back on to the tube, as shown in Fig. 8. The apertures in the flanges were made a snug fit over the tube and tape, the whole being firmly cemented with seccotine, making a strong, rigid assembly. The shiny surface of the bakelite was removed with glass-paper at all contact surfaces to provide a key for the cement. Fig. 8 shows alternative smaller dimensions for the flanges, which are suitable for a low-voltage coil.

Winding the Coil

The bobbin was wound to capacity with 48 S.W.G. S.C.C. copper wire, approximately 0.4 oz. being used, giving about 19,000 turns, and having a resistance of 12,600 ohms. This figure is the D.C. resistance as measured on a Wheatstone Bridge, and not the A.C. resistance or impedance. The task of winding a coil of such small gauge wire by hand was a formidable one and required the expenditure of a considerable amount of time and patience. It was first attempted by mounting the bobbin on a suitable spigot held in the chuck of a wheel brace supported in a vice. Whilst the gearing enabled a high winding speed to be obtained, it was inclined to be "snatchy" and did not give the sensitive control required for the fine wire, which is only approximately 1½ thousandth of an inch in diameter. A simple winder was therefore made up in which the bobbin was rotated direct, by means of a cranked shaft. This gave a better control over the tensioning and guiding of the wire and was quite satisfactory.

Before commencing the winding, the end of the wire was soldered to about 15in. of stouter wire of about 20 S.W.G. to form a connection lead. This lead was taken twice round the bobbin to anchor it, the free length being spiralled by winding round a ⅛in. diameter rod and tied to the spindle of the winder to keep it out of the way whilst winding. Where this lead runs from the tube of the bobbin to the edge of the flange it lies in close contact with the end turns of each layer of the winding, and in order to prevent any possibility of it shorting out any of the layers it was covered with a piece of insulating tape.

It is, of course, impossible to wind such a fine wire in even layers by this method, and no attempt was made to do so, although the wire was guided so as to fill the bobbin evenly, the main object being to get on as many turns as possible.

(To be continued)

Piston Rings

Notes on Their Production

By P. BOUSFIELD

THE great importance of the piston ring cannot be overestimated.

Let us first of all briefly survey this highly skilled product in its finished form to find a few of the requirements which must be embodied in its manufacture.

Ordinary rings are called "compression" rings, because it is their essential function to make the piston—of which they form an essential component—a really close fit in its liner, and to prevent blow-by of the gases. The ring is thus an essential factor in ensuring the efficiency of the piston. Then again there is the question of the ring having an effective joint, and of the working face or "rubbing surface" of each ring.

These are just a few factors which have to be borne in mind when an engineer places an order for rings.

For example, the order will state the diameter, the working width and the thickness (the three main dimensions). On the top of this information it would be stated what type of joint is required—e.g., butt, angle or lap. Besides this it should also be mentioned whether the rings are required to have smoothed off edges (radiused)—otherwise they will probably be left as sharp as razors.

Production

There are three methods of producing piston rings—each one is a casting process, but the process varies. The chief process, and the one which we shall deal with in this article, is the "pot" casting.

It should, however, be mentioned in passing that there are "spun" or centrifugal castings —where the metal is spun into a homogeneous hollow cylindrical mass of molten metal. Then there are single castings, although the writer believes the latter relates chiefly to production in Scandinavia.

Pot Castings

The pot is a cylindrically shaped mass of molten cast iron. This arises from metal poured from the ladle into a mould. The resulting "pot" is removed while still intensely hot and is left to cool.

After cooling, a rough cylinder remains for many further operations; it certainly looks very little like the precision product which may be ready some hours later if for an urgent contract.

The pot casting is a rough method, "as cast" jobs are never to "finished" sizes; on the contrary they are very much oversize. The pot has still to have the rings parted off from it, and then they have to be split for the ring joint. There is a great deal of machining then to be carried out, and accurate "limits" have to be adhered to.

The inner face of the ring has to be skilfully hammered to give the correct outward pressure against the cylinder wall. Then there is the inspection department, and this is where rejections have often to be made on account of what many of us think of as negligible inaccuracies.

The inspection of rings, and the high requirements of that department go to prove whether the firm making the rings are really high-class or not. It is absolutely not worth while to pass a ring which does not conform to the specified "limits," nor must a ring of poor analysis leave the works.

Analysis of the Material

The foundry has a small laboratory attached, and this laboratory has often the custody and knowledge of the closely guarded secret of the "melt." Practically every firm of repute has such a special formula stating closely controlled quantities of the different elements present in the ring.

Foundry Faults

There are, of course, various reasons outside of the control of the laboratory why rings are often rejected at the "pot" stage. There may, for example, be "slag" inclusions. The "slag"—which means impurities present in the melt—which rises to the head of the casting. Or there may be sand inclusions which arise usually through use of the incorrect sand—or due to poor moulding.

In one hundred and one ways the accomplishment of a first-class ring is an achievement only possible by the greatest care at every stage and thorough specialisation; and here are some of the reasons why a ring may fail in service even after it has been passed as satisfactory at the works.

1. It may not be of material which gives sufficient resistance to wear.
2. It may not be machined accurately enough.
3. It may not have been assembled correctly on the piston.
4. The clearance may not have been correctly ascertained, in which event the ring though finished to stipulated sizes, may not be the required fit in the piston groove.

In connection with this last-named point, the vertical clearance in the ring groove may be too great, causing the ring to hammer, and wear will increase considerably. On the other hand the clearance must not be too small or the ring will become solid with the piston, and its function will at once be lost.

Restricted Rings

There are on the market various rings known as restricted rings, and as the name suggests the movement of the ring in the groove is controlled. Most of them are elaborate and hence are somewhat costly to manufacture, but it is known that a restricted ring has often come to the rescue of a job where there has been trouble with plain rings.

To sum up, it should be realised that making piston rings is a job for a specialist firm, and firms who make rings often make little else. The manufacture of rings on a large scale is shared among comparatively few firms, most of which are exceedingly well known, and have the highest standards of quality to their name.

Who Invented Electrical Telegraphy?

The Discoveries of the Early Experimenters

By W. T. LOWE

DOTS and dashes were unknown in early systems of electrical telegraphy. And Mr. Morse did not—as many people imagine—invent, or rather, discover the phenomena.

Experimenters began to get busy in 1727, when Stephen Gray and Wheeler discovered that frictional electricity could be sent along a conductor, and this was confirmed by Benjamin Franklin and William Watson in 1747. Six years later, "C.M.," a correspondent of the "Scots Magazine," suggested using a telegraph with a wire for each letter of the alphabet, and the application of a current to indicate the desired letters.

Prior to 1800 two men, Le Sage and Lomond, both tried out "C.M.'s" idea. After that, Francisco Salva suggested that the electric pile by Volta should be used for sending signals. Samuel Von Sommering took advantage of this, and constructed an instrument which controlled 36 lines. Each of these lines electrically conveyed a letter or symbol. At the receiving end the wires were immersed in water. Of course, 36 keys operated the transmitter, and instead of dots and dashes, the message was read by bubbles on the water! Then, instead of the bubbles, they set light to alcohol. Later, an instrument appeared on which the message was read by shocks. An operator would place his fingers and thumbs on terminals and verbally repeat signals indicated by the shocks. All very crude, but they give a good idea as to the efforts made by the pioneers.

When the eighteenth century was still in its teens, Sir Francis Ronalds produced a more practicable telegraph at Hammersmith. His apparatus consisted of something akin to the now old-fashioned "dolls-eye" telephone switchboard, each "eye" moving by an electrical charge, and exposing a letter.

The Needle Telegraph

Then somebody discovered the needle telegraph. And the eighteenth century was *still* in its teens.

Ten years before Samuel Finlay Morse was heard of, inventors of different nationalities had experimented with the "needle" apparatus. One used 30 needles!

About 1835, however, the pace began to get very hot. Many pieces of telegraphic apparatus constituted features of exhibitions. Moncke, Cooke, Wheatstone, Gauss, Weber, Schilling, Highton, Henley, Allan, Bright, Neil, Steinheil, were but a few of the number practically working for perfection and recognition.

Readers of this journal already know that in 1838 the first commercial telegraph instrument in this country worked between Euston and Camden Town railway stations. Cooke and Wheatstone were responsible for the apparatus. This period appears to coincide with the introduction of the inventor associated with dots and dashes.

Born at Charleston (Mass.) in 1791, Samuel Finlay Morse did not ever wish to become a telegraphist. What is more, he never earned his living at that occupation. In fact, the man whose name is now mentioned much more than when Morse telegraphy held sway, belonged to a totally different school. He painted pictures. I mean, he actually was an artist in the true sense of the word. For in 1813 Morse exhibited his first picture.

Morse often went to Europe to copy pictures, and during one of these voyages it is said he contacted a Dr. Jackson on board a ship named *Sully*. Dr. Jackson had recently been present at a conference in Paris on the electro-magnet. Samuel Morse became interested, and the conversation turned to the possibility of utilising this phenomena for transmitting signals.

Electro-magnetic Telegraphy

In 1835 after various trials of electro-chemical telegraphy, Morse made some experiments with electro-magnetic telegraphy. But the results were not very good. Two years later, however, he heard about Wheatstone and Steinheil. Then an article appeared in America declaring that the electrical telegraph had been discovered, which announcement Morse didn't like. One of his two brothers was editor of an American journal, who stated that Samuel Morse had been working on the idea for five years since he had conceived it on board *Sully*. Naturally, people wanted to see this marvellous electric telegraph; and two of the visitors subsequently worked with Morse on his experiments in September, 1837. They were the brothers Gale and Alfred Vail. It is recorded that their combined early efforts were again not very satisfactory, but Morse insisted that he was the only inventor of the electric telegraph. He also affirmed that all the other European systems were based on different principles, and without exception invented after his own.

Sir Charles Wheatstone.

Thirty-three years before Morse was born, Lomond tried to establish a system of telegraphy with a pendulum. In 1810, the year when Morse graduated at Yale University, the first galvanic telegraph was proved satisfactory, and actually worked.

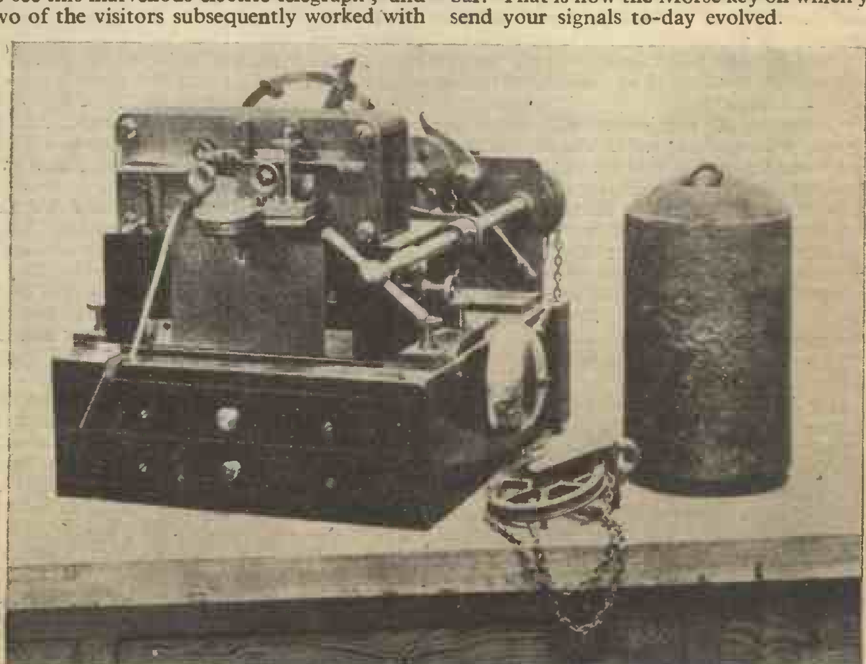
It is a peculiar fact that the spot where the present world-wide trouble started should be the birthplace of an international asset, for this galvanic telegraph is said to have been invented in Munich!

Schilling's Telegraph

Twelve years before Morse, Schilling constructed an electro-magnetic telegraph which was exhibited at Bonn, and then at Heidelberg and eventually introduced into England by Cooke. About six weeks previous to this, another telegraph, constructed on the same principle as that of Schilling, worked over a wire one and a quarter miles long.

Despite all this, and, based on undisputable records that Sir Charles Wheatstone himself forestalled the American, the work of Morse is not to be despised.

Even Morse's first idea had nothing to do with dots and dashes. It was, in fact, the crude birth of the siphon-recorder or undulator used on cables and radio at the present day. "V"-shaped signals were made on a paper tape, and one had to refer to a telegraphic dictionary to translate them. In the experimental stage, acoustic dots and dashes were made by the sending operator passing a pointer over metallic bars. Morse and his collaborators afterwards discovered that this could be done by depressing and releasing a bar. That is how the Morse key on which you send your signals to-day evolved.



By courtesy of the Postmaster-General.

Wheatstone receiver, motor and train—1867.

When Wheatstone automatic telegraphy was just emerging from its experimental stage the press began to show keen interest in experiments at the G.P.O.

Many previous attempts were made to alleviate the tiring effect of hand working high-speed morse for long periods. In 1846, Bain perforated dots and dashes on a paper ribbon which, when passed through an apparatus, caused the signals to be reproduced by chemical means on another slip of paper. Experimentally, the system attained a speed of about 4,000 words an hour. But owing to technical troubles (not at that period understood), in actual working it failed.

Did you know that a weaving loom is said to have given Sir Charles Wheatstone the fundamental idea for his high-speed system? Anyhow, by means of passing perforated ribbons through a transmitter, he dealt with 80 words a minute in 1870. Eventually, the apparatus disposed of 450 words in the same time. In fact, in experiment, the 600 mark had been reached by 1900.

In many instances identical newspaper items had to be transmitted to different cities and towns from the Central Telegraph Office in London. And this is where Wheatstone showed itself to another advantage. The perforated slips could be used repeatedly, and passed from one transmitter to another according to the destinations indicated. Moreover, as many as half a dozen stations would be accommodated on one line, and the whole able to receive the message simultaneously. A slip could be seen running on what was known as the "Up Scotch" (Edinburgh, Glasgow, Dundee and Aberdeen circuit), and often before it had run its course, the message would commence its electrical journey through a transmitter on another line to other stations.

To obtain attention of every station on these lines the operator would call "CQ" and the distant stations, according to geographical situation, would answer in turn, the nearest place to London answering first. But if the message was intended for only two of the six stations on one line the telegraphist would call them separately with the suffix signal "YQ," indicating that another station would also be called.

Pneumatic Perforators

As pneumatic perforators could simultaneously produce eight paper ribbons containing the same message, and as there were an average of four stations on Wheatstone press wires, this meant that the same message would be conveyed to 32 places in the British Isles at identical moments, at a moderate speed of 150–200 words a minute.

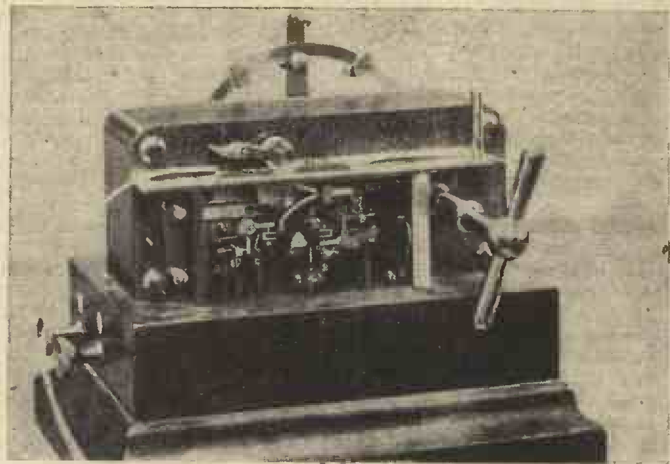
In the first instance, these perforated slips caused morse dots and dashes to appear on a blue paper tape running at the same speed as the transmitter. It is on record that one message would sometimes consist of a mile of this morse slip, containing 26,000 words. So that the receiving clerk and editors could deal with this volume more conveniently, the message would be split up into sections. Each section was torn off the paper ribbon and given to a telegraphist to translate from the dots and dashes. As he (or she) completed the section it was sent out to the editor. Thus, part of a column, we are given to understand, would perhaps be in type before a speaker had said his last word—if the despatch consisted of a speech.

Incoming press work at the C.T.O. largely consisted of racing reports. On the occasion of meetings special offices were set up on the courses, and the most expert operators chosen and despatched to control the apparatus. (The same, of course, applied to some provincial offices.)

In addition to race-meetings, other special events—such as speeches by M.P.s in their constituencies, cricket and football matches, gardening shows, visits of important personages, and other public attractions—required special Wheatstone telegraphic facilities.

Organisation and installation of these special Wheatstone wires demanded a high standard of efficiency by administrative, engineering, and operating staffs.

For instance, a certain small provincial office situated near a racecourse may normally not have been an important telegraphic centre, but during race week a transformation scene was enacted. The engineering staff had been at work, and when the opening day of the meeting arrived the comparatively simple instruments on the regular circuits, except the purely local ones, were displaced by Wheatstone automatic apparatus. Additional wires were brought in similarly fitted, and extended to the grandstand office. Perhaps this office would be equipped with six Wheatstone and four quadruplex key worked circuits, and an imposing array of perforators to complete the plant.



By the courtesy of the Postmaster-General.

A Wheatstone transmitter of 1867.

Circuits proved and handed over, the work began. During the day the special staff would probably reach a total of 90 men. Some worked at the counter receiving the messages from the public or the press representatives, timing the forms, and taking payment. The majority operated in the instrument rooms. Clatter of perforators appeared to pervade the place to the exclusion of every other sound, but a telegraphist could detect the purring of Wheatstone transmitters, each reeling off slip at the rate of perhaps 300 words a minute to London, Liverpool, Birmingham and other centres.

The superintending officer at a race-meeting where part of the work was done at the town post-office and part at the grandstand had to arrange for change over from one to the other. In the morning the post office did most of the work, but as the public gathered at the course it gradually shifted to the grandstand. The clerks moved off in little batches and proceeded to the grandstand, until, by the time the racing had begun, if conditions were normal, the town office telegraph would be very quiet. But at the grandstand work was maintained at full pressure, with all circuits going full blast. In the evenings the town office again got busy, and from there most of the press messages were sent.

On "classic" event days, such as the Derby, or Newmarket or Ascot, the special staff sometimes handled from 11,000 to 12,000 private telegrams, plus 80,000 words of "news" in a day.

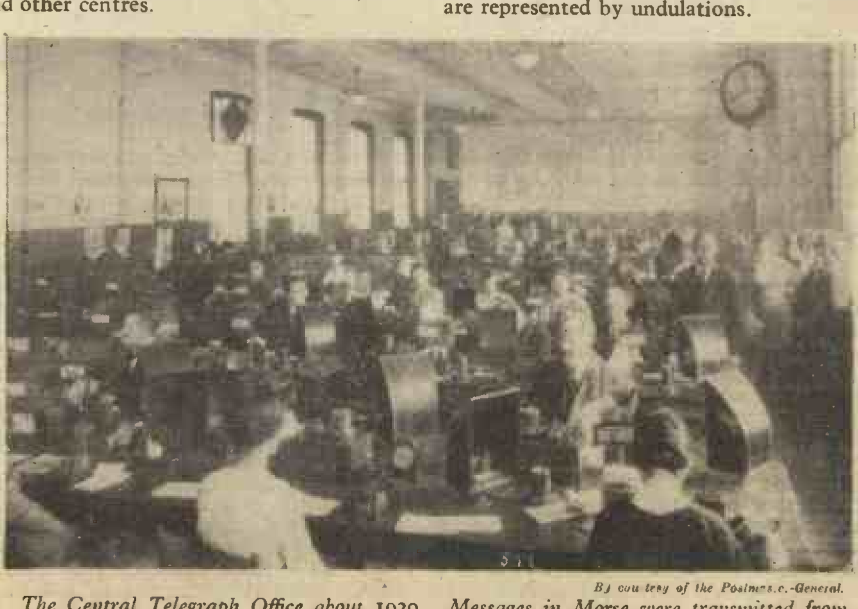
Creed Reperforator

At the receiving end of the press lines, the Creed reperforator and printer—in which an exact replica of Wheatstone perforated slip took the place of morse slip—eventually appeared.

Instead of pieces of slip being handed to various operators the received perforated slip was put through another machine and the perforations automatically transformed into printed characters. This system is still used by newspapers on their private wires, for the telegraph system of Fleet Street is, collectively, a fairly huge institution. A newspaper telegraphist has not only to be qualified in morse key and sounder, Wheatstone, and teleprinter work, but is in some cases also required to manipulate the picture telegraph apparatus, at least, in normal times.

So far as the Inland Telegraphs are concerned, though, I am afraid that Wheatstone telegraphy is a thing of the past.

The Central Radio office, however, still use the system for transmitting news to ships and countries overseas. But the receiver is called an Undulator, in which morse characters are represented by undulations.



By courtesy of the Postmaster-General.

The Central Telegraph Office about 1920. Messages in Morse were transmitted from here to the South Coast.

Photographing Street Scenes

Hints on Specialising in Group Subjects

By JOHN J. CURTIS, A.R.P.S.

IT is a generally accepted theory that if you want to excel in anything, whether a profession, trade, or even a hobby, it is essential to specialise both in the training and the practice of the particular branch for which you have a liking or, as it is sometimes termed, a "flare"; but before taking up a course of training the individual is helped in his selection by some sort of mental guidance. In many people this is accomplished quite unconsciously and extends over quite a long period of boyhood or youth.

An artist may have shown ability in drawing and painting in his early childhood; some architects have reached the top of their school forms simply because of their painstaking to record that extra fine detail in their work, and later on in life they have found themselves keenly interested in buildings or heavy constructional work. Most boys, at some time in their teens, take up the hobby of stamp collecting, but it is only those whose minds find real recreation or instruction in the pursuit of it who keep their collections growing and maintained into their later years.

In like manner we camera users are controlled; we have our first camera as a present, and we expose a few spools of film. Perhaps at first those spools are developed and printed for us; this is unfortunate because it just takes away from us all that goes to make the enthusiastic and real amateur, with the result that the camera is used only on rare occasions. But those of us who have taken to the hobby seriously, and have dived into the fascinating mysteries of making negatives and prints, have been mentally urged to see what photography offered in the way of recreation and interest.

Haphazard Snapping

There are thousands of very keen amateurs, however, who are still doing "unspecialised" work; they seem to revel in taking all sorts of subjects or objects, and while they find lots of real enjoyment in so doing, they never seem to come out on top with any of their results.

I am inclined to think that the answer is to be found in the fact that you are "general" rather than "specialist," and so let us be frank with ourselves, for by so doing we may soon find our results are posted on "the line" at one of the London or local exhibitions.

It is just possible that so far you have not troubled to find out, or even to notice, that any special subject gives you more pleasure than others; you have quite a nice collection of good negatives. I wonder whether you have ever made an enlargement from a particularly good film, mounted and framed it and then hung the finished picture in a prominent place on the wall of your dining room. Well, if you have done this and have been able to live with it and not be tired of seeing it, then there is something in it, and I should advise you to send it to the next exhibition to see if it will get hung.

Specialising

But what about this idea of specialising? Do you really want to know what subject appeals to you most? Then go to the nearest picture gallery as soon as you can and spend some time there; do not rush around, take things quietly, and make a few notes of the particular pictures which caused you to stop, examine and criticise. When you have finished the tour refer to your notes and go and look at those pictures again, and if you find that most of them are of a similar type, for instance landscapes, then you have a liking for landscape work; if they are of interiors and architectural subjects then that class of work is your "flare"; if you have noted figure studies or street scenes then you will find that it is in the direction of these that your mind is anxious to lead you.

You must be careful when criticising the work of masters; I do not mean condemning a print just because it does not appeal to you, but rather to find out for yourself what detail or feature it is that seems to be wrong, and then ask yourself how you would have done it. If you do this examination carefully then you will leave that show with more knowledge than you had when you entered it.

I have in the course of several years judged and examined many thousands of photographs of various subjects, and it has always been a surprise that many more prints are not sent in for competition. There is usually a number from individuals who regularly send to exhibitions and competitions, and one cannot help noticing their work, which is usually so outstanding. I believe that they are keen on making high-class pictures, and are only able to attain a high standard by making regular contributions to the shows; in fact, they recognise that every time they make an exhibition picture they have put their very best into it, and have learned something more; further, these picture makers are specialists, and usually stick to one class or group of subject.

The old curio shop.

Group Subjects

I want to give a few useful hints on certain groups, and will start with Street Scenes, because they offer opportunities all the year round, and especially at this time when other more open spots are barred through bad weather. Most towns have some outstanding buildings, and these might be modern or very ancient; they are features of special importance to the town and, as such, they can be used as backgrounds to some of our shots. That old Lych Gate makes a splendid setting for two or three old folks standing and gossiping near it; the Entrance to the Public Library fits in very well with that group of youngsters just coming out and looking at the books of their choice. Look at that queue of women outside the fishmongers; you can tell by their faces that they have been there a very long time, not a smile to be seen, and what a war-time story it makes! Do not let them see you taking the shot; they might be very troublesome, so wait your opportunity. Turn away from them after measuring the distance by your eye and get the shutter set ready; you might try holding it under the arm with thumb on the trigger, and be sure to get the shop in as background. Just when you are going to touch the trigger, look away from the people at something down the road, so as to divert their attention from you.

School children leaving the school premises will give you many good chances, but be sure to get action into the picture. Boys are particularly good models for this type of work, but avoid any posing; watch out for a spot of fighting or heated argument, but remember the camera must always be ready for any chance shot, as there is never any time for preparation. The shop where old curios are sold is a picture in itself, but if you wait long enough you will be sure to get an old person or couple who will stop and examine something in the window. If you have a friend who has a room on the first floor of any of the shops in the main busy street, you might be allowed to go to the window of this and try your hand at some high angle photography. A little group of talkers on the curb opposite. Wait for a suitable time and maybe one of them will say something funny and set the others roaring with laughter; then is the time for shooting. Some of these "overhead" exposures are very good, but you must as a rule be patient and wait for a suitable subject. It is good to think that there are still a few horses on the road, and I have often noticed what fine studies some make when standing waiting for their master to come out of a shop.

Be careful to avoid ugly backgrounds, and if the horse is opposite a blank space, or if you can take the shot with the camera very slightly tilted so as to get the sky as background, you will possibly get a good head study; you can perhaps chance a low angle study by stooping down. In many small towns one can often find certain individuals who are local characters, such as you see at Whitby at the Fish Market; three or four rather picturesque women preparing crabs. At another place I well remember a man, quite a character, who used to sell shrimps from a barrow; he was snapped many times. Flower sellers are always to be found, and some are good models, especially if you ask them to allow you to take their photograph.

The old-time villages around the country lend themselves to this type of work much more than the average suburban streets, but even these can be put to good account if you find the right spot, and by this I mean the background, for this very often links up or gives purpose to the picture.

Exposure Times

I have found that it is necessary to give fast exposures, and for this reason to use the largest stop, F6.8 or F4.5, if you have them on your camera. A fast film will then permit an exposure of something like 1/250th or 1/150th, according to the time of day, and the power of the light. I try to make use of sunlight wherever I can, for it does make a big difference in the work, as without a suggestion of sun the best of our streets are inclined to be drab, and this tends to flatness in the negatives.

Generally, when enlarging these negatives it is necessary to cut out quite a lot of the matter which got into the exposure; you must use only that part which is subject matter, as if anything else is allowed it will certainly detract the eye and spoil the whole theme.

The crab stall in front of a seaside cottage.

Aircraft of To-morrow

Details of Construction and Operation, and Possible Future Development

By T. E. G. BOWDEN

THE future trend of aircraft design will undoubtedly be the use of far larger types than are in service at the present time. As engines are developed and new materials brought into use, aeroplanes weighing 150 or even 200 tons are feasible, although their shape will vary immensely from the almost universal standard of to-day.

Fig. 1.—Method of refuelling an air-liner in flight.

Wing Loadings

Wing loadings of over 35lb. per sq. ft. are rare at present, but figures of up to 80 or 90lb. per sq. ft. will be common in the future. The reasons for this likely increase are as follows. By increasing the wing loading, the wing area is decreased, e.g., if the figure rises from 40 to 80lb. per sq. ft. the wing area is halved, thus decreasing the weight and the drag. The speed will consequently be increased without using engines of a higher power output. Owing to the reduction in wing size the amount of material and labour required is also made proportionally smaller, reducing the cost of production. More aircraft may be stored in the same space when wing loadings are made greater. The main factor is the increase in speed with equal loads.

The disadvantage which high wing loadings incur are not insoluble. The chief difficulty is the increased stalling and take-off speeds which call for large aerodromes. Climbing speeds are reduced, control difficulties experienced and manœuvrability affected. A fighter aircraft with a wing loading of 30lb. per sq. ft. can turn in half the radius required by a machine loaded to 60lb. per sq. ft. These disadvantages are being overcome by extensive research, and the following notes describe some of the methods likely to be adopted.

Rocket Propulsion

Assisted take-off to overcome the long run required by heavily-laden aircraft is practicable, and is being carried out at the present time. Rocket propulsion will be more commonly used as more information is gathered about the various types of fuels. By fitting rockets to aircraft the take-off speed required is gained very quickly and thus smaller airfields are made possible. An aircraft requiring a normal take-off run of one mile could become airborne after only half a mile by the use of rocket propulsion. Germany has already fitted rockets to the Junkers Ju. 88, and apparently has had some success. Rocket propulsion is least efficient where the air density is high, and is most efficient in regions of low density. This points to the fact that future stratosphere aircraft will be propelled by means of rockets. Before rocket propulsion alone is utilised, it will probably be used as an additional source of power to the normal aero-engine and airscrew method.

Catapults such as utilised by naval aircraft are hardly practicable for large passenger-carrying machines, and it is doubtful whether they will be used in the future for civil purposes. This method has been utilised to shorten the time required for mails to be delivered across the Atlantic. French and German liners have been fitted with catapults, and by flying an aircraft from the ships when several hundred miles from their destinations, an appreciable amount of time may be saved.

A modified form of catapulting, i.e., ground acceleration in which the aircraft is mounted on a carriage and drawn across the airfield is practicable, but probably will be limited to the smaller size of aircraft. By using this method the take-off run may be reduced by half and none of the discomfort and danger experienced in the catapult method incurred. The aircraft need not be stressed for as high load factors as is necessary when designing for catapulting, consequently reducing the structural weight.

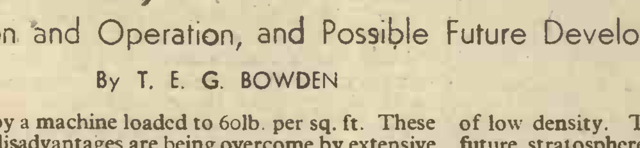


Fig. 2.—All-wing types of aircraft.

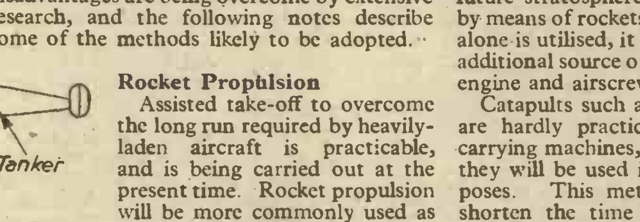


Fig. 3.—Diagrams showing positions of "buried" engines.

Flight Refuelling

Refuelling in flight, which has already been proved a practicable proposition, will no doubt be developed for long-distance freighters flying non-stop from England to Australia or China. This method allows aircraft to take-off with a small petrol load and thus a reasonable wing loading, and to be filled up when safely airborne, increasing the wing loading to what would be a dangerous figure for take-off.

The advantages of flight refuelling are as follows. First, very few structural alterations are required in the air-liner, certainly not so many as required when fitting rockets. Secondly, no elaborate ground mechanisms are required as only a tanker aircraft is needed and this is fully mobile. Thirdly, the take-off of the air-liner is perfectly normal and it does not have to stagger off the ground with abnormal loads. The wing loading is increased only when plenty of height is available for manœuvring. The disadvantages of this system are the facts that low visibility may prevent refuelling and that, at the very minimum, one aircraft is required at each base for tankage purposes.

The actual method which will be used for flight refuelling will probably be similar to the present-day system, which has been developed by Sir Alan Cobham. A brief description of the manner in which fuel is passed from the tanker to the air-liner (or bomber) is as follows. The tanker flies above and slightly behind the air-liner, which trails a line as shown in Fig. 1. A line is thrown from the tanker and engages with the trailing line by means of a grapnel. The line is thus hauled up into the tanker and a petrol pipe attached, following which the line and pipe are drawn back to the air-liner and connected to the petrol system. Before petrol is passed through the pipe, it is flushed with nitrogen to reduce the danger of fire. After the refuelling has taken place the line is flushed with nitrogen again and the delivery pipe hauled back to the tanker. Although the method may seem rather complicated, it is certainly a solution to high wing loading troubles and will almost certainly be used in the future.

A typical aircraft designed for flight refuelling could take off at 35lb. per sq. ft. and be refuelled up to 60lb. per sq. ft., giving a range of 4,000 miles with a payload of 10,000lb. and an all-up weight of 60,000lb.

Mails and other priority freight may also be transferred from the tanker so that as little delay as possible is incurred.

All-wing Aircraft

The idea of an all-wing aircraft has had many advocates in the past and no doubt a development of this type will be flying in a few years. The larger the aircraft is, the more space is available for payload owing to the great depth of wing required to lift the heavy load. The Junkers G. 38 was the first step in this direction, with a span of 146ft. and a weight of 53,000lb. Thirty-four passengers with a crew of seven were accommodated in the fuselage and wing. Owing to the thickness of the wing, the engines could be maintained in flight. Possible shapes for a future all-wing air-liner are illustrated in Fig. 2, one provided with swept-back wings to give longitudinal stability and the other with tail booms to support the elevators and rudders. These booms could be utilised to house the fuel tanks or compact payload.

Flying-boats

The question as to whether the aircraft of the future will be flying-boats or land 'planes requires careful consideration. Both have their advantages and disadvantages. Flying-boats do not require large, carefully constructed airfields, which are very expensive. On the other hand they are liable to damage by any flotsam that may be floating on the take-off line. A very small piece of wood can easily tear the bottom out of a flying-boat travelling at 100 knots. Land 'planes possess the advantage that they can be designed with a very much more efficient aerodynamic shape, and in large aircraft the consequent saving of drag is considerable. A flying boat must possess a planing bottom, and a step which in the future may be made retractable. The weight of the landing wheels, supporting structure and retracting jacks are a very heavy item in the case of land 'planes and they also suffer from the disadvantage that should one be forced down on the sea, little chance of survival may be expected. A large flying-boat, if forced down, could taxi along on the surface to its destination, and no doubt water propellers will be fitted for this contingency.

The surface finish in future aircraft will be absolutely smooth to reduce the drag to as low a figure as possible. All the points must be flush and no external projections allowed, except observation hatches, which may be retracted into the fuselage when not required. It has been found by experiment that extremely small excrescences can cause an increase of 30 to 40 per cent. in the drag. Moulded plastic fuselages and wings produce an extremely smooth surface, and this type of construction will undoubtedly be utilised. An interesting note on the effect of surface

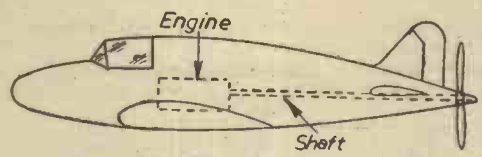


Fig. 4.—Aeroplane with pusher airscrew.

roughness which is apparent on present-day aircraft is the fact that military aircraft, when camouflaged, suffer a loss in speed of several miles per hour. This is entirely due to the rough surface finish of the painted surfaces. Another important fact connected with surface finish is the question of gaps and leaks. No holes connecting the upper and lower surfaces of the wing or the inside of the fuselage to the outer air flow will be permitted, as loss in lift and increase in drag occurs if this is allowed.

Pressure Cabins

Pressure cabins in which the air density is maintained at a reasonable figure to prevent discomfort have already been developed and will become commonplace in the near future. The main difficulty is the manufacture of a leak-proof cabin which is not too complicated.

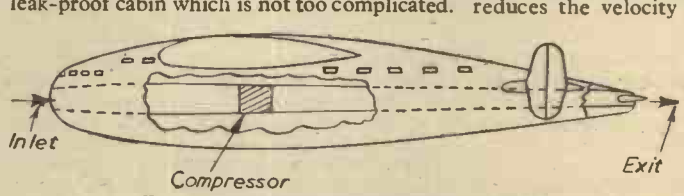


Fig. 5.—Diagram of a jet-propelled air-liner.

Land 'planes are more suitable for the installation of pressure cabins than flying-boats, due to the fuselage profile. Circular section cabins are the most efficient for pressure purposes, being easily incorporated in land 'planes, but they would cause excessive weight in the case of flying-boats.

The power units on all future aircraft will definitely be housed either inside the wings or fuselage and will not protrude as on present-day aircraft. As the size of aircraft increases, the design of buried engines will be facilitated, and layouts as shown in Fig. 3 are probable. Pusher airscrews will supersede the tractor type for the following reason. The airflow in the case of the tractor type, i.e., an airscrew positioned forward of the wing leading edge, causes turbulation and disturbs the flow over the wing. This turbulence increases the drag, whilst a pusher airscrew, shaft driven, allows a good aerodynamic shape to be obtained resulting in maintenance of laminar flow over the wings. An alternative position for the airscrew in the case of the smaller type of aircraft is illustrated in Fig. 4, i.e., protruding from the tail. A long shaft is the main disadvantage, but in combination with a reversible pitch airscrew which may be used as an air brake, a very efficient and controllable aircraft may be obtained.

Control Systems

Present-day control systems are not very efficient when flying at high velocities as they tend to "freeze" solid, and in the future new types of controls must be developed. The force required to operate the normal ailerons, elevators, and rudders, when travelling at over 400 m.p.h., is very high and they tend to become immovable. Boundary layer suction is one answer to the control problem, and experiments have already been carried out to test the results when the wing boundary layer is disturbed. Manœuvring by varying the pitch of the airscrews is also a probability.

Aero-engines fitted to aircraft designed to fly in the stratosphere will be fitted with some form of exhaust turbo-compressor. By this method the exhaust gases are utilised to drive the compressor, and thus avoid taking power away from the normal output. The reason why a supercharger is required is the fact that as the air grows less dense, the weight of the combustible mixture is smaller, resulting in a loss of power. By fitting an impellor the air is forced into the cylinders, thus increasing the power output. The exhaust driven type of supercharger is more efficient at great heights than at lower levels owing to the varying pressures of the exhaust gases and the atmosphere. The higher the altitude the greater the pressure differences and therefore the greater the speed of the impellor. The disadvantage of this system is the fact that a back pressure in the exhaust system is caused, and this necessitates the fitting of a special valve to prevent damage due to backfires.

Jet Propulsion

Jet propulsion has great possibilities, and it is quite likely that aircraft using this method will be common in the future. A layout of a large air-liner propelled by jet propulsion is illustrated in Fig. 5. The principle of the system, explained very briefly, is as follows. Air is allowed to enter at the nose and flows into a chamber which owing to its shape reduces the velocity and increases the pressure. It then passes through a compressor which increases the velocity and also the temperature. Finally, the air is ejected via the tail at a greater velocity and temperature than that occurring at the entry. It is interesting to note that using a normal petrol-driven air compressor the jet propulsion system appears to be more efficient at lower altitudes than at higher altitudes. The main difficulty is the space taken up by the tube and the difficulty of arranging passenger accommodation. An alternative layout would be to have two jet propulsion tubes, one in each wing, thus leaving the fuselage for payload.

Autogiros

Autogiros and helicopters are bound to be developed for taking off and landing in small spaces, although their use is unlikely for the larger types of aircraft. For inter-town services and mail delivery they would be ideal, e.g., landing on flat roofs in the heart of great cities.

From the above description of the possible developments in aircraft design, it will be seen that the scope for new ideas is unlimited, and that very remarkable steps forward will take place in the near future.

The Distribution of Electricity

Cantor Lecture Given Before the Royal Society of Arts

By E. AMBROSE, M.I.E.E.

(*Continued from page 162, February issue*)

THE armature ran between the fixed electro-magnet field coils which were arranged round each side of the circumference of the wheel and projected horizontally inwards, adjacent poles being alternately N and S, and the poles immediately facing each other also of opposite sign. As the armature discs or coils moved from one pole position to another, and so cut across opposite magnetic fields, the induced electromotive force generated changed direction simultaneously in each coil. The voltage measured at the terminals of the machine would be found to vary in the same manner as would that of a single coil rotating uniformly between the magnets of a two-pole machine. Fig. 3 illustrates a Copper type alternator built by Crompton & Co., Ltd.

All of the machines mentioned so far produced currents of the so-called, "single-phase" nature. There were no difficulties about using this sort of current for lighting or heating, but it could not be utilised satisfactorily for operating motors. In 1891, however, the problem of using alternating currents for power purposes was solved at the Frankfurt Exhibition by the use of currents differing somewhat in character from the ordinary, or single-phase, current.

Two-phase Alternator

Consider the simple Gramme ring, with its continuously-wound conductor and arranged to revolve between the two poles of a magnet. If, for example, two tappings be taken off the continuously-wound conductor at the opposite ends of a diameter a single-phase alternating current will be obtained. Now suppose that two more tappings are made at the opposite ends of a second diameter at right angles to the first, then another single-phase current will be obtained. One of these two currents, however, will reach its maximum value after the other at an interval of time represented by a quarter of a revolution of the armature. The machine would therefore be generating two currents differing in phase by 90 deg.; in other words, a two-phase alternator.

Consider now an identical Gramme ring, revolving between two poles as before. If three tappings only be made, each spaced 120 deg. apart, between any two of the tappings a single-phase supply could be taken. The three currents, however, would each reach their maximum values one-third of a revolution apart. The machine would be generating three currents differing in phase by 120 deg. This is called a three-phase alternator with a mesh-connected armature.

If now the armature coil be cut into three equal portions, and the corresponding end of each of the three coils so produced be joined together at a common junction and the other free ends taken to separate collecting rings on the spindle, the armature is said to be star connected.

The modern alternator, though modified very much in details of construction, works on these principles, and although single-phase, two-phase and three-phase machines have been built, the majority of present-day alternators are built for three-phase working.

The very early small machines for laboratory purposes were hand-driven, but as machines became larger mechanical motive power was necessary. For this purpose gas, oil or steam engines, and where it is available, water turbines, are used.

The Transformer

The transformer is a piece of apparatus capable of changing an alternating current at one voltage into an alternating current at another voltage. The principle of the transformer was established by Faraday in 1831, when he made his famous experiment with an iron ring on which he had wound two coils of wire.

In his original transformer, Faraday used a welded ring of soft, round bar iron, ⅞in. thick, the diameter of the ring being 6in. Round one part of this ring he wound about 72ft. of copper wire, $^1/_{20}$in. in diameter, in three layers, about one-half of the ring being covered in this way. On the other half of the ring a length of 60ft. of copper wire was wound in two layers. The three-layer, or primary coil, was connected to a battery, and the other coil, the secondary, was connected to a simple galvanometer. Mention has already been made of the way in which Faraday conducted his experiment. Had he supplied the primary circuit with a rapidly alternating current, he might have obtained an alternating current in the secondary circuit; but his galvanometer would not have indicated the presence of this current if the reversals were too rapid to give the needle time enough to move with each pulsation. Furthermore, there might have been considerable heating of the iron ring, due to the eddy currents set up by the rapid changes in magnetisation. The circulation of eddy currents in the iron represents a loss, and this can be reduced by building up the core with small diameter iron wire or thin sheets of iron. Early illustrations of these methods are recorded in the transformers of Varley and Ferranti.

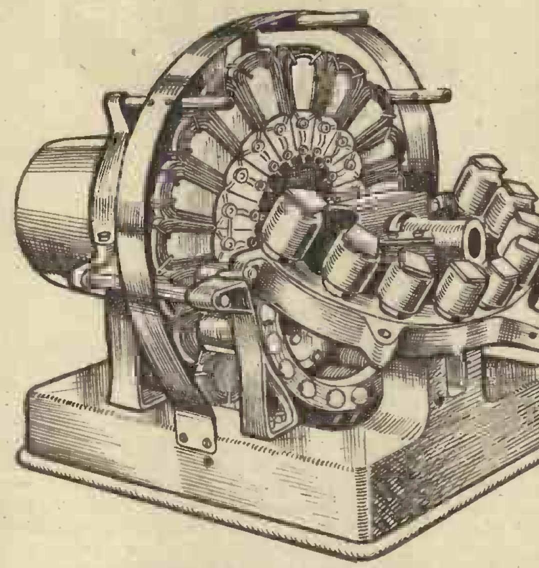


Fig. 3.—An early alternator with armature consisting of bent flat strips of copper.

About 1852, Varley constructed a transformer with iron wires forming the core. He took a bundle of wire of approximately equal lengths, and over this bundle wound the primary and secondary coils. These coils were placed in the middle of the bundle, and extended along it for a distance of about one-third of its length; the iron wires therefore protruded from each end a distance equal to the length of the coils. The two ends of the iron wires were then turned over the outside of the coils and made to overlap each other. In this way the coils were completely encased with iron. Space was made, however, for leading through the connecting wires. Varley was perhaps a little ahead of requirements, because, at that time, the need for anything except small transformers did not exist, but some thirty years later transformers were built by Ferranti which were a further development of the type.

Ferranti took a quantity of thin strips of iron, divided into six bundles and placed side by side. Over the middle of this he wound a layer of thick insulated wire or strip, to form the secondary coil. Finer wire to form the primary coil was wound on a convenient frame in sections, and slipped over the secondary. The ends of the iron strips were then turned over the coils, one half over the top and the remaining half over the bottom, their ends meeting and overlapping in a similar manner to the iron wires in Varley's transformer. The whole arrangement of core and coils was then placed in a cast-iron framework, made in two halves, and securely bolted together.

When a transformer is at work a certain amount of heating takes place owing to the eddy current losses in the iron of the core and resistance losses due to the flow of current in the copper of the primary and secondary coils. In the comparatively small transformers, such as those already described, the heat generated was carried away by radiation into the atmosphere. Subsequently, when transformers were required for considerably higher voltages, it became necessary to immerse the core and coils in insulating oil, thus diminishing the risk of electrical discharge between the high-voltage coil and the frame or the low-voltage coil; it also greatly reduced the risk of personal shock due to accidental contact with the coils.

The transformer, then, is a comparatively simple structure. There are no rotating parts, and the chief elements of its construction are a magnetic circuit comprising the core, two electric circuits comprising the primary and secondary windings, and the auxiliaries comprising tanks, oil and cooling plant.

The Electric Arc

In 1800, the year Volta announced the construction of the voltaic pile, Sir Humphry Davy mentions experiments in which electric sparks were obtained between two carbon points caused by a voltaic pile, and in 1810 he showed to a distinguished audience, assembled in the theatre of the Royal Institution in London, the brilliant light that was produced by passing a current of electricity through two pencils of charcoal about an inch long and one-sixth of an inch in diameter, the points being placed end to end and slightly separated from each other. The only available source of electricity in those days was the voltaic cell, and a battery consisting of 2,000 of these cells was used for the demonstration. Foucault, in 1844, instead of using charcoal, as Davy did, made use of carbon from the retorts of gasworks, which is much harder and did not burn away so quickly. Foucault constructed a hand-regulated arc lamp which Delcuil is said to have made use of in showing the first electric light in the Place de la Concorde, Paris. The next step was to devise means for automatic adjustment of the carbons, and the first apparatus of this kind was devised by Thomas Wright, of London, in 1845. This was carried a step further by Staite in 1848, when he made use of the current of the arc for the regulation of the carbon.

A phenomenon of the direct-current arc is that the positive carbon burns away at approximately twice the rate of the negative carbon, and the end of the positive carbon becomes cup-shaped whereas the negative carbon becomes pointed. This is thought to be due to bombardment of the positive carbon by particles flying off the negative.

"Jablochkoff Candle"

In 1876 Paul Jablochkoff invented the famous "Jablochkoff Candle." This consisted of two parallel carbon rods separated by a layer of plaster of paris. A thin plate of graphite laid across the carbon tips and held in position by a paper band serves to light the candle. The arc thus formed maintained itself between the carbon rods, volatilising the intervening partition. Owing to the unequal burning away of the carbons with direct current, these lamps were found to operate best with alternating current.

The pioneers of electricity supply started by experimenting with arc lamps for lighthouse work. Experimental installations were tried at Blackwall in 1857, then in 1858 at South Foreland and 1862 at Dungeness. The arc lamp was only suitable for the lighting of large areas, and one of the first installations of this kind was at the Gare du Nord, Paris, in 1875. Within the next three years a number of Jablochkoff candles were installed in the same city: some at the Grands Magasins du Louvre, and others for street lighting in one or two of the important avenues. In December, 1878, Jablochkoff candles were installed along the walls of the Thames Embankment, London, between the Waterloo and Westminster bridges. Other installations using the same type of lamp were tried, but they all failed subsequently because of the high cost when compared with gas lighting.

The Incandescent Lamp

When a current of electricity flows through a solid conductor, heat is developed and the amount of heat so developed is proportional to the total energy expended in the conductor. This energy is proportional to the product of two factors, the strength of the current and the difference of potential, or the voltage, between the extremities of the conductor, necessary to maintain the current. So the best developed is proportional in amperes multiplied by volts (1 ampere multiplied by 1 volt equals 1 watt). It was not very long before men conceived the idea of using the heating effect of a current upon a conductor for illuminating purposes, and patents based upon this principle were taken out. In 1858 Jubart proposed to make use of a small carbon rod in a vacuum. Moleyns, of Cheltenham, took out a patent for a lamp which had a glowing platinum spiral upon which coal-dust was allowed to fall. In 1859 Du Moncel obtained very good results by experimenting with carbon filaments of cork, sheepskin, etc. Between the years 1877 and 1880 the incandescent glow lamp began to take practical form, and Edison in America and Swan in this country were independently working on similar lines. The first glow lamp constructed by Edison had platinum wire for the filament. Edison examined the properties of many organic and inorganic substances, with a view to finding the best substance for the filament. He fixed finally upon bamboo fibre.

Edison held the view that to give the carbon the highest possible resistance and the smallest tendency to disintegration, it should retain its structural character. Swan, on the other hand, maintained that the structure of the material should be entirely destroyed, and the carbon filament made as dense as possible. Long before Edison he tried to obtain more durable carbon filaments.

The filament of the Swan type lamp was made either direct from cotton thread or from thread formed by squirting a solution of cellulose through a fine nozzle at high pressure, cellulose being the chief constituent of such vegetable substances as cotton, paper, etc.

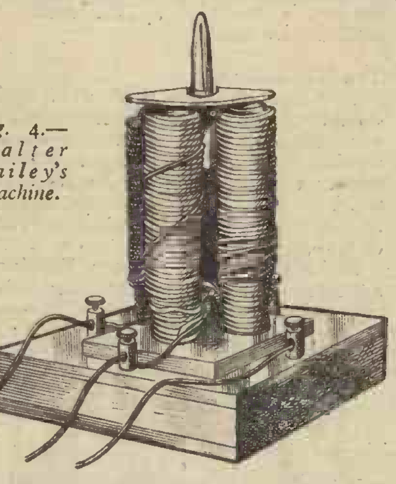


Fig. 4.—Walter Bailey's machine.

Early in 1900 experiments were renewed to obtain a satisfactory metal-filament lamp in place of the carbon filament. About the year 1911 lamps were made with filaments of the metal tantalum. This metal was found unsatisfactory, mainly because it was not possible, owing to its low specific resistance, to make a lamp satisfactory for voltages in excess of about 125. In 1914 tantalum was superseded by tungsten. With this metal, lamps for voltages of 235 to 250 could be made, and as the filament could be run at a temperature some 300 deg. C. above that of the carbon filament, there resulted a great improvement in the efficiency, the consumption of the new lamp being just under one-half that of the carbon lamp. Of recent years the efficiency has been further improved by operating the filament in an inert gas (argon or nitrogen) instead of in vacuo.

The Electric Motor

As early as 1830, that is, before the results of the Faraday experiments on electromagnetic induction became known, various experimenters constructed apparatus which translated electricity from primary cells into mechanical work. In general, the apparatus consisted of a long, straight bar of metal supported rather like the beam of a pair of scales. Attached to the beam on one side of the fulcrum was a fixed piece of iron, called the armature, which was influenced by an electromagnet fixed immediately underneath. At the end of the beam, on the other side of the fulcrum, was fitted a rod which acted as a pawl to a toothed wheel. The electro-magnet, on being energised from a battery, attracted the armature which tilted the beam and so moved the wheel to the extent of one tooth. This movement actuated a switch in the battery circuit and, the current being cut off, the lever reverted to its original position. This sequence then repeated itself, and so the axle, on which the toothed wheel was fixed, rotated. Other similar devices were constructed. In 1845 Froment constructed a machine which showed a great improvement. It consisted of two wheels mounted a short distance apart on the same axle, and at intervals around the periphery, soft iron bars were fastened, in line with the axle, the bars rigidly connecting the two wheels. Mounted on a framework which carried the axle were four pairs of electromagnets so arranged that they would attract the soft iron bars on the wheel and bring about a continuous rotation. Current for energising the electro-magnets was supplied from a battery and was periodically interrupted by a commutator attached to the axle of the wheel, the whole being so arranged that the two electro-magnets which were being approached by the iron bars on the wheel were being energised in turn.

Various motors were constructed in which the reciprocating motion of an iron plunger inside a solenoid was made to transmit motion, in much the same way that the motion of a steam engine piston is utilised.

Pacinotti's Ring Armature

A great advance was made in 1860 when Pacinotti invented the ring armature which, it will be remembered, was improved and used by Gramme in the construction of his dynamo. Notwithstanding, Pacinotti built a small model machine in 1860 which he called an electromagnetic machine. He failed, however, to bring it to such perfection as to justify its adoption for practical use.

In 1867 Siemens observed the reversibility of the dynamo. If the armature of a dynamo electric machine be made to rotate, as does the ring of a Gramme machine, currents are produced in the coils of the ring which may be utilised for the excitation of the electromagnets, and for giving a supply to the external circuit. If the process be reversed, i.e., if the terminals of the machine are connected to a source of electricity supply, the electromagnets will be excited and current will also flow in the armature. The magnetism produced by the armature coils will be affected by the fixed electro-magnets, the armature will revolve and continue to do so as long as the current flows through the coils of the machine.

A public experiment in the transmission of power by electricity and its conversion into mechanical power was made during the exhibition at Vienna in 1873. A Gramme, with permanent horseshoe magnets, driven by a steam engine, was used as a generator, and current was conveyed to a similar machine about 500 yards distant.

When considering the alternating current motor the solution is not quite so simple, particularly with regard to single-phase currents, because with the rapid reversals of the current, the armature conductors would be pulled alternately in one direction and then in the other, with the result that no movement would take place.

As early as 1824 Arago observed that when a copper disc is made to rotate in its own plane, and a magnetic needle is placed over it, the needle turns round in the same direction as the disc. A part of the field from the magnetic needle passed through the copper disc, which, on being rotated, cut the magnetic lines and thereby induced currents in the copper.

In 1879 Walter Bailey showed how Arago's rotation could be produced by a number of electro-magnets acting on a copper disc. Below a pivoted disc he arranged four electromagnets with their vertical axes equidistant from the centre. The magnets were excited by currents from a battery, and a commutator was used for alternately reversing the polarity. By causing the current to be reversed rapidly, the effect of a rotating field was produced. (Fig. 4.)

On this principle the modern alternating current induction motor is constructed. A rotating field is produced by winding on the fixed part of the machine coils displaced at 90 deg. or 120 deg. apart, to which either a two-phase or three-phase supply is connected.

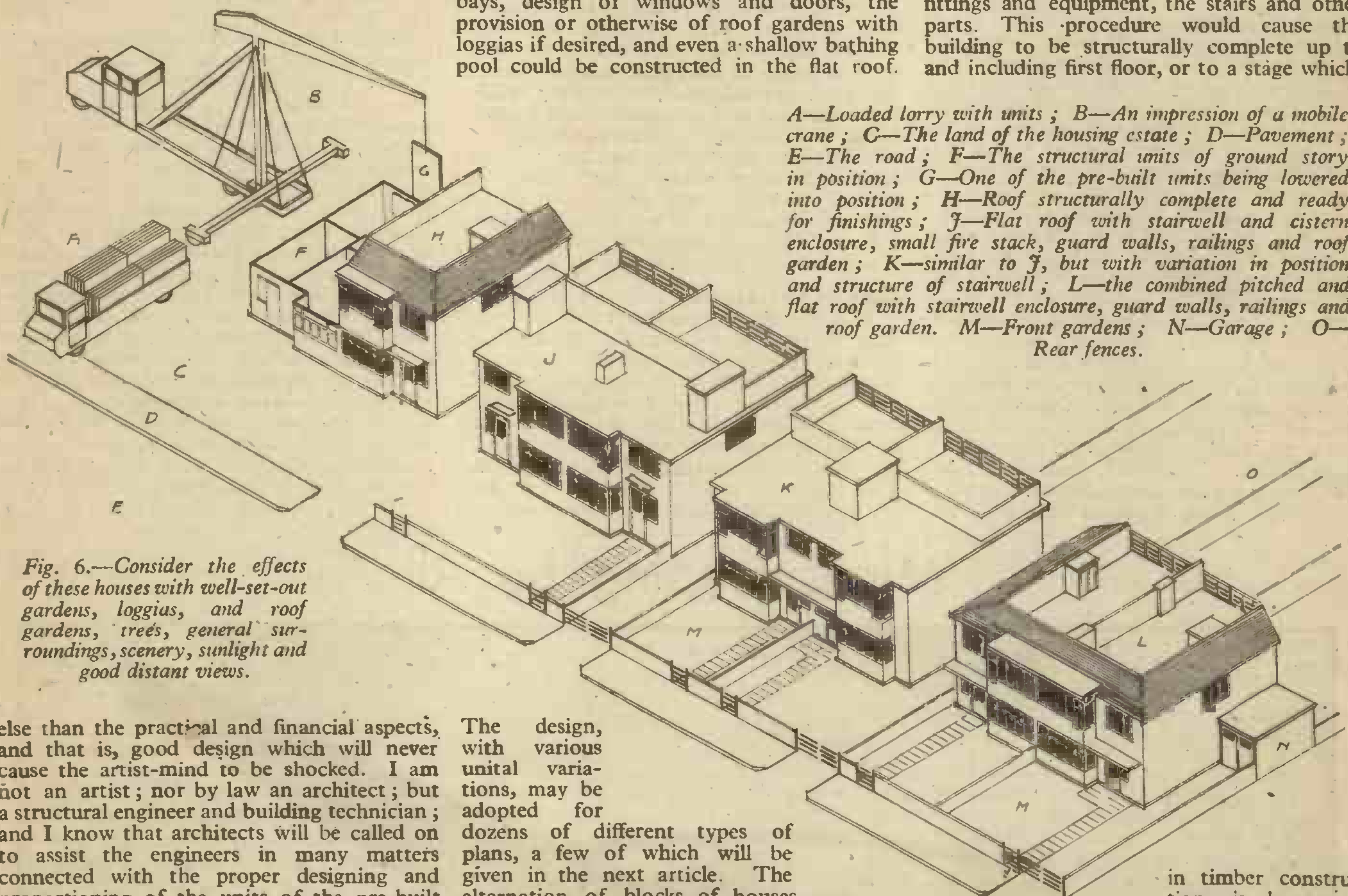
(To be continued)

Engineer-built Houses of the Future—2

New Principles, Speedy Construction, and Comparative Costs

By R. V. BOUGHTON, A.I.Struct.E.

THE main principles and objects of anything new must be planned and considered in a broad way before much detailing is attempted; detail work, in connection with engineering particularly, follows with comparative ease once it is known that the principles and requirements are practical and economical. Houses which are practical and economical provide a great foundation for engineering enterprise, and above that foundation must rise something else than the practical and financial aspects, and that is, good design which will never cause the artist-mind to be shocked. I am not an artist; nor by law an architect; but a structural engineer and building technician; and I know that architects will be called on to assist the engineers in many matters connected with the proper designing and proportioning of the units of the pre-built houses of the post-war period. I also know that women will exercise their minds (and tongues) in the great subject of house design, equipment and decoration. In the first article of this series enough general evidence was given to engender a keen interest in a subject which many millions of people must have in mind. Now further advances will be made to literally force this keen interest into practical action.



A—Loaded lorry with units; B—An impression of a mobile crane; C—The land of the housing estate; D—Pavement; E—The road; F—The structural units of ground story in position; G—One of the pre-built units being lowered into position; H—Roof structurally complete and ready for finishings; J—Flat roof with stairwell and cistern enclosure, small fire stack, guard walls, railings and roof garden; K—similar to J, but with variation in position and structure of stairwell; L—the combined pitched and flat roof with stairwell enclosure, guard walls, railings and roof garden. M—Front gardens; N—Garage; O—Rear fences.

Fig. 6.—Consider the effects of these houses with well-set-out gardens, loggias, and roof gardens, trees, general surroundings, scenery, sunlight and good distant views.

The illustration, Fig. 6, is a simple isometric bird's-eye view of a row of engineer-designed and built houses, some of which are completed and others semi-finished or in course of erection. Note the entire absence of scaffolding, ladders, mortar bins, bricks, stacks of timber, joinery and other materials, and the usual array of things which littered a housing site in pre-war days for weeks, if not months. Next, study the manner by which in main principle (of course bettered as knowledge increases) the pre-built structural units of floors, walls and roofs would be transported to site and erected by a mobile crane, the main parts of which would be lowered on to the chassis when work is completed. The view, with its comprehensive annotations, should make it manifest that the houses may vary very considerably in the design of the general outline, disposition on site, types and shapes of roofs, location and proportion of bays, design of windows and doors, the provision or otherwise of roof gardens with loggias if desired, and even a shallow bathing pool could be constructed in the flat roof. The design, with various unital variations, may be adopted for dozens of different types of plans, a few of which will be given in the next article. The alternation of blocks of houses with all-flat and combined pitched and flat roofs will not only help to break any monotony caused by an unbroken roof line, but the limited depth of pitched roof would assist in maintaining the old traditions of the steeply sloping roof. The method of presenting the bird's-eye view by isometric projection is to allow elevations and roofs to be shown clearly; the reader will understand that a different view would be obtained from ground level—the elevations would be much more in evidence than the roofs.

Order of Erection, Finishings and Equipment

In compliance with a general principle of pre-building which I advocate, the various units would be composed, where it applies, of separate structural and finishing parts, each part, although being separate, would be made to one pattern so as to ensure accurate and speedy application of the finishing part to the structural part. When setting out, and ground and base work has been completed, the erection would commence, and continue until completion is effected to each house, of all structural units in: ground story, including ground floor, walls and partitions, fireplace and flue units, window and door frames combined in the units, the first floor, the structural parts of the combined pre-built fittings and equipment, the stairs and other parts. This procedure would cause the building to be structurally complete up to and including first floor, or to a stage which, in timber construction, is known in America as the first stage of the platform frame system. This good system provides a platform for operatives to work upon to assist in the erection of the first story units. After the ground story is erected, the units, similar to those specified for the ground story, are placed in position up to and including the roof units, although the pitched roof members may be fixed a little later if practical conditions make this course advisable. Waterproofing and sealing the joints of units exposed to the weather would proceed during erection. The finishings to floors, walls, partitions, ceilings, roofs and all other members and parts exposed to view and as required can then be applied. The majority of this work would be of panel formation, shaped to and being part of the structural members to which they are to be fixed. Next will be the fixing of sashes to windows, delivered glazed and complete with all fittings, doors similarly complete, stair finishings, equipment and built-in furniture items, sanitary fittings, boilers, hot and cold water units, fires and various other assembled units. The limited amount of plumbers' work would proceed in conjunction with the work. The installation of electrical work will cause no trouble and proceed with the general finishings.

External Services

The external services include important sections of work as water, gas and electricity services, drains, paths and fences. Not many of the old principles and details will be followed by the designers and builders of the engineer-houses. The running of the services can conform to much better codes of practice than have hitherto been practised; drainage inspection chambers may be of standard and complete units ready for placing into position and connecting to the pipes; paths may follow old principles; fences will certainly not be constructed with short-life timber buried in the ground.

Speedy Construction

Speeds in erection and habitation of dry houses are two of the many advantages of pre-building which does not call for the building, assembly and application of anything like the great quantities of materials specified in the first article of this series—over 50,000 bits and pieces in each house as well as several tons of cement, many cubic yards of ballast and sand, and hundreds of gallons of water, etc. The pre-built units to form the floor, walls, roof and other parts of each house will number a few hundreds only in structural and finishing units, the majority of the small items in the units being mostly machine-made and assembled ready for speedy and accurate fixing on site; and each unit would be comparatively light in weight to give sufficient structural strength and ease of manipulation. Further study of Fig. 6 will give an indication that there is every opportunity, with quite a limited number of skilled, semi-skilled and unskilled operatives, of erecting the structural units of one house in two or three days, and under certain conditions of organisation this time may be shortened. The finishings should be done under the same time limits. In my considered opinion, a house should be ready for habitation in about a week from the day it is set out.

Catalogued Units

We already have catalogues of many standardised building units, such as metal and wood windows and doors of various types and sizes, all machine-made; we have many items used in building which conform with British Standards specifications which are machine-made; we have machine-made bricks, tiles, floorings, fittings and hundreds of other materials and goods—all made with the scientific, technical, and commercial knowledge of engineers.

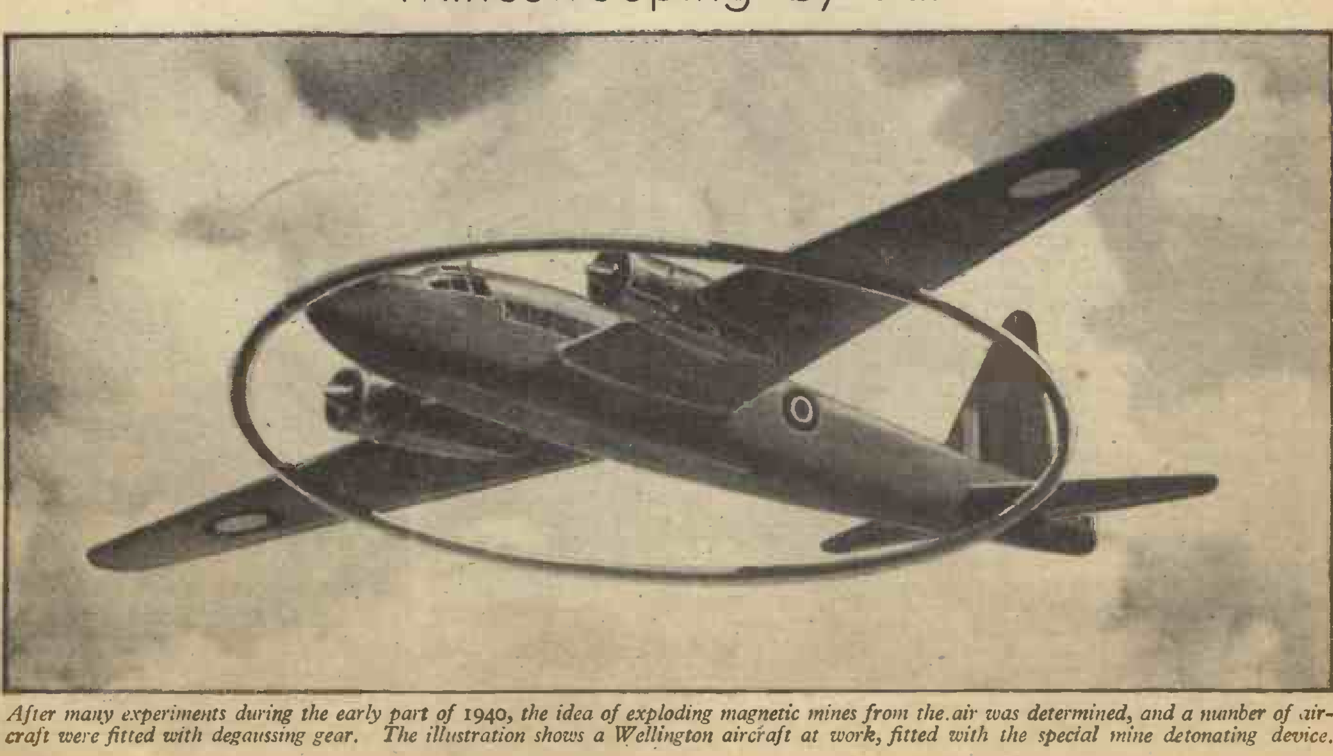
It should be manifest that a sane collection of all these advantages hitherto provided by the combined brains of engineers and builders can and will produce comprehensive standard schedules in catalogue form, which will provide architects and builders with hundreds of standardised pre-built units suitable for every practical want in the planning, including size of various rooms, etc., for the elevational and sectional needs including heights of stories, and to conform not with the architectural genius of such old masters as Wren or Barry, or the atrocities of the jerry builder, but something at least equal to, and probably better than, the efforts of the box designers of the decades between this and the last war; and, what is of extreme importance, the general planning and equipment of the engineer-designed, built and catalogued house will have those arrangements and equipment which suit the housewife.

Cost of the Houses

It is, of course, prudent to discuss costs only in proportional sense. It would be unwise to prophesy the costs of materials and labour after cessation of hostilities, but it is safe to state that a pre-built engineer-designed house, exclusive of land, will cost about two-thirds of the post-war cost of the ordinary pre-war type of house of equal accommodation. This statement alone is insufficient, as there are several other factors to consider with the utmost care. Land and road charges will be similar for all types of houses of equal land frontage. The cost of new houses after the war will, in all probability, be much higher for a number of years than the cost of houses built in the last decade of the pre-war period. These two factors may have a balancing effect on the values of pre-war houses and engineer-built houses, and, of course, show a considerable direct advantage of a new engineer-built house over a new brick-built, tiled roof house. This practical financial subject may now be extended into the field of many other direct and indirect financial advantages and they are: Pre-built machine-made units complying with a good specification assure precision and almost entirely eliminate the use of bad materials and workmanship, and certainly avoid the curses of jerry building; and they do not require the jobbing-builder-surgeon to use his sundry impedimenta, ranging from transport of much plant, through the various processes of hacking, sawing and dirt making to making good, and dabs of paint. Instead, it will mean referring to the Book of Instructions and Schedule of Units and ordering what is required, which will be either fixed by the local builder or by the house-owner. Financing by building societies or local authorities should be simplified considerably (as will be explained in a future article of this series) as all parties will know exactly the position as to the quality of the houses. The duties of building inspectors of local authorities will be lessened as their main concern will be connected with foundations, bases and drains; as to other parts of the structure, they will know that the best brains of the engineering professions have designed all structural and finishing works to guarantee their compliance with the best principles and details. House owners will not be burdened with heavy expenditures on repairs and decorations, for the simple reason that there will be no cracked and defective plastered ceilings; no slipped and broken roof tiles or slates; no settlements in walls, no jamming windows and doors, no defective hot-water systems, no freezing-up in winter, and not very extensive *essential* protective decorations.

(To be continued.)

Minesweeping by Air



After many experiments during the early part of 1940, the idea of exploding magnetic mines from the air was determined, and a number of aircraft were fitted with degaussing gear. The illustration shows a Wellington aircraft at work, fitted with the special mine detonating device.

Odd Jobs in House and Garden

Laying and Repairing Linoleum : Staining and Polishing Floors

By "HANDYMAN"

BEFORE laying lino over ordinary floorboards care should be taken to see that all tacks or nail heads are removed or hammered flush, otherwise the lino will wear through quickly. If the floor is an old one knots may stand proud of the surface, and must be levelled with a chisel or plane. Another trouble is uneven boards, and, in this case, it will be necessary to trim off the upstanding edges with a plane.

In order to make a good join when laying lino a proper knife and a "straight-edge" should be used. The best kind of knife is one with a hooked point, as shown at A, Fig. 1, but a shoemaker's knife (B) makes a good substitute. For a "straight-edge" a piece of wood 3ft. to 4ft. long and about 4in. wide, with a planed edge, can be used.

After marking the piece of linoleum where it is to be cut, hold the piece of wood down

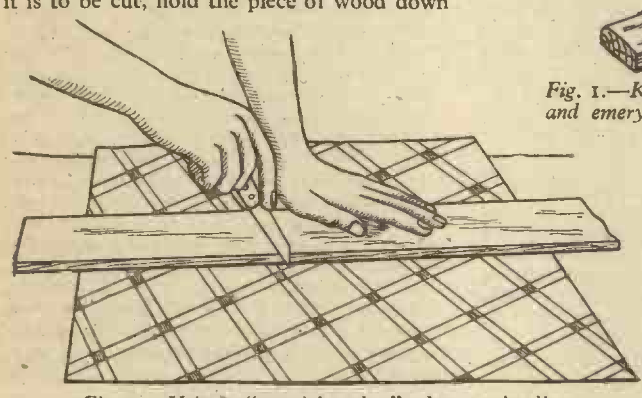


Fig. 2.—Using a "straight-edge" when cutting lino.

firmly, and use the planed edge as a guide for the knife, as shown in Fig. 2. To keep the knife sharp, rub it on a water-stone or on a piece of fine emery cloth wrapped round a flat block of wood, as at C, Fig. 1.

When cutting narrow widths, the lino can be placed on the kitchen table (Fig. 2), but for the large main piece the work of cutting must be done on the floor. Kneel well on the lino and draw the knife along steadily, and with a firm pressure. A second or third cut may be necessary before the knife is through.

Headless brads, of tapered square section, should be used for nailing down the linoleum; these brads make it easy to lift the lino when necessary. There is no need to put in many brads, as lino tends to lie flat. A neat finish can be made along the bottom of the skirting by nailing down lengths of plain triangular wood moulding. This not only covers any slight unevenness along the edge of the lino, but also facilitates sweeping and cleaning the corners.

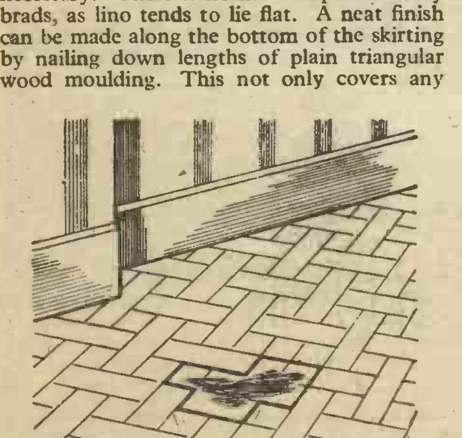


Fig. 3.—Marking out a damaged part of linoleum for removal.

Repairing Damaged Lino

It is sometimes necessary to repair lino which has been damaged by heavy furniture or broken castors. One method is to obtain a sound piece of lino to match the damaged part, which should be carefully removed by

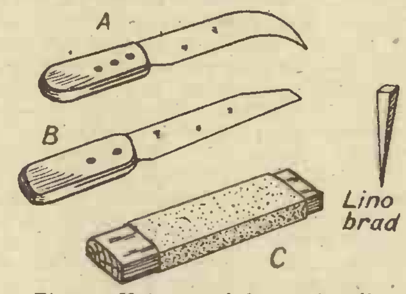


Fig. 1.—Knives used for cutting lino; and emery-paper block for sharpening.

cutting along the lines of the pattern, as shown in Fig. 3. Using this piece as a template, cut the new material to the size required and neatly fix this in place with brads, punching the heads of the brads slightly below the surface of the lino.

Another method is to cut out the damaged piece and after removing it slip a new piece of lino (of larger size) underneath. Shift it until it matches the pattern properly, and temporarily fix it with a few brads half driven in. By carefully drawing the knife along the edge of the hole and through the piece of lino underneath a good fit will result. Remove the brads, lift all loose pieces of lino out, then insert the new piece, and finally fix it in place.

Cleaning Linoleum

If the surface is matt, it can be washed occasionally with warm soapy water. On no account should soda be used, as this tends to dry out the oil in the material, causing it to crack. A little linseed oil applied after washing will act as a preservative.

If the surface of the linoleum has been wax polished it is only necessary to apply liquid polish about once every two weeks to keep it in good condition.

Staining Floors

Before staining a floor it should be properly prepared by first of all removing all tacks or nails and plugging the holes with plastic wood. All traces of dirt or grease must be removed by washing the floor well with strong soap and water, followed by clean water. After drying, rub the floor over with a piece of glass paper wrapped round a flat block of wood.

It is usual to stain only the surround, or that portion of the floor not covered by the carpet or lino, plus an extra 6in. for the edge of the floor covering to overlap.

There are several kinds of stain that can be used, one of the cheapest being made by dissolving permanganate of potash crystals in warm water. The stronger the solution the darker the tone. If the first coating does not give a dark enough tone another coating can be applied after the first one has thoroughly dried.

Another cheap stain is made by dissolving Vandyke crystals in warm water, adding to each pint about ¼ oz. of ammonia, and a little glue size. This is suitable for a light oak or walnut colour, but if a darker shade is required a mixture of Brunswick black and turpentine can be used, adding less turpentine the darker the shade required. Other water, oil or spirit stains are readily procurable at any oil and colourman's shop.

Apply the stain with a wide flat brush, and work with the grain of the wood where possible.

A Simple Polisher

The easiest way of polishing is to use a polisher with a long handle to avoid kneeling down to the job. Such a polisher can be purchased, but the simple device illustrated in Fig. 4 will be found to answer the purpose quite well, and can easily be made at home.

The base consists of a piece of wood 9in. long, 6in. wide and at least ¾in. thick. This is covered with several layers of old flannel, to form a pad, and this in turn is covered with a piece of strong calico, the ends of which are turned up over the wooden base, and secured by brass-headed pins. Screwed to the centre of the top of the base is another piece of ¾in. wood 5in. by 4in. wide, to the ends of which are screwed two pieces of the same thickness and width, and 2½in. wide. Between these pieces another piece of wood (D) is pivoted by means of two stout iron screws, the two lower edges being rounded, as shown at E. The screws should be driven tightly

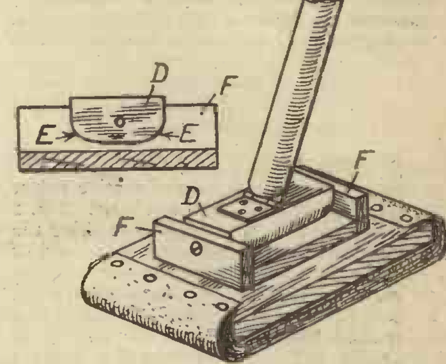


Fig. 4.—A simple floor polisher, and detail of swivel top.

into the part D, but the holes in the part F must be an easy fit for the shanks of the screws. One end of the handle (an ordinary broom handle) has a flat chiselled on one side, to which one leaf of an iron hinge is screwed. The other leaf is screwed to the part D, so that the end of the handle comes about the centre of the polisher. It will be seen that when in use the handle of the polisher can be moved from side to side as well as backwards or forwards.

Toy Manufacture: Principles and Practice

The Methods of Operation, and Constructional Details

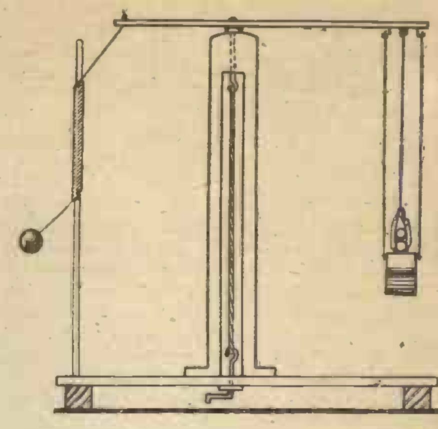


Fig. 5.—*An amusing elastic-driven swinging toy which, when correctly adjusted, will work for over a quarter of an hour.*

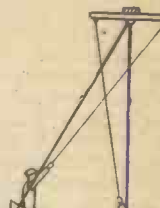


Fig. 6.—*A detail of the swing boats shown by Fig. 5.*

AT the present time, when toys are scarce and only obtainable at prohibitive prices, this new series of articles on Toy Making should prove a boon. Sufficient information is given to enable anyone with a few tools to make simple working toys quite cheaply.

There are two main classes of toys—soft and hard. Soft toys include dolls and similar toys, and hard toys such novelties as clockwork locomotives, tops, steam engines,

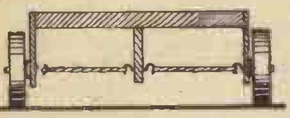


Fig. 1.—*A twisted skein of elastic may be applied to drive a toy motor-car or any similar type of runabout toy.*

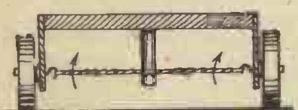


Fig. 2.—*A peg passed through the centre of a single elastic skein enables both wheels to revolve in the same direction.*

etc. In both these classes are working models and non-working models. A further examination of these two classes will reveal that all of them work on a number of well-known principles, employing simple mechanical movements. In some toys gravity is the actuating power. In others, chemical action is used; wind power, clockwork springs, twisted elastic, steam, and many other mechanical and natural forces are employed to create movement in the toy itself.

Elastic-driven Toys

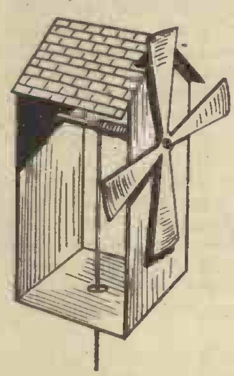
Perhaps the simplest form of motive power for toys is the twisted skein of elastic. Fig. 1 shows how this may be applied to drive the rear wheels of a toy motor-car. This form of drive may be applied either to the front or back wheels. Each wheel has a small hook extension of its axle, and this is connected to a similar hook suspended from the bottom of the car. It will easily be seen that when a skein of elastic is connected from each wheel hook to the hooks suspended from the floor of the car, and the latter is drawn backwards along the floor, the skeins will be twisted, and when the car is released it will run forward. A variation of this idea consists of connecting both wheels with a single skein of elastic and passing a peg through the skein, as shown in Fig. 2, which virtually splits the skein into two and enables both wheels to revolve in the same direction.

Elastic-driven Bicycle

Fig. 3 shows another novel toy. Here the figure of a man is mounted on a bicycle. A pointed peg carries two wire struts connected to the bicycle, which may be of the penny-farthing variety or a safety bicycle, and a small bracket carrying a crank hook by means of which the elastic skein is wound. The other end of the elastic skein is connected to the rear wheel of the bicycle, through which the drive is effected. The figure seated on the saddle is suitably jointed so that when the bicycle is in motion (it travels, of course, in a circle), the limbs simulate the action of a real cyclist.

The Acrobatic Balls

Fig. 4 shows two fairly heavy balls, with hooks screwed into each, and connected by a skein of elastic. By twisting the two balls in opposite directions the elastic skein will become twisted, and when the balls are placed on the floor they will perform a series of amusing and queer antics. There is one other peculiar property of the elastic skein when used in this way. The two balls when unwinding will gather considerable momentum, so that they will overrun themselves and rewind the elastic skein in the opposite direction, but, of course, not to the same extent as the initial winding. It will continue to unwind and rewind itself a considerable number of times before the initial force stored in the elastic is finally spent.



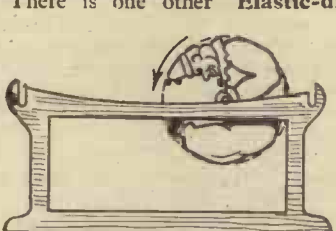


Fig. 7.—*When the lower end of the string is pulled the windmill will rotate at a rapid rate, whistling whilst doing so. It will also re-wind itself.*

Fig. 8.—*A simple tumbling acrobat, operated by means of momentum obtained from a revolving flywheel.*

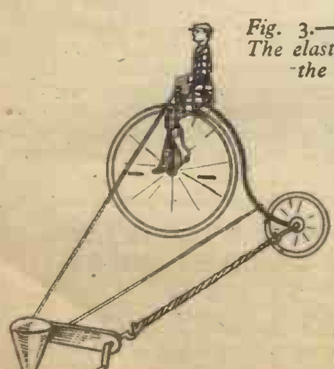


Fig. 3.—*Another elastic-driven toy. The elastic, when twisted, will make the toy revolve in a circle.*

Fig. 4.—*By twisting the balls in opposite directions, and releasing them on the floor, they perform a series of amusing antics.*

Elastic-driven Model Boats

The elastic skein has of late years been adopted to drive model boats; a simple bearing carrying the propeller and hooked propeller shaft, with a single skein of elastic secured at the bow end of the keel to another hook, constitutes its simplest application for this purpose. For larger boats, however, geared motors should be used to provide greater power. The idea here is to use two separate strands of rubber geared together so that they may act on the single propeller. The skeins should be arranged so that they are not quite parallel, which enables the gearing to be reduced in width at the fore end of the boat. The construction must be designed to suit the size and shape of the vessel. The gearing consists of two spur wheels of equal size running in bearings in an angle plate of sheet brass and carrying hooks to which the rubber strands are hitched. Special gears for this purpose are obtainable from model aeroplane accessory dealers. Clock wheels are quite unsuitable.

Elastic-driven Swing Boat

Fig. 5 illustrates an interesting elastic-driven toy which came on the market a few years ago. It consists of two figures in a swing boat suspended from a cross-arm, rotated by an elastic skein interposed between two uprights fastened to a base. Beneath the base is a small winding crank, which extends through the base, and is crooked at its upper end to engage with the elastic. At the other end of the arm carrying the swing boat a piece of twine is fastened, and the lower end of this carries a small metal ball.

It will be obvious that when the elastic is wound the top arm will revolve for one revolution. The momentum thus imparted to the string will cause this to swing out and catch on the supplementary upright fixed to the base for that purpose. the ball will thus twist itself round this upright, and the check action thus imparted to the revolving arm will cause the boat to swing, and the figures in it, having jointed limbs, will imitate the action of two

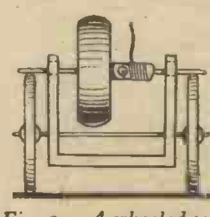


Fig. 9.—*A wheeled toy can be operated by momentum in the manner shown here.*

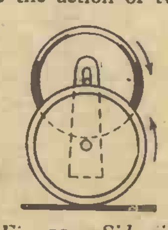


Fig. 10.—*Side view of the device shown in Fig. 9.*

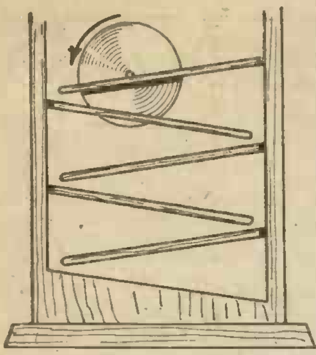


Fig. 11.—An inclined plane mechanism for working clowns, acrobats, and see-saws.

human beings operating a real swing boat. There are certain niceties in the adjustment of this novelty to be observed before it will work satisfactorily, but the toy once correctly adjusted will continue to work for over a quarter of an hour. Fig. 6 is a detail of the swing boats.

Fig. 7 shows a model windmill having a string attached to its spindle. The vanes of the windmill are set at a slight angle and have a small whistle attached. The spindle is rotated by means of the vanes to wind the string upon it. When the lower end of the string is pulled the windmill will revolve at a rapid rate, whistling while doing so, and it will overrun itself and rewind the string. By continuously and alternately exerting tension on the string and releasing tension the windmill will continue to spin indefinitely. It will be seen that the underlying principle of this toy is that of momentum, which may be applied in many other ways to operate toys.

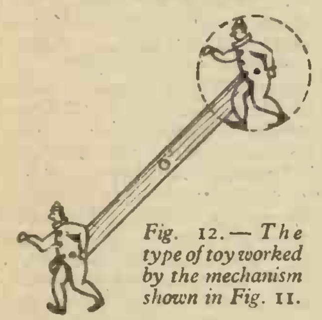


Fig. 12.—The type of toy worked by the mechanism shown in Fig. 11.

Toys Operated by Momentum

Fig. 8 shows a simple tumbling acrobat connected to the spindle of a spinning flywheel. This spindle should be made of the smallest possible diameter so that the figure makes a considerable number of revolutions before it reaches the end of its track. A string is wound round the spindle to operate it. Small slots are provided at each end of the track support to prevent the figure rolling off. The clown can, of course, be jointed at the arms, knees and hips.

This same motion may be used to drive wheeled toys, such as a motor-car, in the manner shown in Figs. 9 and 10. Here the spindle to which the flywheel is attached extends through the body of the toy and makes contact with the peripheries of the two rear wheels. A small drum is also mounted between the two wheels, and string is wound round this. When the string is given a sharp jerk the flywheel is set in motion, and when the toy is placed on the floor the wheels make contact with the ends of the spindle, which thus drives them. Owing to the gear reduction occasioned by the difference in the diameters of the spindle and the wheels, the rate of progression of the toy will not be rapid, although the duration of its run will be about twice as long as the ordinary clockwork toy.

Inclined Plane Toys

A development of this idea, and one which is a decided improvement on it, is illustrated in Fig. 11. Here a wheel with spindle attached is made to roll down a series of inclined planes. Any number of inclined planes may be used, and the ends of the spindle may be employed to drive working models, such as clowns, acrobats, and see-saws, as shown in Fig. 12.

Gravity-operated Toys

Quite a number of interesting toys of the swinging and see-saw variety may be made, utilising gravity as the operating force. For example, the simplest toy of this type is shown in Figs. 13 and 14. Here the figure of a soldier (or any other figure, for that matter) is mounted on a hemispherical base loaded with lead. When the figure is inclined with the finger it will continue to swing or sway backwards and forwards for a considerable time, owing to its very low centre of gravity. Another toy working the same on principle is shown in Fig. 15. Here the figure is mounted on a pedestal, and two wire arms, with loaded balls attached, enable the figure to swing and sway for a considerable time without becoming unseated from its perch. Fig. 16 illustrates the vaulting horse. Here the weight is disposed a fair distance behind the point of support of the horse, which will continue to prance and vault once the weight is set in motion.

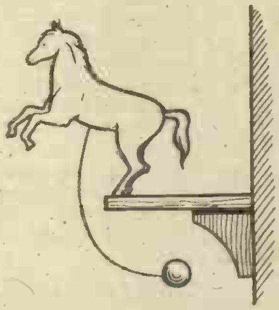


Fig. 16.—The vaulting horse, employing the same principle as in Fig. 15.

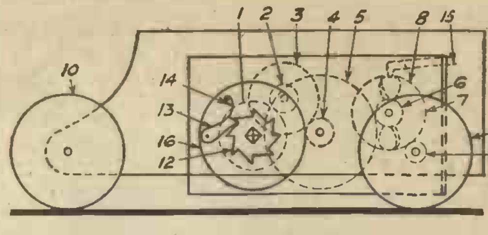


Fig. 18.—Elements of a clockwork motor for toys. It may be made from old clock parts.

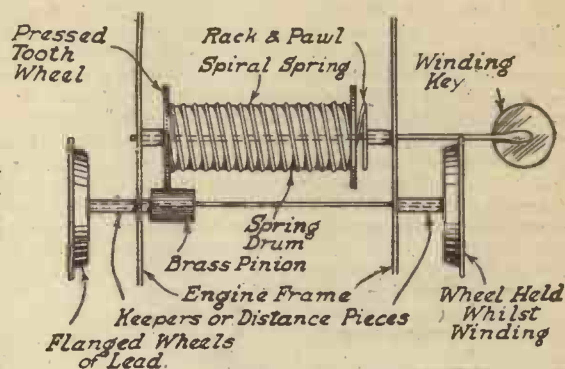


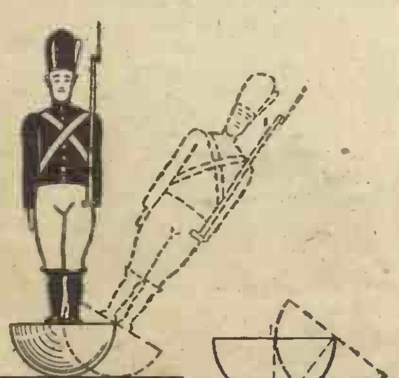
Fig. 19.—A simpler type of clockwork motor using a helical spring.

An interesting and realistic toy is that illustrated in Fig. 17. Here two acrobats, both pivoted between two tubes containing mercury, vault down a series of steps in a very realistic manner. Any number of steps can be arranged; the figure will continue to work as long as there is a step for them to tumble down. The principle on which the toy works is this: When the figures are placed upon the top step, the mercury will run to one end of the tube and lift the hindmost clown off his feet, thus swinging him over the head of the other clown. The two clowns are also connected together by two threads which cause the figure in the air, when it reaches a certain point, to capsize and to descend upon the next lowest step. This cycle of operation continues until the last step is reached.

Clockwork Motors for Toys

There are two forms of clockwork toy motors: that which uses a clockwork spring properly so described, and that which uses a spiral spring wound upon a drum. Both of these types, which are illustrated in Figs. 18 and 19, may be made from old clock parts. In Fig. 18 the various pinions are shown; 12 is a ratchet wheel, 13 is a pawl, and 14 is the pawl's spring. The first driving wheel is indicated by the figure 1, and the second by the figure 3; 4, 5 and 6 are a pinion and spur wheel. Fig. 19 is self-explanatory.

(*To be continued*)



Figs. 13 and 14.—When the soldier is inclined with the finger it will continue to sway backwards and forwards for a considerable time. It will refuse to lie down.

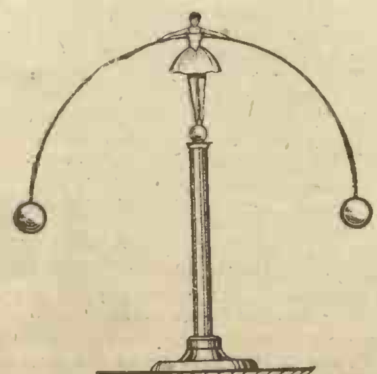


Fig. 15.—A figure which swings and sways for a considerable period without falling off the pedestal, owing to the weights being below the centre of support.

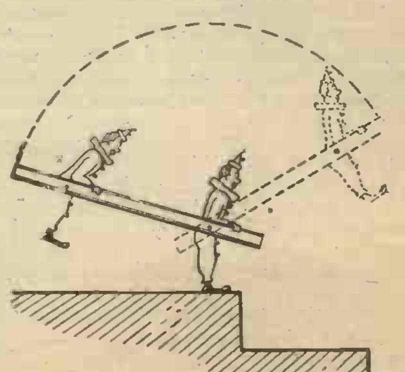


Fig. 17.—Two figures pivoted between two tubes containing mercury will somersault downstairs in a realistic manner.

MASTERS OF MECHANICS

No. 83.—Francis Maceroni, the Manchester-born Italian, and his Road Locomotives

THE engineering student of the present day may well be excused for probably never having heard of Francis Maceroni, since this individual, despite his energetic enthusiasm and originality of mind, was one of invention's "unlucky ones," and the details of his career have lain buried under the accumulated weight of more than a century of mechanical invention and discovery.

Yet Maceroni was a power in his day. Had it not been for the coming of the railways, this pioneer of steam-power application would no doubt have prospered and made good for himself. But because this early inventor concentrated the majority of his ingenuities upon the production of serviceable steam-powered "road carriages" he sank into obscurity and even, it is thought, into a profound state of poverty in consequence of the several vested interests which, during the early period of Queen Victoria's reign, well-nigh totally closed the roads of Britain to any semblance of mechanically propelled vehicle.

Maceroni's Italian-born father was in business as a merchant in Manchester, and it was in a country house near to that then prosperous and growing cotton town that Francis Maceroni, his engineer son, first saw the light, in the year 1788.

A reproduction of an early eighteenth century cartoon. It embodies the artist's idea of a steam plough, and was issued to ridicule the use of steam for locomotive purposes.

Of his early years and boyhood, his education and upbringing, nothing seems to be known. He first comes into the picture of history in 1814, in which year he was resident in Italy, and had been made an aide-de-camp to Murat, King of Naples. Although only 25 years of age, he held the rank of colonel, and this title, through some whim or fancy, he proudly retained and used to the end of his life.

How Maceroni first obtained an interest in, and an insight into, the technicalities of engineering and mechanics is quite unknown. Doubtless, however, his early military career had something to do with his mechanical leaning.

In 1825 Maceroni moved to London, and apparently sought in that city new interests and new fields for activity. He chose to be a steam-engine inventor, doubtless in consequence of his having seen a number of the early locomotives "in action" and having had opportunities for criticising their many defects.

At that time Goldsworthy Gurney, the Cornish engineer and mechanical experimenter, was making trials with steam boilers and road locomotives. Between 1825 and 1828 we find Maceroni helping Gurney to improve his engines and also to find financial support for his inventions. It seems, however, that after a period of three years with Goldsworthy Gurney, Maceroni convinced himself that Gurney's efforts would, for one reason or another, never succeed. And, having this conviction in mind, he suddenly threw up his association with the Cornish engineer and took himself off to a no less romantic city than Constantinople, in which town he appears to have led merely a wandering, haphazard existence.

The summer of 1831 saw Maceroni back in London, this time with the idea in his head of constructing a steam "road carriage" which would really run. Similar vehicles had been designed and constructed in the past, but the majority of them had had only very short-lived successes, and this lack of success Maceroni put down principally to defects in their boiler systems.

Maceroni's Boiler

So, with his head full of road-carriages and steam boilers, Maceroni, in conjunction with an individual named Squire, invented and patented what was inherently a really efficient portable multi-tube boiler for road locomotive use.

Maceroni's boiler was made up of 81 vertical tubes arranged in nine rows and with the firegrate in the centre. All the tubes were connected together at top and bottom, the bottom connections being for water and the top ones for steam. From these latter connections steam escaped to a central dome, from which it was taken to the engine cylinders. There was a good diffusion and economy of heat in this boiler, and it proved to be a rapid and an efficient steam generator, its working pressure being of the order of 150 lb. per sq. in.

Consequent upon obtaining his patent for the newly invented steam boiler, Maceroni, aided by a few workmen, constructed a steam carriage for use on the public roads. The vehicle carried 11 passengers, besides the driver, and one historian of the time called it "a fine specimen of indomitable perseverance." The vehicle travelled at about 18 m.p.h., the boiler being fixed at the rear of the carriage, its two engines being secured in a horizontal position underneath the body of the carriage. On the open carriage body were placed water tanks, and upon these wooden benches were fixed for the passengers.

Steam Carriage No 1

Maceroni's first road carriage was something of a nine days' wonder. It attracted great attention, particularly as its inventor publicly invited any interested persons to inspect it minutely in his workshop at Paddington.

In 1833, the London *Morning Chronicle*, commenting upon the success of Maceroni's steam carriage, remarked that "this steam carriage has plied daily for some weeks between Paddington and Edgeware without meeting with any accident. Since it has started it has travelled a distance of upwards of 1,700 miles, yet in the whole of that time it has not needed any repairs."

Maceroni's steam carriage of 1833 made its appearance in all parts of London. Sometimes it journeyed from the metropolis as far as Harrow-on-the-Hill, the journey being completed in just under the hour, the famous hill at Harrow being ascended at the rate of 7 m.p.h. In the early part of the following year (1834) the celebrated carriage was to be seen voyaging regularly between Oxford Street, London, and the village of Edgware, and afterwards it made a short series of trips between Regent Street and Uxbridge, a distance of about 16 miles, which was covered in a little more than an hour's non-stop running.

Usually Maceroni himself presided at the engine controls, but his associate, Squire, was generally the steersman of the novel vehicle.

Steam Carriage No. 2

Encouraged by his success, Maceroni constructed his Steam Carriage No. 2. This was nearly double the size of the first. It carried a complement of 16 passengers, in addition to their luggage. Had Maceroni been of a more equable temperament, he might have made a good thing out of this Steam Carriage No. 2. As matters were, however, he developed one of his periodic fits of restlessness, and, towards the end of 1834, he took it into his head to dissolve partnership with Squire.

Left to his own resources, Maceroni very quickly found himself in extremely low funds. In order to raise money, he associated himself with an Italian Jew named Asda, whom he allowed to take his two steam carriages over to the continent. The agree-

A steam coach built by W. H. James in 1830.

ment was that Asda was to pay Maceroni £1,500 cash for a share in the steam carriage patents and, also, that one of the carriages was to be returned to England within a couple of months.

From the available contemporary reports, it appears that the two steam carriages did well in France and in Belgium. So, also, did Asda. He literally made hay while the sun shone. The French King was prevailed to take a ride in one of the steam carriages, and that royal personage was so enthralled with the new experience that he made a handsome monetary award to the lying Asda, who, incidentally, was villain enough to style himself the inventor, constructor and owner of the steam carriages. Out of his continental exploits, Asda made some £16,000 by selling the steam carriages and the continental manufacturing rights to a syndicate of French capitalists.

At the same time, Maceroni, in England, nearly starved. He did not receive a single penny from the rascally Asda, and most of his tools and workshop equipment at his Paddington factory were taken by creditors as payment for his outstanding accounts.

That was Maceroni's first major disappointment. The next one came a couple of years later, when, in 1837, the year of the accession of Queen Victoria, he attempted to start a company for the construction of steam buses, and for their running in the streets of London and elsewhere. Maceroni even had visions of beginning a regular steam-bus service between London and Birmingham. But the attempt to form the company failed, as did another similar endeavour in the following year.

A steam-propelled carriage, built by Maceroni, 1833-34.

Railroad Competition

The fact was that the public at this time was in the grip of the "railway mania." The iron railroads were being constructed all over the kingdom. Capital was being lavishly expended in this direction and the railroad promoters had every reason to discourage the endeavours of steam road-carriage constructors to form companies which would give rise to direct competition to their efforts.

But in 1841, owing to the determination and even, one might say, the obstinacy of Francis Maceroni, an enterprise known as "The General Steam Carriage Company" was brought into being, with the object of constructing steam carriages under the Maceroni patents. A certain Mr. Beale, an engineer who had works at East Greenwich, was prominent in this endeavour. He demonstrated the ability of Maceroni's steam carriage to run up Greenwich Hill fully laden with 17 passengers, and at a speed of 14 m.p.h., and, for a time, lasting success seemed again to appear upon Maceroni's ever-changing horizon.

Beale, however, throughout his whole association with Maceroni, was mainly intent upon feathering his own personal nest. Maceroni had contracted with the new company to supply his steam carriages at £800 each. After the first carriage had been completed and passed as satisfactory, Beale sent in to Maceroni a bill of costs amounting to £1,100, stating that he had included in this charge the sum of £200 for various alterations to the vehicle as a result of its trial trips extending into some hundreds of miles. The company refused to pay this amount, taking the view that Beale had made an unjustifiable and an unreasonable charge. Beale then retaliated by instantly refusing to make any more steam carriages and, what was even worse, by not allowing the one carriage which had been constructed under Maceroni's supervision to go out of his works.

The last of the steam carriage. A steam road-vehicle of unknown make of about 1840.

In this chapter of difficulties Maceroni again got the worst of it. Beale remained adamant, and the Steam Carriage Company went out of existence.

Again, Maceroni reached the verge of starvation. He then endeavoured to combat his bad circumstances by offering for sale outright the patent rights of his steam boiler, which rights had then about seven years to run. There was no doubt that this particular boiler had been a highly efficient and successful one, having been the means of propelling all Maceroni's steam carriages successfully, so that, as its inventor hopefully announced in an advertisement, by the employment of this boiler in a suitably designed steam carriage, "a great fortune might be made on the common roads."

Rival Patent

However, about this time, Maceroni's former partner, Squire, the mechanic and engineer, patented another form of steam boiler. This new patent almost drove Maceroni frantic, for he insisted both verbally and in communications to the press, that the Squire boiler was plainly an infringement of his own.

Neither Maceroni nor his erstwhile partner, Squire, nor even the renowned Goldsworthy Gurney, had any more successes with their steam boilers and road carriages after about 1840, for the railways, in consequence of their novelty and of the large amounts of capital which had then been invested in them, held the day against all road competitors.

Maceroni's vexations, justified or unjustified, were all useless. His star was very definitely on the wane, and, before long, it became all but extinguished. He wrote a book which he entitled *Memoirs of the Life and Adventures of Colonel Maceroni*, and perhaps it was this publication which kept his memory alive for the few remaining years of his life.

Maceroni died in London on July 25th, 1846, by which time his steam carriages had become almost completely forgotten in the excitement of the "railway fever."

Lord Hirst of Witton

WE regret to record the death of Lord Hirst, chairman and managing director of the General Electric Co., Ltd., at his home, Fox Hill, Earley, nr. Reading, on Friday, January 22nd, 1943, after a short illness. He was 79 years of age and until early in January had been in regular attendance at his office.

Lord Hirst, who was one of the founders of the G.E.C., over 50 years ago, became managing director in 1900 and chairman in 1910, and it is in this guise that the world knows him best as a great industrialist and controller of a world-wide organisation with an issued capital of nearly £8,000,000.

The romance of his career and the amazing growth of the enterprise he created are apt to obscure the great work he did as adviser to the State and to industry at large in many capacities, and the varied interests in life for which he always found a place however heavily his time was occupied.

Early Career

Hugo Hirst came to this country at the age of 16 and he entered the electrical industry three years later, but it was not until 1886, when he joined Mr. Byng in what he himself called "a little electrical shop," that his life's work can really be said to have begun, for this business was the seed from which sprung the G.E.C.

Mr. Hirst early made up his mind that he was not going through life merely as a merchant, but that also he was going to be a producer, an industrialist proper, and with the dawn of the 20th century a manufacturing organisation with factories in many different towns had been created. His aim was then, as always, to make as well as supply "everything electrical," and to-day the products of G.E.C. factories are distributed all over the world. The G.E.C. was formed in 1889, and throughout its growth Lord Hirst has been its inspiration, its dynamic force and its pilot. He so guided the G.E.C. that it grew rapidly, keeping abreast of a rapidly growing industry, and he was still at the helm of the company at his death. Lord Hirst was one of the first people to realise the importance of research in industry, and the company's research laboratories are among the finest industrial laboratories in the world. Many of its staff are scientists and technicians whose names are known the world over.

In 1937, while president of the F.B.I., he presided at a dinner given in honour of Lord Baldwin, who paid the following tribute to Lord Hirst: ". . . Lord Hirst is a man who, by his own ability and gifts of character, has made for himself an unchallenged position among the great employers of this country . . . if all big employers in this country were men of Lord Hirst's character, with his vision and breadth of mind, there would be no trouble in industry."

An Electric Guitar

Concise Instructions for the Conversion of an Ordinary Guitar to an "Electric" Model, and the Making of an Electric One-string Fiddle

By L. O. SPARKS

The completed "electric" guitar being used in conjunction with the pick-up circuit of a radio receiver.

PRIOR to the introduction of electric guitars to this country by, I believe, the popular American exponent of the guitar, Ken Harvey, several systems had been developed for the production of musical tones by electrical or electro-magnetic means, but none of them appears to have had any lasting success.

It was with the full understanding of the thermionic valve that came the inventions of the Trautonium by Dr. Trautwein, the Hellertion by B. Helberger and P. Lertes, the Sphærophone by J. Mager, who, incidentally, was one of the first scientists to investigate the subject, and, as far back as 1929, the noteworthy work by an Englishman, J. Compton. The latter applied for patents connected with what is best described as an "electro-mechanical" system for the production of musical sounds, as against the general use of the properties of a valve as an oscillator by the other investigators. It is the electro-mechanical system which is now widely used in conjunction with string instruments and certain electric organs.

All of the early valve arrangements suffered from the inability to produce chords or a series of tones at a given instant; they were purely "single-note" instruments, and a good example in this class, and one which has been heard a great deal in this country, is the Theremin—invented by Professor Theremin—which makes use of two oscillators to produce an L.F. oscillation equal to the difference between the frequency of the two oscillators; the range of musical tones being governed by varying the capacity of one of the circuits by movement of the player's hand with relation to a small rod which projects from the instrument.

In all the purely electrical arrangements the thermionic valve was not used only as a generator of musical frequencies, it was also employed to amplify such oscillations to the desired audible volume reproduced via loudspeakers.

Electro-mechanical Methods

If a coil of insulated wire is placed around a pole-piece of a permanent magnet, and if by some means the magnetic field about the pole-piece is disturbed, an electric current will be created in the coil. The strength of the current will depend on various factors; briefly, the number of turns of wire forming the coil, the strength of the magnetic field and the intensity of its disturbance. The frequency of the current will have a direct relationship with the frequency of the disturbance.

A Simple Example

One of the simplest applications of this system to a string instrument is shown in Fig. 1, which depicts an "electric" one-string fiddle, which, incidentally, is ideal for demonstrating the basic principle of the electro-magnetic system.

The body "d" is a strip of hard wood approximately 3ft. × $1\frac{1}{2}$in. × 1in.; the two points "a" and "b" form the anchoring posts for the steel string "s" which passes over the small bridge "c." To allow the tension of the string to be adjusted "a" is peg-shaped, and can be rotated in a similar manner to those used on many string instruments.

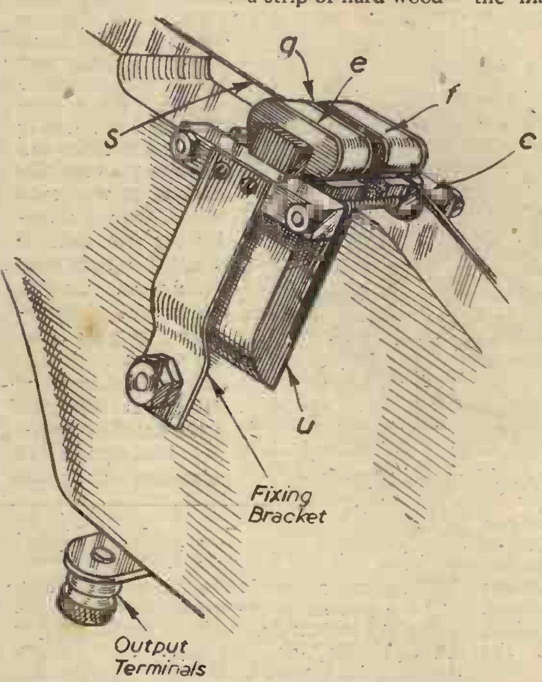


Fig. 2.—An enlarged view of the unit fitted to the one-string fiddle. Note the method of fixing.

The assembly is a skeleton one-string fiddle; if it is played with a bow the volume of sound produced would be on the low side as no sounding board, box, or horn is fitted. By using the electro-magnetic system these normally essential features can be ignored, as one is not concerned with the production of sound but with the conversion of the vibrations of the string "s" into electrical currents of identical frequency. The conversion is obtained by utilising the simple electro-magnetic assembly shown in Fig. 2, which for simplicity we will call the "unit"; its position, with relation to the string "s" and the bridge "c" is indicated by "u" on Fig. 1. Reference to Fig. 2 will make clear the construction of the unit; "u" is a permanent magnet of the "U" pattern, its approximate dimensions being 2in. in length, $1\frac{1}{2}$in. in width and a cross-section of $\frac{3}{8}$in. × $\frac{3}{8}$in.

To provide a concentrated magnetic field in the area of the string, and a means of mounting the coils "e" and "f," two extension pieces have to be made. These are cut from transformer laminations, or $\frac{1}{2}$in. × $\frac{3}{16}$in. soft iron strip, the latter being bent to form the "L"-shaped pieces as shown in Fig. 2. After filing the horizontal portions to fit the coil bobbins, a tight push fit being required, the pole-pieces are secured to the ends of the magnet by means of $\frac{1}{4}$in. square brass rod and two—one each side of the magnet—*brass* bolts. This method of fixing was necessary for the experimental model, owing to the fact that the magnet used did not have any holes drilled in it in convenient positions.

The gap "g" is approximately $\frac{1}{8}$in., and the unit must be fixed to the body of the fiddle so that the string passes along the centre of the gap and parallel to the faces of soft iron pole-pieces.

Fixing the Unit

There are two methods of fixing, depending on the shape and size of the body. If a plain strip of wood is used it is best to shape it so that it is a tight fit between the arms of the "U" magnet and brings the string in the correct position. If oversize holes are then drilled through the wood, the clamping bolts can pass straight through, provided short lengths of metal tube are cut to act as distance pieces between the inner faces of the brass clamping pieces and the outer surfaces of the wooden body, and slipped over the clamping bolts. The oversize holes allow final adjustment to be made.

An alternative, and, I think, a better method, is that which was used for the second model I made.

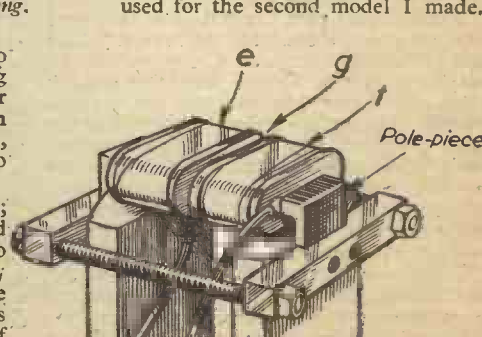


Fig. 3.—Assembly of the electro-magnetic unit, showing how pole-pieces are clamped to magnet.

For this a commercially produced one-string fiddle of a well-known make was used, and it had a much deeper body at the bridge end to allow for the fixing of the horn and knee-grips. (Fig. 1.)

This permitted a slot being cut in the body to accommodate the "U"-shaped magnet and bring the horizontal pole-pieces in their correct position for the string. The unit was securely held on each side by means of two strips of brass which were fastened to the brass clamping pieces and screwed to the wooden body. (See Fig. 2.)

The two coils "e" and "f" were taken out of an old moving-iron loudspeaker, having a resistance of 4,000 ohms, i.e., 2,000 ohms for each coil; they are connected in series on the unit and one wire from each taken to the input terminals of an amplifier.

The Guitar

Just after completing the electric fiddles, which, incidentally, originated from an assembly made solely to provide a wide range of L.F. frequencies for amplifier and speaker testing, I heard about electric guitars and decided to make one. As tonal response and volume of sound did not matter, I secured a cheap Spanish type of guitar and set about converting it to an electric model. Unlike the one-string fiddle, the electro-magnetic system had to embrace six strings, and this presented quite a problem as a uniform magnetic field around each string was really essential for best results. Experiments revealed that it was possible to use one magnet and one large coil, or, two magnets and one or two coils, but I was not satisfied with the response obtained from all the six strings individually and collectively. Eventually I devised the system shown in Fig. 4, which provides a pole-piece and coil for each string, thus ensuring a much more faithful response and uniform output during all styles of playing.

The completed instrument was very satisfactory, so much so that I decided to invest in a hand-made 20-fret Hawaiian-Spanish guitar made by John Grey. The fitting of the unit entailed cutting the belly of the instrument, and I admit I was a little apprehensive about touching the beautifully finished woodwork. However, I need not have worried, as the appearance of the guitar is in no way marred by the fitting.

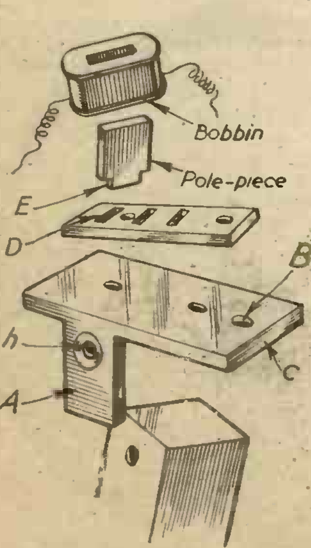


Fig. 5.—An alternative method of constructing the sets of three pole-pieces as explained in the text.

The original electro-magnetic system was used in principle, but modified and improved in detail.

The Magnetic System

The permanent magnet was again of the "U" pattern, its dimensions being 3 $\frac{3}{16}$in. in length, 2$\frac{1}{4}$in. in width, and a cross-section of $\frac{3}{4}$in. × $\frac{3}{8}$in. It was produced by Messrs. Darwin, Ltd., and I understand it was *then* a stock shape. Near the top of each arm of the "U" was a $\frac{3}{16}$in. hole, which simplified matters considerably as regards fixing the additional pole-pieces, as it is impossible—speaking for the amateur—to drill the magnets.

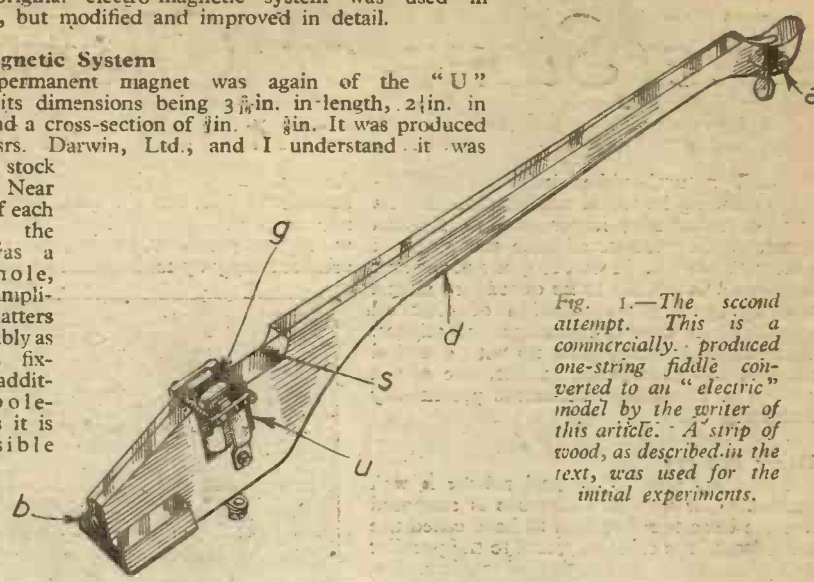


Fig. 1.—The second attempt. This is a commercially produced one-string fiddle converted to an "electric" model by the writer of this article. A strip of wood, as described in the text, was used for the initial experiments.

The six pole-pieces were made in two sets of three, and were designed to fit on top of the extremities of the "U" of the permanent magnet as indicated by Fig. 4. The original sets were *cut from the solid*, the material being mild steel, and then riveted to their bed-plates "C" (which were cut from a piece of 1in. × 1in. angle-iron, each being 2in. in length). Accurate marking off is essential, otherwise the pole-pieces will not line up with the strings of the guitar and/or it will be found impossible to slide on the coil bobbins. The distance between pole-pieces shown in the diagram seems universal, but it would be as well to *check* the string spacing of the guitar under consideration, before marking off the metal work. An alternative system of construction is shown in Fig. 5. The points for the pole-pieces are marked off on a small iron strip 1$\frac{1}{2}$in. × $\frac{1}{2}$in. × $\frac{1}{8}$in., and the small slots "D" cut. The pieces for the pole-pieces, which, incidentally, can be made out of the waste cut from the angle-iron during its shaping, are provided with the tongue "E" so dimensioned that it forms the male fitting for the slot. When located, the tongue is riveted over, care being taken to see that the pole-pieces are at right angles to the strip. The completed parts are then riveted to the bed-plates as in the other method.

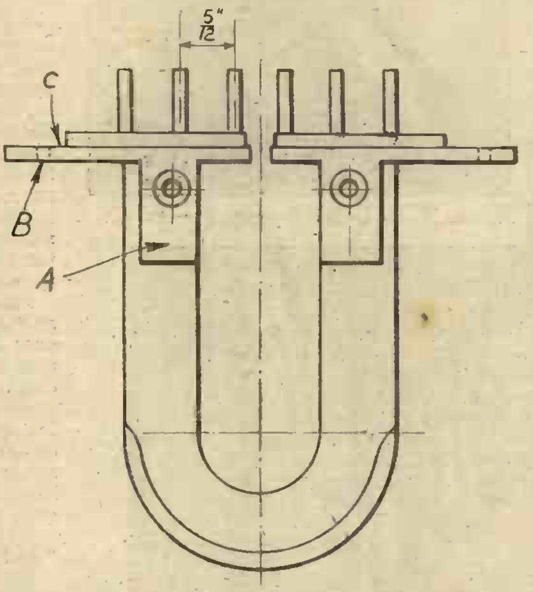


Fig. 4.—The magnetic unit for the six-string guitar. The additional pole-pieces are assembled and then bolted to magnet.

The fixing of the completed assemblies to the magnet is by means of the portion "A" and the hole "h" which lines up with the hole in each arm of the magnet, a suitable bolt being used to secure the parts. The hole "B" in the bed-plate is tapped, say, 4 B.A., and takes a $\frac{1}{2}$in. round-headed nickel-plated bolt, which, in conjunction with the top-plate—see Fig. 6—secures the complete unit to the belly of the guitar, but more about that later.

One important item to watch when fixing the pole-piece sections to the magnet is the need for the bed-plate to *bed right down* on the surface of the magnet. No gap or unevenness must exist between the two faces, otherwise the flux density at the tips of the six pole-pieces will be reduced considerably.

The Electrical Section

A coil is needed for each pole-piece, and the more turns of wire used in its construction the better. The limiting factor, however, is the small space between each pole, but the writer was able to secure a number of moving-iron L.S. bobbins of the 1,000 ohm type, which satisfied requirements as regards width and efficiency.

The pole-pieces have, of course, to be made to suit the bobbin hole or slot; therefore, before shaping these parts, it is advisable to secure the bobbins first, otherwise the pole-pieces might be too large or too small. The cheeks of some bobbins project beyond their coils; in such instances it is often possible to utilise what at first sight might appear to be oversize bobbins, by carefully rubbing down the cheeks, provided the winding is not damaged.

Before and after placing the bobbins on the pole-pieces, apply a simple continuity test to make quite sure that the windings are intact. If all is well, they are then connected in *series* by *neatly* soldering the *end* of one winding to the *start* of its neighbour, and so on. See that all joints are insulated so that they cannot short-circuit through any of the metal-work. When this is completed, two wires will remain unconnected (the start of the first, and the end of the last bobbin). These form the connections for the output of the unit, and they should be lengthened by joining on, say, 18in. of flexible instrument wire or, even fine twin twisted flex.

Fitting to Guitar

The following figures are given only as a guide, as many of them will be governed by the size of the bobbins used and individual construction. With the assembly described,

(Continued on page 206)

The Story of Chemical Discovery

No. 20.–The Founding of the Rubber Industry

THE natural-rubber industry, notwithstanding its world ramifications and its overwhelming importance in modern times, is the product of little more than a century's growth. It was, too, one of the first large-scale industries to be dependent almost entirely upon the application of chemical science to its various operations and science. The rubber industry grew up with chemical science, and constitutes, in fact, one of the earliest of chemistry's numerous present-day industrial offspring.

Early History

The early story of natural rubber is well known. Christopher Columbus is supposed to have been the first man to have called the attention of the civilised world to the peculiar and remarkable properties of rubber, for, according to the chronicle left by contemporary historians, it was during Columbus's second voyage to the New World between 1493 and 1496 that he found the natives of Haiti playing their tribal games with hard, elastic balls which, they told him, had been fashioned from the flexible gum of a certain species of tree.

Thomas Hancock, the discoverer of vulcanisation.

A rubber plantation in the tropics. Upon these trees the world's supply of natural rubber depends.

Apart, however, from a single record which is extant concerning the use in Mexico by Spanish troops of rubber juice for the waterproofing of garments, the Old World and its peoples seem completely to have ignored the possibilities of natural rubber for close upon two and a half centuries.

Indeed, Europe's first close acquaintance with this naturally elastic product only came subsequently to 1736, in which year the French Academy of Sciences equipped an expedition to Peru for the purpose of measuring an arc of a meridian. After the expeditionary task had been completed, one member of the party, a certain Charles de la Condamine, remained behind in order to indulge his passion for geographical exploration and, in particular, to map out the track of the Amazon River.

Condamine made many discoveries concerning the people of the Amazon valley. Among the interesting matters which he brought to light was a process devised by the natives of this part of the world for making waterproof garments, bottles, shoes and other articles simply by coating thin fabrics with the juice of native trees, and allowing the treated fabrics to dry above a smoky fire.

This explorer brought back to Europe many samples of raw rubber for analysis by the French chemists of the day, but the material defied analysis, and unfortunately it was found impossible to transport the rubber juice or " latex " to Europe in view of the fact that it so rapidly solidified when taken from the tree.

This, indeed, was the fact which held up rubber development and utilisation in Europe for so long a time after its first introduction by de la Condamine, the French explorer. During the middle portion of the 18th century, when the question of discovering a use for this novel and remarkable product from the New World was first mooted, industrial chemistry was almost entirely non-existent. Some chemists, as, for instance, Macquer and Herissant in 1763, suggested that the coagulated rubber juice might be dissolved in turpentine, while at a later date it was found that ether, a well-known solvent, was better for this purpose.

It was not, however, until the last decade of the 18th century that it was discovered that petroleum spirit could be made to dissolve rubber.

The First Rubber Tubes

Consequent upon this important discovery came the first utilitarian employment of processed rubber. A chemist named Grossart succeeded, in France, in fashioning rubber tubes by cutting strips from coagulated rubber, by heating these in order to soften them and finally by cementing them together by means of treatment with petroleum spirit.

About the same time, another French chemist, Foucroy by name, found that the coagulation of the natural rubber " milk," or latex, could be prevented by treating the material with a small amount of alkali, and he went so far as to suggest that large consignments of the material could be transported to Europe safely if only it could be pre-treated with alkali in this manner.

Foucroy's suggestion never materialised, and indeed, surprising as it may seem, it is only since the conclusion of the last war that natural rubber latex, stabilised by the cautious addition of ammonia, has become a commercial product in England and other European countries, the natural-rubber industry evolving itself during the 19th century solely upon the utilisation of the coagulated latex, that is to say, the " raw rubber " in its solid form.

" India-rubber "

Dr. Priestley, the famous English chemical philosopher of the 18th century, the discoverer of oxygen and other gases, put

The invention which " made " the rubber trade—J. B. Dunlop's first pneumatic tyre.

forward the suggestion that this natural product from the Indies should be utilised for the rubbing out of pencil marks on paper. Priestley is usually credited with having originated this suggestion, but, as a matter of fact, it was made in France some years before he himself became personally acquainted with raw rubber and its properties. Still, the suggestion of Priestley caught on, and thenceforth the rubbing material from the Indies, or india-rubber, as it was ultimately termed, gradually became a commercial commodity in England.

Charles Goodyear, American pioneer of the rubber industry.

The lack of suitable solvents and machinery for the treatment of rubber were the two factors which for so many years effectively militated against attempts at the large-scale production and processing of rubber in this country. Indeed, the rise of the rubber industry in Britain may be said to have been an unexpected outgrowth from the successful inception of the coal-gas industry in this country.

The early exploiters of the coal gas industry were faced with not a few difficult problems, first and foremost among which was the question of the adequate and remunerative disposal of the large quantities of tarry matters which were generated as by-products during the manufacture of the gas. It was about this time that street paving with tar first came into use, but, seemingly, this early utilisation of coal tar was not altogether successful for, eventually, the owners of gas companies, not being able to find a suitable outlet for their tars, had to develop methods of actually using the material for the firing of their retorts.

Thomas Hancock

In 1815, there lived in London one Thomas Hancock, who was in partnership with his brother, John, as a coach builder. Hancock was, indeed, a practical genius for, apart from successfully designing steam road-carriages and bringing omnibus companies into existence, he was an adept at two or three other trades, and also evinced a great interest in chemical experimentation. All Hancock's experiments were directed towards strictly practical and utilitarian ends, and one of his series of experiments concerned the utilisation of raw rubber which, at that time, was becoming available in greater quantities.

It was in 1819 that Thomas Hancock began his experiments with solutions of raw rubber in turpentine. These, however, were all failures, for the turpentine refused to dissolve the rubber properly and the semblance of a solution which resulted consistently failed to dry out effectively.

But despite the apparent intractability of the rubber problem, Hancock hit upon the idea of slicing thin strips from large masses of the crude rubber and by applying these for use in garments, such as gloves, braces, garters and the like, in which some degree of elasticity was required. In fact, Hancock actually took out a patent for the utilisation of raw rubber in this manner. It constituted the first of the innumerable line of British patents which have since been granted in connection with the chemical, physical and mechanical technology of rubber and its products.

Hancock's rubberised garments came in for a fair measure of commercial success, so much so, that their inventor quickly found himself in the position of having large amounts of useless scraps of rubber on his premises which were too small for incorporation into garments and articles of attire. In order to utilise these, he designed (after some considerable trouble) a sort of rubber-mincing machine, which shredded-up the waste rubber and enabled the inventor to press it into a solid block by means of a suitable mould and heavy pressure.

Rubberised Garments

About the same time, Charles Macintosh, a Glasgow manufacturer, contracted to purchase for a period of 10 years all the tarry distillates from the then newly equipped Glasgow gasworks, Macintosh's intention being to utilise the tar for the production of ammonia. This ammonia process, however, although it was successful, left him with the problem of disposing of the remainder of the tarry distillates. The idea of using a spirit which could be distilled from the tar, and which was called "naphtha," seems to have occurred to the mind of Macintosh almost at once. His notion was to dissolve raw rubber in the distilled naphtha and then to paint the resulting solution on to prepared fabrics in order to make them waterproof.

In his factory at Campsie, near Glasgow, Macintosh was fairly successful with his rubberised garments. It was not long before he became inundated with orders from the Government and from various industrial quarters for his new waterproofed material.

Early in 1824, Macintosh opened new works in Manchester, transferring his manufacture from Glasgow to the former town. Meanwhile, Thomas Hancock, in London, had been further experimenting with his shredded waste rubber, and he found that this material was much more suitable for the preparation of rubber solutions than was the original raw rubber with which Charles Macintosh was working. Hancock entered into an arrangement with Macintosh to use the very cheap solvent naphtha, the latter having previously patented the use of the coal-tar naphtha from the gasworks in this respect.

The arrangement operated very favourably for Macintosh. It enabled him to prepare rubber solutions of at least double the strength of his original solutions. Consequently, the effectiveness of his rubber-proofed garments increased considerably. The "macintosh" became a household article. A demand speedily arose for all types of rubberised articles, and it was Macintosh himself rather than Thomas Hancock who rose to fame as a result.

Up to this juncture, articles of raw rubber were seldom used, apart from the rubberised garments of Hancock. Rubber was employed, for the most part, in thin layers deposited upon canvas or other material, its use in this respect being mainly on account of its excellent waterproofing qualities.

The demand for rubberised goods was, of course, present in the United States equally as much as it was in England. In America, one Charles Goodyear, who was originally a dealer in agricultural instruments, had himself, among other activities, toyed with the rubber problem. His aim, about the year 1832, was to make sheets of solid rubber, sheets which would be tough and durable, besides being waterproof and elastic.

Goodyear was associated with a man named Nathaniel Hayward who had had some experience in connection with the early American rubber companies. Hayward had conceived the notion (as the result of a peculiar prophetic dream, he avowed) that if sulphur were incorporated with raw rubber the product would be immensely hard and tough.

Vulcanisation

Goodyear seems to have been the one to put this suggestion into actual practice, and to take a patent out on the results of it. He mixed a certain quantity of sulphur with raw rubber and then exposed the resulting product to the warm rays of the sun, whereupon the material blackened and became very tough. In 1839 Goodyear made an accidental discovery whereby he ascertained that if a small amount of white lead were present in the rubber, the extent of the rubber-hardening or "vulcanisation" was considerably increased.

Making an incision in the bark of a rubber tree for the purpose of collecting the raw rubber "milk" or latex.

On this side of the ocean, a similar notion had occurred to the mind of Thomas Hancock, working away indefatigably in London. Hancock, like Goodyear, had also been trying to make large sheets of durable, tough rubber. Somehow or other (it is not known exactly how) Hancock hit upon the idea of combining sulphur with rubber in order to toughen the latter. He dipped strips of his prepared rubber into baths of molten sulphur and, to his surprise and delight, he found that the sulphur treatment completely changed them in nature, rendering them tough and absolutely non-tacky. Moreover, Hancock found that if his sulphur treatment were prolonged, the rubber became converted into a black, horny material which was, unlike the original rubber, quite brittle. Here, of course, was the beginnings of ebonite and vulcanite, although Hancock himself did not develop these materials.

Ten weeks after Hancock had lodged his claim at the British Patent Office, Charles Goodyear, of America, put in a similar claim. Naturally, Hancock's claim had priority and constituted the one which succeeded.

The respective claims of Thomas Hancock and Charles Goodyear to the discovery of that most fundamental process of rubber technology, vulcanisation, has been disputed by technical historians at great lengths. The question will probably never be settled. The Americans naturally claim their countryman, Goodyear, to be the discoverer of vulcanisation (surprisingly enough, little is said about Hayward, Goodyear's co-worker), while the British claim Thomas Hancock as the originator of vulcanisation.

It is certain that neither Hancock nor Goodyear copied each other. They were truly independent workers who were separated from each other by the then vast expanse of the Atlantic Ocean. Yet by some not infrequent twist of fate, they both worked along closely parallel channels.

The discovery of vulcanisation, together with Hancock's use of white lead, and afterwards of litharge, as an "assistant" to the process, made possible the production of durable articles of solid rubber. The rubber industry, in these formative years, consolidated itself and forthwith settled down to the detailed working-out of its processes.

A further advance in rubber technology came towards the middle of the last century when Alexander Parkes, a one-time Birmingham locksmith, discovered a "cold process" of vulcanisation which consisted of immersing the rubber material in a solution of sulphur chloride in carbon disulphide.

The commercialisation of the bicycle and, at a later date, of the motor vehicle, further increased the sphere of the rubber industry. Rubber plantations had been developed carefully for a number of years. The study of rubber-producing trees had been carefully undertaken by a number of English botanists. Hence it was that at the beginning of the present century supplies of rubber for this country were adequate.

Modern rubber research still continues. The introduction of various complex organic compounds into rubber in order to assist and modify the vulcanisation process is entirely a modern development, and one which will assuredly yet be extended in scope.

Synthetic Rubber

Synthetic rubber has its many indisputable advantages, but, at the present time, natural rubber excels the synthetic product in point of excellence and durability. Moreover, it is long likely to do so. For this reason, the temporary cessation of natural rubber supplies which the present world war has unfortunately brought about must, so far as possible, be made good with the coming of peace. Natural rubber is one of the world's truly essential commodities. It is one which has enormous technical promise, the scope for invention and discovery in the realm of rubber being as great nowadays as it was in the early days of its now historic technology.

AN ELECTRIC GUITAR

(*Continued from page* 203).

the aperture shown in Fig. 6 was cut in the belly of the guitar, about a centre line parallel with and ¾in. in front of the bridge of the instrument. After removing all strings the wood was cut out—after lightly scribing the required outline—by drilling a series of ⅛in. holes around the *inside* of the outline. To avoid possible splintering of the polished surface, it is a good plan to go over the scribing lines *before* drilling with a fine sharp cutting edge just to sever the top surface and the grain of the wood. With a sharp chisel, it is then possible gradually and carefully to cut through material between the holes, and, eventually, square up the opening thus formed. *Do not exert undue pressure* during any of the above operations, otherwise there is the danger of cracking the belly.

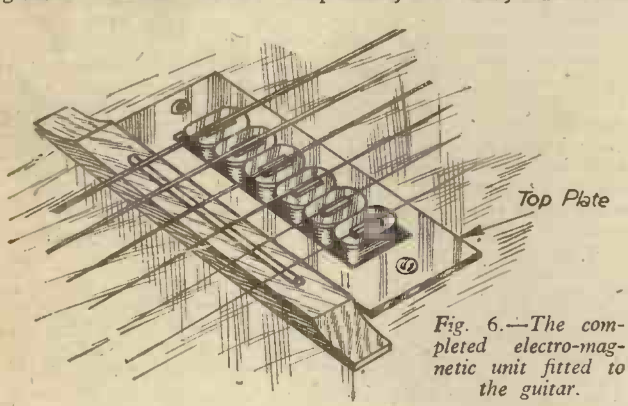


Fig. 6.—The completed electro-magnetic unit fitted to the guitar.

The top-plate can be cut out of ⅛in. aluminium, or, if nickel-plating can be done, brass. Bevel the outside edges and drill the fixing holes to line up with those ("B") on the bed-plates "C." The top-plate can, of course, be used as a template for marking out the opening and locating drilling holes on the belly. I made the holes slightly oversize, to allow final line-up adjustments to be made.

Getting the Unit In

The circular hole in the belly of the guitar is, approximately, 3⅜in. in diameter on my model, and it did not allow any too much room for the unit to pass through. This is a point to be watched, as if the hole is smaller, then it would be advisable to use a shorter magnet.

Before fitting the unit, the twin leads from the bobbin assembly are soldered to a single-circuit jack, and this is fitted into a suitable hole drilled in the foot or side of the instrument.

With a little manipulation, the unit is got into the interior of the instrument; get the pole-pieces and bobbins up through the aperture, and, with the other hand, place the top-plate over the bobbins and pass one of the round-head nickel-plated bolts through one hole in the plate, the belly, and—after locating it—one of the holes "B" in the bed-plate. Don't screw it right home; just a thread or two will be sufficient until you get the other screw through the other end. Tighten both gradually, making sure that the unit comes into the required position.

The strings and bridge are then refitted, and, if all is well, the tips of the pole-pieces will be dead underneath their respective strings and, approximately, ⅛in. below them. After tuning, the electric guitar is then ready for connection to an amplifier.

Amplification

To obtain the true advantages offered by the electro-magnetic system, it is essential to use a first-rate amplifier and loudspeaker, otherwise results—as regards tonal qualities and faithful reproduction—will be far from satisfactory.

What wattage output is required from the amplifier? This is a question which must be answered by the player according to his requirements. For example, for solo and normal playing in a room of average size, one would require far less output than the player in a dance band performing in a large hall. I have obtained ample output for home use from an amplifier having a rated output of 3 watts; on the other hand, I have had my guitar played in a super-cinema (by a musician) with only a 5-watt amplifier and the volume was quite sufficient. Something around these figures, therefore, appear to be the required value, although, of course, for dance band work one must bear in mind the background noise of the dancers, etc., and the size and acoustic properties of the hall.

I would recommend resistance-capacity coupling with two triodes in push-pull (Class A) in the output stage. Two stages of voltage amplification preceding the P.P. arrangement. A good make of permanent magnet speaker is advisable as it dispenses with energising leads and thus gives greater latitude as regards its location.

A volume control—0.5 megohms—can be connected across the output from the unit, and, if so desired mounted on the guitar within easy reach of the right hand. An alternative arrangement is to make the volume control foot-operated, and with this method it is not difficult to arrange the operating device in such a manner that the tremolo effect, normally associated with organs, can be obtained by a slight motion of the foot. Similarly, a tone-control can be incorporated, but this, I think, calls for careful consideration, otherwise the true beauty and range of the instrument can be ruined by false unbalanced coloration. It is far better, at least in my idea, to concentrate on the amplifier and loudspeaker to ensure that they *are good*, and get all the effects one requires by playing accordingly.

Owing to the use of the electro-magnetic system of reproduction, one need not be concerned with the quality of the guitar; in fact, the six strings could be mounted on a piece of board, and, provided the magnetic system was arranged as already described, highly satisfactory results would be obtained. Quite a number of American models were constructed without any resonating body or belly; and, so long as the amplifier responded, all was well but, if the latter broke down—and this is a possibility one has to contend with, though, of course, it is not usual—then the performer was placed in an awkward position. With the model I have described, one can play it with or without an amplifier, as the normal sound-reproducing qualities of the instrument are not impaired in any way by the fitting of the electro-magnetic unit.

A.C./D.C. Circuit

If the guitar is to be used for band work or professional engagements, it would be advisable to use an amplifier designed for operation off A.C./D.C. supplies, as it is not always certain that A.C. will be available. One advantage, in addition to that concerned with the supply of electricity, offered by this type of circuit, is that it can usually be more compact and much lighter than an A.C. operated amplifier, especially if an energised speaker is used.

Owing to the fact that the chassis or common negative line of A.C./D.C. equipment is common with one side of the mains, it is necessary to take certain precautions to protect the player from the possibility of shocks at mains voltage. Provided the first valve in the amplifier has across its grid-cathode circuit its grid-leak or potentiometer (volume control), the two leads from the guitar unit can be connected to the grid and earth line via mica dielectric condensers, each having a capacity of, say, .001 mfd. to .01 mfd.

An alternative method is to use a suitable designed transformer between unit and input to valve, and the component can have a ratio of 1 : 1 or higher according to the characteristics of the unit.

Dynamo Fault Diagnosis

Methods of Dealing with Voltage Troubles

By J. L. WATTS, A.M.I.E.E.

IN the event of a dynamo giving trouble, due to irregular operation, it is best to tackle this in a systematic manner to avoid delay in restoring the machine into normal commission.

Failure to Build Up Voltage

Since the initial voltage due to the residual magnetism alone is very small, a slight amount of resistance may be sufficient to prevent the passage of current through the shunt field windings, in which case the dynamo will not build up on no load. This may be due to sticking brushes, brushes having insufficient pressure (the pressure should, in general, be about 2 lb. per square inch of brush contact surface), rough or dirty commutator, or intersegment micas projecting above the surface of the copper bars in the commutator. These simple matters should receive first attention.

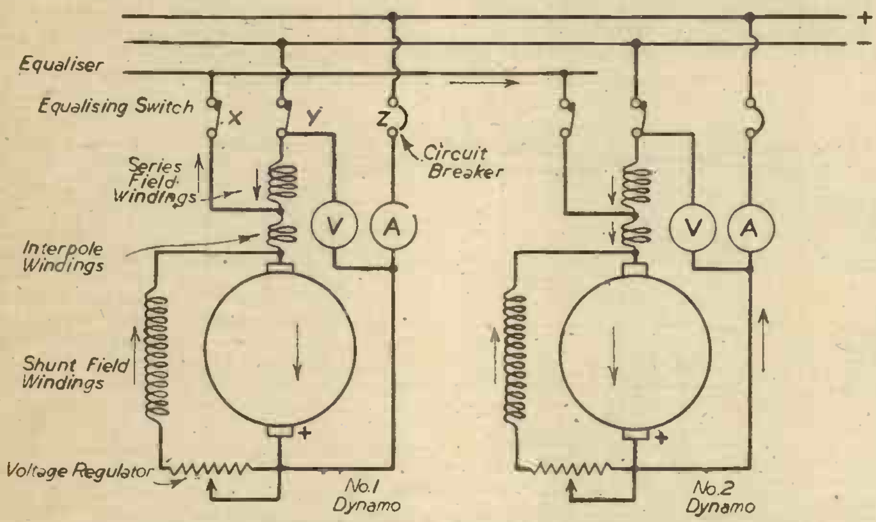


Fig. 1.—Method of magnetising a compound dynamo from a parallel dynamo.

Should the voltage regulator be set for minimum volts, the high resistance of this regulator in the shunt field circuit may prevent building up. This should be moved to the maximum voltage position to assist building up. It will be understood that if the moving contact of the regulator does not make a proper connection to the studs the whole of the regulator resistance may be connected in the shunt field circuit. In case of doubt it is a simple matter to try the effect of connecting a piece of wire across the regulator terminals; this test may also be used to expose any open circuit in the resistance units which may be preventing field current passing. Wrong brush position may also prevent building up. In case of doubt, the effect of slight rotation of the brushgear in either direction could be noted.

A method which is sometimes adopted to assist a troublesome compound dynamo to build up is to connect a piece of fuse wire across the terminals of the machine. This wire will then provide a low-resistance external circuit through which a comparatively heavy current can flow due to the voltage resulting from the residual magnetism. Such current passes through the series field windings, the magnetic field of which will assist the residual magnetism. The wire should have a melting current of about half the full load current of the dynamo and will melt as the machine builds up voltage.

Absence of Residual Magnetism

Should a dynamo fail to build up after attention to the points mentioned, it is possible the residual magnetism has been lost from the field system. This may occur due to mechanical shock to the dynamo, the effect of magnetic field from other electrical apparatus nearby, or due to a reverse current having passed through the dynamo.

If the dynamo is supplying a motor which drives a machine having high momentum, the motor should always be switched off before the dynamo is shut down. If the dynamo is allowed to slow down whilst still connected to the running motor it is possible the speed of the motor may fall more slowly than that of the dynamo, during which period the generated back voltage of the motor may be greater than the voltage generated by the dynamo. A reverse current may then flow from the motor through the dynamo armature and any series field coils. The direction of current through the shunt field coils would be unchanged, but their strength would be reduced by the falling voltage, and they might then be overpowered by the opposing field of the series coils and, to a slight extent, the armature.

Similar trouble may occur on dynamos operated in parallel if the voltage of the machines is not adjusted the same by the regulator before connecting the dynamo in parallel.

Remagnetisation of Field System

When it is suspected the dynamo has lost its residual magnetism it is best to test by connecting a low reading voltmeter or low voltage test lamp across the brushes. If zero voltage is indicated it will be necessary to remagnetise the machine.

Where compound dynamos are used in parallel the switchboard provides a simple means whereby one dynamo can be magnetised from another. When the sound dynamo No. 2 is working on load the single pole switch Y on the series field side of the defective dynamo (Fig. 1) and the equalising switch X can be closed to allow part of the load current supplied by No. 2 dynamo to flow through the series field coils of dynamo No. 1. This will magnetise the field system of dynamo No. 1 with the correct polarity.

An important point to remember in connection with a dynamo is that the shunt field circuit should never be broken whilst upwards of half the normal value of field current is passing through as this is liable to induce a high voltage in these windings. Where a second dynamo of the same or a lower voltage is available it could be used to magnetise the defective dynamo through the shunt field coils. A simple method of doing this is to raise the brushes of the defective dynamo, connect its shunt field winding to the other machine, and allow the second dynamo to slow down before disconnecting the field windings. This will avoid breaking the field circuit with full current. Should it be inconvenient to alter the speed of the sound dynamo or where a steady voltage D.C. supply only is available, a discharge resistance, such as a few lamps in series as shown in Fig. 2, may be connected across the shunt windings before connecting these to the D.C. supply. The resistance should not be disconnected until the supply has been cut off so that the field circuit is not broken on load.

It may frequently happen that no alternative D.C. supply is to hand. In this case a battery, which should have as high a voltage as possible, may be used to magnetise the field magnets. If the regulator is set for minimum volts and the battery connected across it as shown in Fig. 3 the battery may be left in circuit whilst the dynamo is run up to speed and afterwards disconnected without breaking the field circuit, assuming the dynamo builds up to normal voltage.

Reversal of Residual Magnetism

After losing its magnetism it is quite possible the residual magnetism may be reversed. This may be due to stray magnetic field from other apparatus, reversed current through the machine, or owing to it having been used as a motor.

With reversed residual magnetism the machine should build up voltage in a normal

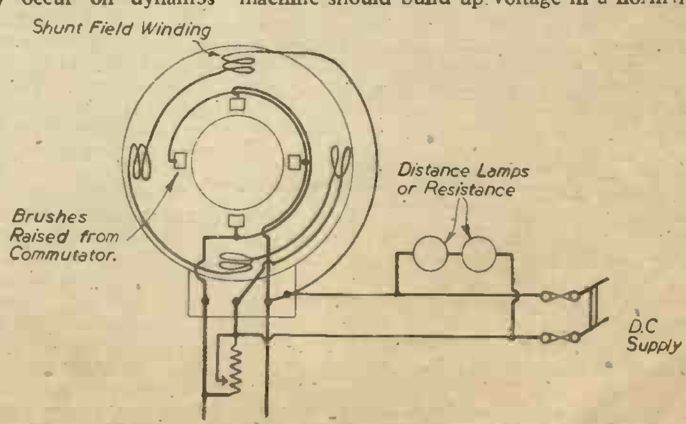


Fig. 2.—Method of using a discharge resistance when magnetising a dynamo field system.

manner, but the terminal polarity of the dynamo will be reversed. This may prevent certain types of voltmeter or ammeter from reading, but, where a dynamo works on an isolated supply, it would otherwise have no effect on the power and lighting system, and, in fact, might not be noticed. Where dynamos are used in parallel it is essential the terminal polarity be correct. In certain cases a motor circuit may be arranged so that it can be supplied from either of two dynamos through the medium of a change-over switch that may be thrown over without stopping the motor or motors. In this case also the terminal polarity must be correct, since, during the brief interval the switch is moving over, the motors will continue to run, and the polarity of the back voltage they generate will depend upon the polarity of the dynamo which has been feeding them. The dynamo polarity would not matter if the motors were stopped before being supplied by the other dynamo.

Should the polarity of a dynamo become reversed it is generally a simple matter to change over the connections at the switchboard to compensate for this.

Load Circuit Faults and Field Winding Faults

If the test indicates that residual magnetism is present, the voltage regulator is set for maximum volts, and the brushes and commutator are in good condition, and the dynamo still does not build up, the effect of opening the main switch of the dynamo should be noted. If the dynamo then builds up it indicates that the shunt field circuit is reasonably sound, and the trouble may be due to the load circuit having too low a resistance, possibly all the lighting switches may be "on," or one of the motor starters may be sticking in the "on" position and its switch closed, or there may be a short circuit somewhere. These points should be checked.

A compound dynamo may build up voltage on load, but not on no load. This may be tested by closing as many lighting switches as possible, and perhaps closing a motor switch and holding the starter handle in the running position. Alternatively, the terminals of the dynamo may be short-circuited with a fuse wire, as mentioned before. If the machine then builds up somewhat the trouble may be due to an open circuit in the shunt field circuit, particularly if it still does not build up to normal voltage. The machine may be building up on its series field and running purely as a series dynamo, in which case the terminal voltage will rise with increased load current. A simple test of the shunt field coils is to connect a piece of wire across each coil in turn, when building up of the voltage would indicate an open circuit in the coil across which the wire was connected. The writer had experience of a dynamo which would only build up on load, although it would then maintain its voltage on no load. This was due to a small corroded break in one shunt field coil which prevented current passing through the coil when only the low voltage due to residual magnetism was present. After building up on the series field coils the voltage was high enough to jump across the break and allow the dynamo to work normally.

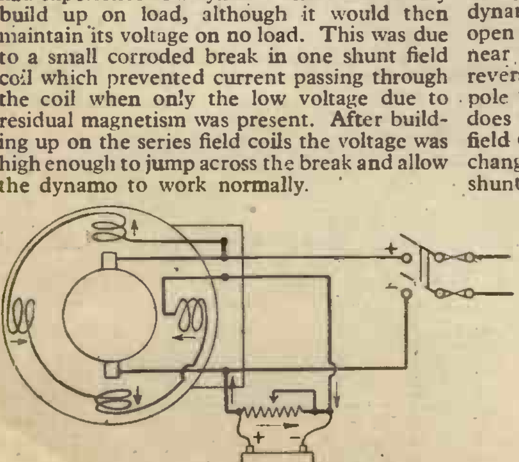


Fig. 3.—Use of battery to magnetise a dynamo field system.

Should short circuiting the shunt field coils have little or no effect, and the machine be new to its present duty it is quite likely that the shunt field coils are reversed. The remedy is to change over the connections to the whole set of shunt coils and note the effect.

Dynamo Voltage Too Low

Since the dynamo voltage is proportional to magnetic field strength and speed, low voltage may be due to reduced speed, possibly due to slipping belt, prime mover not strong enough or badly governed. This trouble is likely to be more pronounced on heavy loads. After ensuring the regulator is set for maximum volts, and that it is not open circuited or making bad contact, as may be found by noting the change of voltage when the regulator is adjusted, the speed of the dynamo should be checked.

Overload may be responsible for the dynamo voltage being low, the ammeter reading should be compared with the full load current shown on the nameplate of the dynamo. In some cases it may be found that the dynamo voltage falls rather a lot after a few hours' run. This is probably due to bad ventilation allowing the temperature of the dynamo to rise so that the shunt field resistance increases, and the field current falls.

Low voltage will be evident if the brushgear is too far advanced in the direction of rotation, and this will cause an excessive voltage drop on load. The brush rocker may be moved round slightly in either direction, and the effect on the voltage noted, taking care that this does not cause sparking at the brushes.

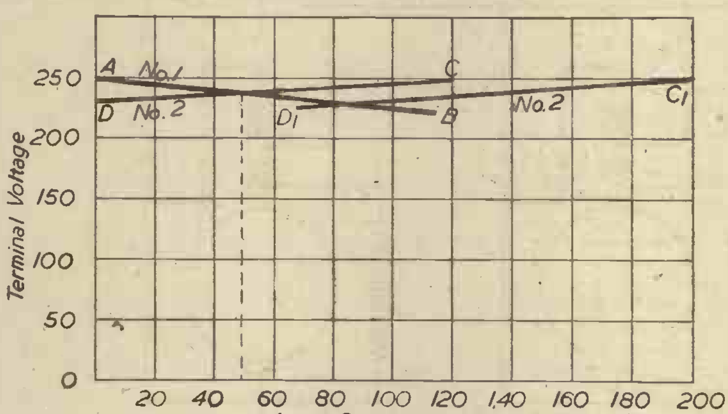


Fig. 4.—Chart indicating parallel operation of shunt dynamos.

Reduced voltage at all loads may also occur if one shunt field coil is reversed or short circuited. A reversed coil is only likely on a newly-fitted machine, and to check this the dynamo should be run with the main switch open on no load, and a compass needle brought near each pole in turn. The needle should reverse its deflection when moved from one pole to the next round the dynamo. If this does not happen the connections to the shunt field coil having the wrong polarity should be changed over. To locate a short-circuited shunt field coil or, in fact, a series coil also, a suitable voltmeter should be connected in turn across each coil. A coil showing an abnormally low reading is short-circuited internally, and in need of expert attention. A short-circuited shunt field coil is generally cooler than the sound coils.

In some cases a reduced voltage on load of a compound dynamo may be due to short-circuited or reversed series field coils. To check this the dynamo should be run on load, and a heavy copper conductor used to short-circuit the series field coils, making quite certain the coils have been identified correctly. If the dynamo voltage falls when the coils are short-circuited by the conductor it may be taken that the coils are correct. If the voltage rises the coils are reversed, and the connections should be changed over. A short circuit in a series field coil would cause reduced terminal voltage on load and would be indicated by no change of voltage when that coil was short-circuited by the heavy copper conductor.

The voltage of a shunt dynamo is bound to fall somewhat on load, and this is why compound dynamos are generally used for power and lighting supplies.

Increased Dynamo Voltage on Load

This rather rare trouble may be due to the brushes being set too far from neutral in the opposite direction to rotation and the effect of slight brush movement should first be tried when this trouble is encountered.

If the shunt field is weak the voltage of a compound dynamo may rise on load, although it may be lower than normal. This trouble may be due to incorrect adjustment or bad contact at the shunt regulator, open circuited, short circuited, or reversed shunt field coils. The methods of locating these defects have been dealt with previously.

Parallel Operation of Dynamos

For dynamos to operate successfully in parallel it is essential that they should have the same sort of characteristic curve. For example, a shunt dynamo in which the voltage falls with load will not work in parallel with an over-compounded dynamo which has a rising voltage on load.

Curve AB in Fig. 4 shows the relation between the terminal voltage and load current of a shunt dynamo, No. 1. Curve CD shows the relations for a second dynamo No. 2. On a total load current of 120 amps. it is seen that the terminal voltage of dynamo No. 1 when carrying 49 amps. is the same as that of dynamo No. 2 when this carries (120—49)=71 amps., and the dynamos will automatically share the load in this manner. On a total load current of 200 amps. the terminal voltages will be equal when dynamo No. 1 carries 80 amps. and dynamo No. 2 carries (200—80)=120 amps. so that the load will be shared thus, the circuit voltage being slightly lower than before.

If it is desired that dynamo No. 1, for example, shall carry a greater proportion of the total load its shunt regulator can be adjusted so that it has a greater voltage at all values of load current. The curve AB in Fig. 4 will then be raised so that the characteristic curves of the two dynamos will intersect more to the right, and dynamo No. 2 will automatically take a smaller proportion of the total load, whatever that may be. Shunt machines with similar characteristic curves should, therefore, carry the same proportion of the total load without adjustment of the regulators, and form a very stable combination. When shunt machines do not operate well in parallel, and the regulators have to be adjusted to make them take the same share of the total current when this varies, this may be due to one machine having a greater drop of voltage on load than the other dynamo, possibly due to the brushes being too far advanced.

With compound dynamos special precautions are necessary for parallel operation. If the voltage of one machine falls, for any reason, the other dynamo may tend to send a reverse current through its series field windings. This would reduce its field strength and voltage still further, so that the second machine would tend to take over all the load. In any case the constant, or rising, voltage of a compound dynamo on increased load may cause the ratio of load sharing to vary considerably for slight changes of total load. To avoid these troubles an equalising switch, as shown in Fig. 1, is used, which connects the series field windings of the two machines in parallel, and this ensures that current always flows through the series windings in the same direction. The circuit breaker also is generally fitted with reverse current trips which will trip the breaker and disconnect a dynamo if its voltage falls too low. Bad operation of compound dynamos in parallel may be due to wrong brush position or to the series field windings of one dynamo being stronger than on the other machine. In the latter case the strong series field coils could be weakened slightly by connecting a diverter resistance in parallel with the strong series field coils so that they carry a reduced current on a given load.

When any dynamo is started up and is to be connected in parallel with a dynamo which is already in operation, the voltage of the incoming machine must be adjusted the same, or very slightly higher than that of the running machine before closing the switch to connect the dynamos in parallel. If the voltages are much different there will be a considerable rush of current in one direction or another when closing the switches. When the switches are closed the regulator of the incoming dynamo can be adjusted to transfer the required amount of load current from the other machine. When disconnecting a dynamo which is working in parallel with another dynamo, the regulator should be adjusted to reduce the load on the outgoing machine practically to zero before opening the switch; this is advisable to avoid sparking which would damage the switch contacts when this is opened.

In the case of a compound dynamo which is to be connected in parallel with a running machine, the switches X and Y of dynamo No. 1 (Fig. 1) should first be closed and the circuit breaker Z closed after the voltage of the incoming dynamo No. 1 has been adjusted the same or very slightly higher than that of the running machine.

The Steam Car

IN connection with the above subject, we have received the following interesting letter from Mr. J. W. Dodds, of Harborne, Birmingham:

"I have read the article by W. J. Roberts in the January issue of PRACTICAL MECHANICS with very great interest. There are one or two points, however, I would like to bring to the attention of your readers.

"Firstly, one of the earliest, if not the first, makers of steam wagons was Leyland Motors, Ltd., and they only discontinued manufacture about 1924. I was their works manager at Chorley, where these wagons were made, and our last experimental vehicle was well worthy of notice. It was made from a standard petrol 5-ton vehicle chassis. A field-tube boiler with exhaust feed water heater and coil superheater was fitted and the working pressure was 280lb. per sq. in.

"The engine was a four-cylinder, twin-opposed, single-acting horizontal on two cranks, with poppet valves and a sliding camshaft with variable cut-offs.

"I append a list of consumption figures obtained from this vehicle which may prove of interest.

"Secondly, the above-mentioned article does not refer to what I consider to be the best steam car produced at any time.

"This was a French make called the Gardiner Serpollet, from which I copied the engine we produced at Leyland.

"This engine was so small and compact that it could be accommodated under the floor, and was no longer than a modern car gear-box.

"I am one of the small band of people who have ridden in White, Stanley and Gardiner cars, and from the experience gained I would exchange my Chrysler at once for a really sound steam car.

"The limitations of the early steam cars were mainly due to boiler trouble, and I am sure, with the much more suitable materials at our disposal to-day, and also developments in such things as thermostats, etc., a very good job could be put on the market.

"The following list of figures was taken on three types of steam wagon.

"The Sentinel boiler will be familiar to readers, and that on the Leyland F2 was fitted with internal curved tubes, which curved from holes at the lower end of the fire-box to the upper—all round the inside.

"They used to silt up quickly, and had to be removed for cleaning. The Thimble tube boiler was developed and was tried out, and its trial coincided with Clarkson's patents.

"The Thimble tube boiler correctly designed is self-cleaning, and all sludge collects in the bottom of the boiler, and can be blown off."

	Particulars of run from Chorley to London with Standard F2 Steam Wagon and fitted with new diagonal water tube boiler. T. C. Q.	Test taken on a "Sentinel" Steam Wagon. (Extract from *Commercial Motor*, Oct. 4th. 1921). T. C. Q. L.
Gross weight of wagon leaving works	11 5 0	11 5 2 14
Weight of wagon (fuel and water)	6 10 0	—
Weight of load ..	4 15 0	4 18 0 0
Miles run ..	240	61
Running time ..	—	4 hrs. 1 min.
Average speed ..	—	15.19 m.p.h.
Total weight of water used ..	10,220 lb.	2,310 lb.
Water used per mile	42.7 lb.	37.96 lb.
Water used per gross ton mile ..	3.8 lb.	3.54 lb.
Water used per useful ton mile ..	9 lb.	7.73 lb.
Total weight of fuel used	1,344 lb.	328 lb.
Total weight of fuel used per mile ..	5.6 lb.	5.38 lb.
Total weight of fuel used per gross ton mile ..	.498 lb.	.50 lb.
Total weight of fuel used per useful ton mile ..	1.18 lb.	1.10 lb.
Water evaporated per lb. of fuel ..	7.62 lb.	7.04 lb.
Gross ton miles ..	2,700	
Useful ton miles ..	1,140	

These figures include fuel for lighting up on three occasions.
Note: Horizontal double-action engine, two cylinders 4½ x 6in. stroke. Final chain drive to rear wheels on each side. Diff. in engine case.
Gas coke.

Conditions: Roads dry, but atmosphere humid.
Route: Hilly and tortuous, max. gradient about 1 in 8.
Fuel: Gas coke from Birmingham and Chester.

Test Run Steam Wagon Fitted with New Type Engine

Horizontal twin-opposed single-action engine, 4½in. by 6in. stroke. Gas Coke.

Thimble tube boiler. Bottom superheater. Bottom row of tubes removed. 2in. large diameter tubes.

	T. C. Q.
Gross weight of wagon leaving works	12 2 2
Weight of wagon (fuel and water)	6 1 3
Weight of load	6 0 3
Miles run	22
Running time—hours and minutes	1.30
Average speed—miles per hour..	14.3
Total weight of water used ..	850 lb.
Water used per mile	39 lb.
Water used per gross ton mile ..	3.2 lb.
Water used per useful ton mile..	6.4 lb.
Total weight of fuel used ..	110 lb.
Total weight of fuel used per hour	73.32 lb.
Total weight of fuel used per mile	5 lb.
Total weight of fuel used per gross ton mile	.414 lb.
Total weight of fuel used per useful ton mile	.828 lb.
Water evaporated per lb. of fuel	7.73 lb.
Gross ton miles	266
Useful ton miles	133

Extract from *The Commercial Motor* of December 7th, 1920.

Coal v. Oil Fuel for Steamers

The Editor, *The Commercial Motor.*

SIR,

My attention has been called to the letter in your issue of November 16th, 1920, and your added note.

It is our constant policy to understate the performances of our wagon, and this has resulted in our having so many satisfied users; but it is only fair to the writer of the letter referred to that we should state that consumptions as low as 4½ lb. of suitable Welsh coal per mile are not unusual. It is also our policy, with a view to conserving the national fuel supply, to advocate the use of coke, and I give below results of tests run recently with this fuel, on an average course of 60 miles out and home from these works, over second-class country roads.

Test No. 1.—6.7 lb. per mile. Ordinary gas coke.
2.—6.65 lb. per mile. Ordinary gas coke.
3.—6.2 lb. per mile. Ordinary gas coke.
4.—4.79 lb. per mile. Better class coke.
5.—5.6 lb. per mile. Gas coke.
6.—6.6 lb. per mile. Gas coke. (Roads very heavy after rain.)
7.—6.4 lb. per mile. Gas coke.
8.—5.7 lb. per mile. Ordinary gas coke.

We will be very pleased to run a test for your representative at any time you arrange, and he will also have the opportunity of testing the coke for comparison with Welsh coal, when we have no doubt the figures mentioned by your correspondent will be found fully possible.

Yours faithfully,
The "Sentinel" Waggon Works (1920), Ltd
G. Woodvine, Works Manager.

THE WORLD OF MODELS

By "MOTILUS"

The Development of a New Modelling Medium; Britain's Latest Streamline Train

Streamlined S.R. engine "Orient" leaving Waterloo Station after her naming ceremony.

Pyruma Modelling Exhibition

WHEN I wrote of Pyruma in this journal last September I little thought it would develop into so universally popular a modelling material as it undoubtedly has.

One useful item to remember is that there is as yet no restriction on supplies, it is easily obtainable, and skilful and enthusiastic modellers have been able to introduce so many varieties of Pyruma modelling on both subject and finish.

This was wonderfully demonstrated at an excellent exhibition organised in December by Mr. Herbert M. Sankey, of Messrs. J. H. Sankey and Son, Ltd. (the makers of Pyruma and its allied products).

The "Pyruma" Modelling Exhibition was displayed in a large showroom and consisted of over 40 models, 60 per cent. of which were submitted for exhibition only, the remainder forming the "Pyruma" Modelling Competition, which was judged by two experts, Mr. W. J. Bassett-Lowke, M.I.Loco.E., managing director of Bassett-Lowke, Ltd., and Mr. George Sell, managing director of A. D. Services.

Professional Models

First, to mention the "professional" models as apart from "competitors." The great point about them was the highly successful manner in which they demonstrated the variety of finishes that can be achieved in Pyruma. Some of the models appeared to be carved in stone, others of highly glazed pottery, some of tinted metal, and one even looked as though it were modelled in bronze!

Exhibition model of stallion in natural finish

In my opinion, the most attractive professional model, from the artistic point of view, was the model stallion, finished in the natural Pyruma, which had the appearance of being hewn out of stone. Others which caught my eye were the figure of a Home Guardsman in the bronze finish, a penguin family in natural colours, and a black shiny seal balancing a painted ball on its nose.

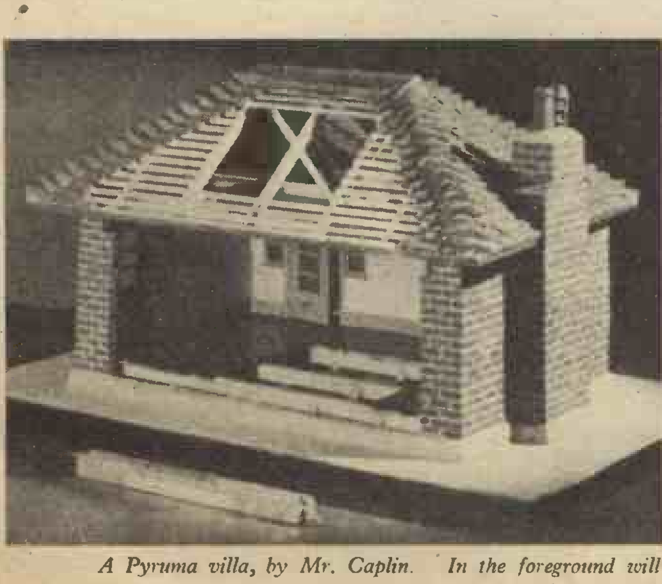
In one exhibit of a model villa, the work of Mr. Caplin, every brick and tile had been separately moulded. A part of the roof and floor were left unfinished to show the method of construction. The scale of this model was ½in. to the foot.

Actually the exhibition was arranged in sections, under the headings of "Utility and Decoration," "Animal Models" and "Architecture and General," but the exhibits were so varied—ranging from houses to necklaces—that precise cataloguing must have been an impossibility.

There were a large number of visitors, and I am sure that many were so impressed that they will soon be "trying their hand" at modelling in this new material as a war-time hobby.

"Mirror Grange"

Now we come to the competitors. The first award was outstanding—a model of an old country house, the "Mirror Grange." It was a delightful piece of craftsmanship, and one which showed in the best way the universal application of Pyruma as a modelling medium. This was the work of Mr. Sankey's son, Donal, and is a "hollow" model, made entirely of plastic Pyruma, rolled into flat



A Pyruma villa, by Mr. Caplin. In the foreground will be seen the mould for making the miniature Pyruma bricks.

sheets, cut to sections, and scored with a penknife to represent the various finishes of brickwork, timbering, tiles and thatch. It was then baked and jointed with Tiluma cement. The finishing touches when completely dry were achieved with poster paint. Readers will remember the illustration of "Mirror Grange" appearing in last month's PRACTICAL MECHANICS.

Award No. 2 was the work of one of the fair sex, Miss Hubbard, and her model was of a crinolined lady. As you will see from the illustration, she has most successfully portrayed the daintiness and detail of the dress. Altogether it is a delicate piece of modelling, and well finished.

Miscellaneous Models

For Award No. 3 we enter the "Animal" section and choose a fearsome-looking monster —the gorilla. This bears close inspection as regards detail, particularly in the gorilla's face, and was the work of Mr. Hext.

Award No. 4 was of a humorous character by Mr. J. Tyler, and formed a novel ashtray and match-holder under the title of "Top Hat and Tails."

Book-ends are always a favourite subject for model makers, and here again Pyruma is a suitable medium, as, in addition to its other qualities, it also provides weight. The two book-ends by Mr. F. Jones, with figures of monks on them, well deserved the fifth award.

A lighthouse by Miss Blythe gained Award No. 6, and was another indication of the adaptability of Pyruma.

The special award went to Mr. Malpas for a colourful and decorative galleon wall plaque, which, had it not been for a technical error, which caught the eagle eyes of the

The winner of the special award—a galleon wall plaque by Mr. Malpas.

judges, would have gained for its designer an award much higher up the list. Actually the bowsprit was foreshortened and should have been carried much higher, allowing more space for the ropes carrying the foresail, jib and flying jib. Apart from this error, the plaque was a very fine effort.

Mr. George Sell was a complete newcomer to the world of Pyruma, so his remarks will no doubt prove enlightening to readers.

"When Mr. Bassett-Lowke asked me to collaborate with him in the judging of a Pyruma Modelling Competition," said Mr. Sell, "I was, I must admit, somewhat doubtful as to what I was going to see. But when I arrived there I was definitely amazed, not only at the scope of the models, but the detail that can be obtained in this medium. The collection of models, as a whole, was a most fascinating and bewildering exhibit for any judge to set about, and we had a most difficult task to decide the merits of the individual entries."

Streamlined S.R. Locomotive

A friend, who used to be very keen on making models of the latest types of locomotives of the various British railways, complained to me recently that very few pictures have been published of the new streamline Southern locomotive.

I received from the Southern Railway the other day an excellent view of the engine "Orient" leaving Waterloo Station after having been named by Mr. J. C. Geddes, chairman of the Orient Line, and Colonel Gore Browne, deputy chairman.

A crinolined lady, a Pyruma model by Miss Hubbard, which gained award No. 2.

The gorilla, by Mr. Hext, a realistic model, which was awarded third prize.

Post-war Modelling

I am hoping that when the war is over not only will model railway engineers want to make a model of this latest streamline production for their own railways, but that commercial firms will also produce models for those who own and run railways, but have not the facilities for making their own models.

Incidentally, there are probably many readers who, at some time or other, have made models of locomotives, rolling stock, or various types of stationary steam engines, photographs of which have never been published. Such readers are asked to send along photographs, together with a short description of their models, to the Editor, with a view to inclusion in these notes.

A CORRECTION

In the article "The World of Models" which appeared in the January issue, the caption given under Fig. 8 (page 139) refers to the model loco. illustrated in Fig. 9, and vice versa.

Books Received

N.C.U. Diary for 1943. Published by the National Cyclists' Union.

THIS handy little diary, of vest-pocket size, contains, in addition to a four days to a page diary, much useful information for cyclists. There are also sectional maps of the British Isles showing the main and trunk roads.

Marine Radio Operator's Guide. By H. E. Chamberlain. Published by Hutchinson and Co. 72 pages. Price 5s. net.

THIS handy volume is intended to supplement the training a marine radio operator will have received before obtaining his P.M.G. certificate. The author has had several years at sea as a radio operator, and in this book he has collated a large collection of hints and tips which should be of great help to the young operator who has yet to serve his sea apprenticeship. Not only does the book deal with technical problems, it also tells the newly fledged operator what to buy in the way of kit and equipment, and what to provide in the way of comforts and medicine. The book contains several good illustrations of typical radio equipment on board ship.

"Procedure Handbook of Arc Welding Design and Practice." 7th Edition. Published by Lincoln Electric Co. 1,267 pages. Price 10s.

SINCE the publication of the sixth edition of the above book, the application of electric arc welding has become a leading factor in speeding up war production, and concise, up-to-date information is now more essential than ever before for executives, works managers, draughtsmen, welding foremen, welders, and the ever-growing number of trainees. Welding equipment, procedures, speeds and costs, methods of testing, weldability, design and applications are all dealt with in the new enlarged edition—price 10s. post free in the United Kingdom, 11s. Overseas. The "Fleet-Fillet" Section is also of particular interest.

The address of Lincoln Electric is Welwyn Garden City, Herts.

Our Busy Inventors

By "Dynamo"

Three-dimension Pictures

A VERY interesting invention is one which, it is asserted, furnishes a third dimension in the picture on a screen. We are all familiar with the flat picture which has length and breadth. I understand that, some years ago, the principle of the stereoscope was utilised to cause on the screen the effect of figures and objects which stand out. But this, I believe, was produced by an optical instrument worn before the eyes. The new device, however, provides a screen which, it is stated, itself displays the illusion of a picture possessing depth in addition to length and breadth.

The screen in question has a thickness of transparent material and a background of a substance which reflects very little light. In the front of the transparent material there is a translucent substance.

Preferably the screen is formed with a hollow curve across its front surface. This curve is part of a circle of which the radius is equal to the width of the screen. As a consequence, the light rays of the beam from the projector strike the display surface at right angles or approximately so. Thereby distortion of the matter projected is avoided, or reduced.

The transparent material of the screen can be ordinary refractive glass, but preferably non-brittle such as a transparent plastic or resin capable of being curved, cut and otherwise worked.

If this device lives up to what is claimed for it, it should prove an attractive adjunct to the cinema.

Anti-aircraft Missiles

A RECENT invention relates to a projectile which is designed to be fired from guns and howitzers, and which, its inventor affirms, would be particularly effective against enemy aircraft.

This projectile has a casing packed with a multiplicity of detached missiles. The casing comprises a one-piece nose cap at its front end and a one-piece base cap at its rear end. The wall of the casing is built up of a number of longitudinally divided portions extending between and held together by the nose cap and the base cap.

The nose cap is arranged to be forced forward from engagement with the front ends of the wall portions by means of a light separating charge just behind it. This is exploded by a fuse at a given time interval after firing. The connection between the rear ends of the aforementioned portions and the base cap is such that, as soon as the wall portions begin to spread at their front ends consequent upon the nose cap being forced off, they free themselves from the base cap. As a result, the whole projectile is separated into its component parts of nose cap, base cap and wall portions.

The contents of the casing are missiles in the form of hexagon section rods. These, as soon as the casing separates as stated, spread, together with the wall portions, by virtue of the centrifugal force arising from the spinning of the projectile. At the same time, the nose cap, base cap, wall portions and hexagon rods continue to move forward and a large portion of space is traversed by them.

For the Deaf

A PORTABLE appliance for aiding the deaf usually consists of a microphone, one or two headphones with or without an arrangement for the conduction of sound through the bones of the head, and a primary battery to supply electric current at a voltage suitable for feeding the microphone. The apparatus may include an amplifier.

The British Patent Office has recently had submitted to it an appliance of this kind, which comprises the microphone and headphones above mentioned. In addition there are a smoothing choke in series with the microphone feed intake, and one or more smoothing condensers in parallel with the intake and the choke. The whole apparatus is adapted to be connected to the current obtained by transforming and rectifying the latter from an alternating current mains. An amplifier may be added.

The information on this page is specially supplied to "Practical Mechanics" by Messrs. Hughes & Young, Patent Agents, of 7, Stone Buildings, Lincoln's Inn, London, W.C.2, who will be pleased to send free to readers mentioning this paper a copy of their handbook, "How to Patent an Invention."

Improved Milking Appliance

THE mechanical milkmaid, if one may so term the modern machine which extracts the lacteal fluid from cows, has become a feature of agricultural life. But although we associate it with cows, it is also available for the milking of ewes and goats.

It appears that the milking of these smaller animals presents some difficulty. The normal yoking means employed in the case of the cow is not suitable for the ewe and the goat, which are capable of jumping a considerable distance from the ground. If there is any restraining means above their heads, they may suffer injury. However, it is imperative that they should be yoked in order to prevent them from turning round and from backing into the stall. These animals must be so yoked that their heads are free to turn without discomfort and to move in an upward direction without causing them injury.

A milking stall for these creatures is the subject of an application for a patent in this country. It has side walls and a door at its front end. This door consists of a pair of gates hinged to the walls and opening in opposite directions. The door is fitted with yoking bars capable of being adjusted to a position allowing the animal's head to pass comfortably between them and also to a position preventing the head from passing through them.

For Training Air Pilots

A METHOD of teaching on the ground the flying of aircraft is the subject of an application for a patent in this country. The object of this system is to train the pilot to maintain his aircraft at a predetermined altitude to the horizontal, or to another aircraft. By this means the instinct of the beginner to judge his altitude by looking at the ground is counteracted. As a consequence, the correct habit is acquired from the start.

The new invention is especially, though not exclusively, advantageous in connection with gliders and ground trainers. It is also beneficial in the case of power aircraft which have no engine in the nose. Consequently, these machines possess no structure at or near eye-level.

According to the device, an instrument has a pair of horizontally spaced sights mounted adjustably vertical in relation to the pilot's seat.

Near this seat there is a pillar upon which a bracket is slidably mounted. This bracket is adjustable along the pillar and clamped by means of a bolt in any desired position. There is also an index co-operating with a scale on the pillar, so that the device can be re-set at any height.

Cigarette Roller

ANOTHER recent invention is a simple cigarette-making apparatus.

The new device consists of a tube having a movable section which can be opened to allow this tube to be filled with tobacco from a lateral direction, or sideways.

When the movable section is closed, the exterior of the tube is designed to enable one to form a cigarette paper into a cylinder. Provision is also made for simultaneously sliding this paper cylinder off the outside of the tube, and extruding therefrom tobacco endwise. Thereby a cigarette is made as the paper cylinder and the tobacco are ejected from the appliance.

In this Indian steel works, plates are being handled by powerful electric magnets.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on back cover, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Steam Heating for Rooms

IS it possible to heat a large bed-sitting room by a steam radiator from the fireplace already being used, but which only heats within a 2ft. radius ?

Could not a small boiler be placed at the back of the grate and connected up to a radiator placed in the coldest and most draughtiest corner of the room ? Would the hot water installation of an eight-roomed house, supplied from the kitchen fireplace, be sufficient for the use of four or five radiators about the house ?—Percy Nava (Blackpool).

TO instal a steam-heated radiator, the steam being generated by an ordinary coal fire in a bedroom, or a boiler placed at back of such fire, is impracticable, owing to the cost involved. Steam heating by ordinary systems necessitates steam under certain pressure, and the installation cannot be considered simple as viewed from your standpoint, which evidently does not call for a great expenditure.

If a water-heated radiator is required to be operated from a small boiler placed at the back of the ordinary fire, a complete heating system on a small scale would be necessary. The system would require a hot water tank, with cold water supply, expansion pipe, and proper flow and return pipes to the radiator. All this would be costly, and it is probable that a " good " fire would be essential to generate the necessary heat.

Without knowing the size of the existing boiler in the kitchen and its heating duties it is not possible to state whether it would be capable of supplying adequate heat to four or five radiators. Unless the boiler is of abnormal power for its present duties it is safe to state that it is almost certain to be quite inadequate for the additional heating. Radiators heated by water must be designed with utmost care with proper circulating loops, and it is probable that any radiators situated on the same floor level as that on which the boiler is placed will make it essential to cause the return pipe on the circulating loop to enter the boiler at a low level to ensure a good circulation; this requirement, although not always necessary, may mean placing the boiler a certain distance below floor level. Another matter of importance is that it is not good practice to feed radiators off the domestic supply, as by doing so there is a constant change of water which will eventually cause furring up of the pipes. The indirect or calorifier system is much better, as the hot water is not constantly changed, but used over and over again, the only loss being by a little evaporation.

From the foregoing it will be evident that you should consider the matter most carefully and study the possibility of other methods of heating, such as gas or electric fires. If hot water heating is necessary then it is advised that a local heating engineer be consulted.

Spot Welding

I WOULD be much obliged if you could give me some information on a six-volt D.C. electric welder to weld up to 20g. with bare electrodes. I believe such a tool is very popular in America, but I cannot get any actual particulars on how to construct one. I believe it runs from a six-volt car battery.—W. R. Williams (Newdigate).

THE fusing current of a No. 20 S.W.G. copper wire is about 70 amperes, but as you do not state the material of which the wire is composed it is difficult to advise definitely. We think you refer to a " spot-welding " device, however, and not to the arc-welding process ; in which case there is no reason whatever to make up a transformer provided the 6-volt accumulator you propose using has a sufficiently high discharge capacity in amperes, such as a starting battery from a large car. All that is needed is a pair of heavy copper clamps hinged like the jaws of a vice attached to a short length of copper flexible, such as 637/.010 or equivalent, lightly braided or insulated, with heavy terminal lugs for attachment to the accumulator. The clamps are secured to the wire you wish to weld at a short distance from the welding point, and the wires brought into contact to form a " butt " weld. A foot switch in circuit with the flexibles is a convenient way of interrupting the current while both hands are engaged.

Tempering of Motor-car Road Spring

I WOULD be glad to know how to correctly " temper " a spring leaf. I know that it should be done by spring specialists with their special equipment, ovens, etc., but, as a motor mechanic, I know it is possible to do so in an emergency by heating and using a piece of wood rubbed on the heated leaf. It is this method I desire to be sure of, and any advice you could give me would be appreciated.—D. C. Brookes (Wirral).

THE old-fashioned hand-fitting method is to heat the spring leaf sufficiently to bend it to correct shape or camber, then harden it in either water or oil, and afterwards reheat at a lower temperature. Then a piece of hard wood such as a hammer shaft is rubbed on the tempered leaf to give a spark up to a smoke.

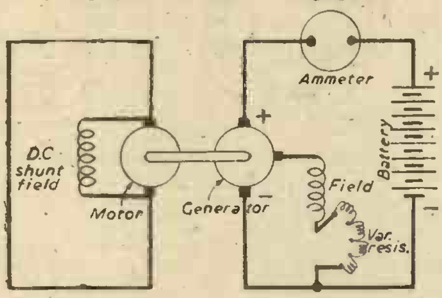
As you have not the facilities for tempering or regulating the various furnace temperatures, there is little we can do to advise you. Experience as to whether the plate is correctly tempered can be your only guide. The risk, however, of too soft or too hard plates being built into a spring by the old-fashioned method suggested is great, in view of the fact that the steel generally used in these days for motor-car spring plates is silico-manganese.

For your information, the heat-treatment for silico-manganese spring steel is heat slowly to a bright cherry red or just to a scaly heat (843 deg. C.), and harden in warm water when the heat has gone down to a cherry full red (746 deg. C.). Do not let the plate remain stationary in the water, but move it freely about until all the heat has gone. Temper in a slow fire until a piece of hard wood, when rubbed on the plate, will just catch fire, or when the plate can be seen to be a dull red heat when held in a dark place (500 deg. C.).

Battery Charging

I WISH to construct a charging board for 12- and 6-volt batteries, and intend to fix up a car generator driven by a 1/4 h.p. motor. I should be much obliged if you would give me a diagram of the best method of wiring a board for 12- and 6-volt batteries.—Thos. Hunt (Rowlands Gill).

A CAR generator is self-regulating only when used with the standard number of batteries and standard charging rate for which it was designed, and you may find your proposal to use it for charging batteries of either 6 or 12 volts, and of various sizes, somewhat troublesome to accomplish. Your best arrangement will be couple it to a 1/4 h.p. driving motor, with a variable resistance in the field circuit regulating the latter by hand until the charging rate is suited to the size of the battery on charge. If more than one battery is on charge at a time connect them in series, with the total voltage not exceeding 12 volts, and regulate the current to suit the full charging rate of the smallest cell in the series. Parallel charging is not recommended unless you have a separate variable resistance and ammeter in each branch to check up the charging rate. The accompanying diagram illustrates the simplest connection.



Circuit diagram of a battery charger.

Depositing Carbon on Refractory Surface

COULD you tell me how I can deposit a thin layer of carbon on a refractory surface, say, fireclay ? I only want it a few ten-thousandths of an inch thick. How can I get on top of this a thin layer of magnesium oxide of similar thickness ?—H. Brown (Thetford).

YOU cannot satisfactorily deposit a thin layer of carbon on a rough surface by chemical means alone, and, for this reason, you will have to employ some physical method of obtaining this end. The best way will be for you to experiment by passing the fireclay surface at a known rate through a smoky gas flame or through the flame of burning turpentine. By dint of careful experiment you will be able to get reproducible results by this simple method, since by passing an article quickly through a smoky flame an exceedingly thin film of carbon can be deposited upon it.

The same method applies, also, in the case of the deposition of a thin film of magnesium oxide. In this instance, the article is passed above burning magnesium ribbon or wire.

These methods are simple and fairly efficient and they do not call for the use of expensive apparatus. Chemical methods in the instances you name are unavailable.

Boiling Points and Pressures

THE coupon enclosed is from the last issue I was able to procure, having just completed 12 months' service in the Orkney Islands.

Will you please answer the following queries :

1. At what temperature Fahr. does water boil when it is under the following pressures :
A. 650 lb. per square inch.
B. 750 lb. per square inch.
C. 850 lb. per square inch.

2. The amount of water to be evaporated to raise a pressure of 250 lb. per square inch in a cylinder, the dimensions of which are 4½in. by 5½in. By that I mean that when a 250 lb. pressure has been reached, all the water has been evaporated. —F. B. Almond (Hatfield).

PURE water boils at the following approximate temperatures under the pressures named :
650 lb. per square inch—248 deg. C.
750 lb. per square inch—270 deg. C.
850 lb. per square inch—285 deg. C.

Above a temperature of about 360 deg. C. water refuses to remain liquid, no matter what the pressure may be. This is the " critical temperature " of water. Roughly speaking, water advances 10 deg. in boiling point for every five atmospheres increase in pressure above medium pressures.

2. Your problem is not solvable with any precision for the reason that you do not state the temperature at which the evaporated water vapour is to be maintained. Assuming, however, that the water vapour (steam) is maintained around 100 deg. C., you would require about .31 c.c.s. water (or a little over an ounce) to attain the pressure you prescribe.

Locating Nails in Timber

I SHALL be grateful for any information you can give on the following matter :

Owing to the extreme shortage of timber, second-hand and reclaimed material has to be increasingly used for munition cases and suchlike work. As you can imagine, although every effort is made to remove all nails, we are constantly encountering large pieces of nail buried in the timber, and these are not discovered until they have ruined the teeth of saws or the knives of planing machines.

I was wondering, therefore, if it would be possible to rig up any form of nail detector, that could be placed on a suitable table over which suspected timber could be passed, and which would indicate by light or sound, etc., the presence of buried nails. Incidentally, the size of the timber involved would vary up to about 6in. by 3in. maximum cross section. I thought it might be possible to rig up something on the lines of the " growler " used to detect faults in armatures.—W. V. Cox (Bristol).

THE location of nails or iron spikes buried in old timber is always a problem. If the timber does not exceed 3in. in thickness it may be assumed that the buried nail cannot be more than 1½in. from one or other of its surfaces, in which case it should be possible to detect its presence before reaching the saw by passing the timber as closely as possible underneath a very freely pivoted long magnetic needle, keeping a close watch to see if any deflection of the needle takes place as the timber is fed up to the saw. The pivot of the compass needle should be slightly to one side of the timber and not directly over it. No other iron must be in the vicinity or it will mask the effects. The use of a " growler " as used for detecting faults in electrical windings would hardly be effective, and the airgap between its poles would be excessive and the results too weak in consequence. The use of X-rays would solve the problem effectively, but the preliminary expense of the necessary outfit would be prohibitive, and in any case it is hardly a workshop appliance. The deflection test with a sensitive magnetic needle is simple and cheap, and it would be a simple matter to pass the timber along under it previous to placing it on the sawbench. If a secondhand "mirror" galvanometer could be obtained, this would increase the sensitivity of the test.

Doubling Speed of Motor

I WOULD be very grateful if you would give me some simple instructions for doubling the speed of a motor, which I possess. This is an American (Century Motor Co.), 220v. A.C. type S.P. (single phase, I believe), 50 cycles, 1.6 amps., 1/6 h.p., 1,440 r.p.m. I have been told that if I halve the number of poles, I can obtain double the speed, but on taking out the rotor, I failed to find any simple way of doing this without precise instructions, as the fields appear to be sealed into the body with bitumen. I need the motor for buffing up small objects, so if the h.p. happens to be decreased slightly through alterations, this does not matter much, so long as I obtain about 3,000 r.p.m.—J. M. Fisher (Finchley).

THIS motor is apparently of the split-phase squirrel cage type of single-phase motor, having a 4-pole stator winding and a 4-pole starting winding intermediate between the main coils. It is possible that there may also be a circular coil of resistance wire connected in series with the starting winding and secured to the stator coils. The possible methods open to you are as follow.

You might mount your motor on the floor and drive by means of a belt to the buffing head, the diameter of the motor pulley being twice as large as the buff pulley to give you about 3,000 r.p.m. at the buff without alteration of the windings.

If you are able to check the ends of each of the main windings and the ends of the starting windings, you might change over the ends of the coils as at a, b, c and d on the main stator windings. You might also disconnect the ends of the two starting coils E and F, leaving these open circuited, and reverse the ends g and h of the starting coil K. Any resistance coil you may find in the starting coil circuit should be left in circuit and an external resistance, such as a lamp, connected also in circuit. Alternatively, you might complete the starting circuit by a tumbler switch external to the motor, as well as a lamp. The switch should then be closed only during starting and afterwards switched off to break the starting coil circuit.

The only other method would be to rewind the motor, giving this two main stator poles of opposite polarity, with intermediate poles of high resistance windings as at present. In this event make quite sure that the type of wire used in the starting winding is the same as at present and that you understand the arrangement of these windings. In certain machines of this type the required resistance is obtained for the starting winding by winding this with resistance wire or by reversing the direction in which the coils are wound partway through each coil.

Step-down Transformer

I HAVE built a rotary converter as follows: I fitted a pair of slip rings to the armature shaft of a 1/6 h.p. compound wound D.C. motor, running at 1,500 r.p.m. and connected the slip rings to two opposite segments of the commutator. The input voltage is 230 D.C. and the output voltage with no load is 165 A.C. 25 cycles, and with a 75-watt lamp across the output terminals the output voltage is 150 A.C.

I want to step-down the output voltage to 8 volts A.C. with as great a wattage as the converter will give (I hope to use anything between 2 amps. and 8 amps. if possible) and would like the particulars of a suitable transformer. If you can give me the windings and type of stampings required I shall be very grateful.—James Robertson (Perth).

IF you can obtain sufficient current from the output side of your D.C. to A.C. rotary transformer to light a 75-watt lamp at 150 volts, there should be no difficulty in operating a step-down transformer with an output capacity of 8 volts 9 amperes. Owing to the low frequency of 25 cycles, however, the core of the transformer will be as large as one normally employed for double the output on 50 cycles. Build the core of stalloy strips 1¼in. wide of No. 26 gauge, to an overall dimension of 6in. by 4¼in. by 1¼in. deep, which leaves a winding space internally of 3in. by 1¼in. For a 150-volt 25-cycle input wind the primary with 1,050 turns of No. 24 S.W.G. d.c.c. copper, and the secondary with 56 turns of No. 13 S.W.G. d.c.c. copper. You may be able to obtain the stampings from J. Sankey and Sons, Ltd., Albert Street Works, Bilston, and the wire from Ward and Goldstone, Ltd., Frederick Street, Pendleton, Manchester, provided you can furnish an authorisation to purchase on Form "M" from the Board of Trade.

Smoke Bombs

I HAVE been asked if I can make up some form of smoke bomb which can be either thrown by hand or rifle, for the use of the Home Guard in exercise. I would be obliged if you could supply me with a formula for such, with the means of igniting it, and any other helpful suggestion would be greatly appreciated.—W. Miller (Glasgow).

YOUR best plan is to make use of a "zinc" smoke which is fairly slow burning and which gives a dense white, non-poisonous smoke.

A suitable formula for a smoke-producing material of this nature is the following:

Zinc dust	25 per cent.
Carbon tetrachloride	50 "
Zinc oxide	20 "
Kieselguhr	5 "

The above mixture is ignited with a charge of iron dust and potassium permanganate, or, alternatively, by any photographic flashlight powder.

A somewhat superior zinc smoke is obtained according to the following formula:

Zinc dust	28 per cent.
Zinc oxide	50 "
Hexachlorethane	50 "

This is ignited by means of the following mixture:

Antimony powder	76 per cent.
Zinc dust	11 "
Potassium perchlorate	11 "

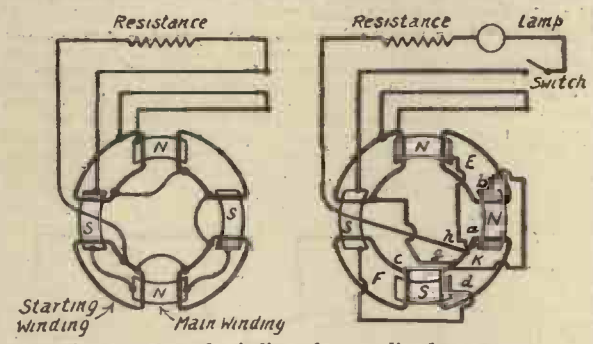
Alternatively, you may employ the following smoke composition which gives a brown smoke:

Saltpetre	45 per cent. (by weight)
Sulphur	12 " "
Pitch	30 " "
Borax	9 " "
Glue powder	4 " "

This is ignited by means of a flash powder composition, say a mixture of magnesium powder and potassium chlorate or perchlorate.

In making up any of these chemical smoke mixtures, pack the composition in a tin can, and have a central core of the igniting mixture about three-quarters way up the can. This central core is connected to the surface of the mixture by means of a trail of ignition powder, with or without a length of magnesium ribbon.

We fear that it will be difficult for you to obtain most of the materials above-mentioned at the present time. The best place to make inquiry for them will be at your local chemical wholesaler, as, for example, Messrs. Griffin and Tatlock, of Glasgow.



Arrangement of windings for a split-phase motor.

Plumbago Crucibles: Contamination

CAN you give me any information on the following queries:

1. Where can I obtain a small plumbago crucible to hold about two pounds of metal?

2. Does contamination take place if different metals are melted in the same crucible? The metals I desire to melt are copper, brass, iron and aluminium.

3. Is any kind of flux required when melting the above metals for casting purposes?—G. L. Fox (Nottingham).

YOU can obtain these crucibles from J. Preston, Ltd., 208, West Street, Sheffield, 1.

2. There is a grave risk of contamination if different metals are melted in the same crucible.

3. A flux of the charcoal type is required with copper, brass and aluminium. Generally, no flux is needed with iron.

Reclaiming Used Oils

THERE is a plant marketed for the reclaiming (or cleaning) of used and dirty engine oil. Can you tell me the method of cleaning, and also is it possible to make my own small plant?—D. Anyon (Seafield).

SUITABLE plants for the reclaiming of waste oils are manufactured by Metafiltration Company, Ltd., 4, Belgrave Road, Hounslow, Middlesex, this company specialising in this type of work. We would, therefore, advise you to get in touch with them, stating the type and quantity of oil which you wish to reclaim.

We are inclined to doubt whether it would be feasible for you to construct a really satisfactory reclaiming plant. You might, however, filter the oil under pressure through a column of animal charcoal mixed with fuller's earth or kieselguhr, but this would necessitate your using compressed air. We think, therefore, that before you proceed along any such lines, you would be better advised to approach the above-mentioned company on your problems. Streamline Filters, Ltd., Ingate Place, London, S.W.8, is another company which makes similar filters.

Faulty Aneroid Barometer

I HAVE an aneroid barometer which is not functioning properly, possibly due to the diaphragm or bellows leaking.

Can you please tell me how to test for air leaks, and the best way to exhaust the air when resoldering?—F. G. Weir (Rainham).

UNLESS your aneroid barometer has been mechanically rough-handled, we do not see why the diaphragm or bellows should give rise to leakage. However, you can quickly assure yourself on this point by carefully dissembling the bellows and by heating it cautiously in front of a fire. In this heated condition, the part is then dropped quickly into a vessel of cold water and held below the water surface. If leakage is present, water will obtain access to the bellows, and it will make its presence known on shaking the bellows.

The only way to exhaust the bellows when resoldering is to connect the bellows to an efficient vacuum pump, and then to "draw out" quickly the tiny air exit tube in a hot flame. It will take considerable practice for you to do this, and we think the job would best be done by a good optician and instrument-maker.

It is more probable, however, that the bellows of your barometer does not leak, and if you examine the instrument carefully you may be able to find traces of dirt or grease which may be causing the parts of the barometer to stick.

Insulator for Magnetism!

I WOULD be pleased if you could give me the name of any material that is resistant to passing magnetic rays, or a material that is a baffle for magnetic rays.—W. R. Cleaver (Abergele).

WE do not know of any material yet produced which can be considered an insulator for magnetism. Air offers a high resistance to the passage of magnetic lines of force, about 13,000 times as high as iron, so that the best way of screening a piece of apparatus is obviously to keep it well away from the magnetic field. Another method of protecting apparatus situated in a magnetic field from the effects of that field is to direct the field away from the apparatus by providing an alternate path of low reluctance. This may be done by fitting a piece of iron, of as large a cross section as possible, on the field side of the apparatus and in a direction parallel to a line joining the poles. If the magnetic field is varying, as may be set up by an alternating current, the iron should, preferably, be constructed of thin laminations which are lightly insulated from each other.

Emulsifying Wax: Cellulose Acetate

I WISH to make some emulsifying wax and shall be glad if you will help me regarding the following points: (1) Could you give me a suitable formula, the product to emulsify several times its own weight of H_2O + a little oil? (2) How are sodium carbonate pea crystals made? (3) Can cellulose acetate be made with acetic acid, or must the anhydride be used? (4) How much of the acids nitric (HNO_3) and H_2SO_4 and H_2O are used, and how long is the reaction, and at what temperature to make collodion?—C. A. Godden (Twickenham).

YOU can make an emulsifying material by mixing about 5 per cent. of ammonia with turkey red oil, but you would be better advised to purchase a quantity of "Abracol" emulsifier (price about 2s. lb). from Messrs. A. Boake, Roberts and Co., Ltd., "Ellerslie," Buckhurst Hill, Essex. This material is a waxlike paste, and is excellent for the emulsifying purposes which you name.

(2) Sodium carbonate "pea" crystals are made commercially by recrystallising the "technical" or impure grade of sodium carbonate from hot water. The solution is made up to a predetermined strength and is cooled down at a definite rate. The controlled crystallisation of the solution results in these small pea-like crystals. They are separate from the excess solution and are usually dried in a "whizzer" or a centrifuge. For special purposes, the crystals are sometimes passed through a screen or sieve in order to ensure them all being of the same approximate size.

(3) You cannot make the cellulose acetate which you require with acetic acid alone, no matter how strong the acid may be. Cellulose (hexa) acetate is made by heating pure cotton wool or cellulose with acetic anhydride for five hours at a temperature of 180 deg. C. under a reflux condenser. A white flocculent mass results. This is cellulose acetate. It must, of course, be washed very thoroughly in clean water and dried slowly. Most text-books on organic chemistry describe the process in some detail.

(4) Collodion is a solution of nitro-cotton in a mixture of alcohol and ether. The proportions of these two solvents in the mixture vary according to the purpose for which the collodion is required. A little castor oil is sometimes dissolved in the mixed solvents in order to increase the flexibility of the cellulose film.

To make the necessary nitro-cotton, ordinary cotton wool is soaked for four hours at ordinary room temperature in a mixture of three parts of concentrated sulphuric acid and one part of concentrated nitric acid. The resulting white mass is then most thoroughly washed in plenty of warm water in order to free it from all traces of acid.

THE Cyclist
Editor: F. J. CAMM

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Comments of the Month By F. J. C.

Vehicle and Street Lighting

THE important topic of debate at the meeting of the Roadfarers' Club held at the Clarendon Restaurant on Saturday, February 6th, was Vehicle and Street Lighting. The meeting was well attended and was preceded by a lunch. Mr. C. G. Grey presided over this meeting of the Roadfarers' Parliament and contributed to the debate. In opening it he said that the first Act which made provisions for the lighting of road vehicles was the Locomotive Act of 1898. This, however, merely specified that vehicles should carry a light—any sort of a light, fixed anywhere. This law failed to prevent accidents on the highway. The Lights on Vehicles Act of 1907 was the first Act which legislated solely for obligatory lights on horse-drawn vehicles. It is a far cry from red flag days to red rear lights, and much heat has been generated in the controversies relating to lights. What are the minimum requirements? In the first place the driver of a vehicle needs to fit a lamp which will not only illuminate his presence on the road, but will enable him to proceed with safety during the hours of darkness, and illuminate the road for a sufficient distance ahead to enable him to observe obstructions, pedestrians, cattle, or other vehicles and to be able to stop within the limit of the braking capacity of his vehicle. Paradoxically enough when rear lights became compulsory on vehicles the Act only applied to motor-cars, and not to the slower moving vehicles. On the other hand, the driver of a vehicle of any class, whether motor-car or a cycle, is entitled to rely upon the common law that the onus of responsibility rests upon the driver of the overtaking vehicle. Thus it can fairly be argued that rear lights are really unnecessary. You will remember the old couplet

He was right, dead right, as he sped along,
But he's just as dead as if he'd been dead wrong.

The lighting of streets and vehicles, therefore, must effect a compromise without imposing any unfair burden on any particular section of road user. Anything which moves along the road can be regarded as a vehicle. It may be logically argued that if rear lights on vehicles are necessary at all pedestrians and cattle should carry them!

During this war when for reasons of national security the lighting of vehicles has been restricted, and the number of vehicles on the road is reduced to one-tenth, accidents at night have increased. They have not been reduced by the slight concession allowing motorists to use two dimmed headlights instead of one. The compulsory dimming of headlights during the war has not helped. Before the war, motorists sometimes used headlights which were far too powerful; some had become selfish, and dazzle was the common excuse for head-on collisions at night. Motorists, of course, are not compelled by law to have headlights; the law merely specifies two white lights showing ahead and fixed a certain distance from the ground, and also a certain distance in from the extreme edges of the vehicle. Headlights should be compulsory, and it should be compulsory to use them.

After the war, dazzle should be made an offence. We have seen that it is possible to get rid of dazzle during the war, and when the street lights return it would seem that the present vehicle lighting will be adequate.

For one thing it keeps speed down, and this should, in peace-time at any rate, help to reduce accidents at night. The question of rear lights and headlights, and the position of those lights on various vehicles, is a matter on which various members of the club keenly debated. We can do much to solve the lighting problem by giving greater attention to street lighting. Powerful headlights are only used on roads which are poorly lighted. Greater use could be made of reflectors and street lamp standards could conveniently be lowered. A great deal of experiment has been conducted in this direction, and especially with sodium and phosphorescent lighting. Coupled with it all is the question of the colour of the roads. By general consent a whitish surface is best. We must learn to light the way of the roadfarer during a fog. After all these years is it not pathetic that road transport should be brought to a standstill and roadfarers benighted because we have not evolved a fog-lighting system?

In towns and cities should we permit flashing signs advertising various commodities, which distract the driver of vehicles and cancel out the effect of his lights? Piccadilly Circus and Oxford Street in peace-time are good examples.

The red light should only be used to indicate danger. If that is not possible the red light should only be used on the nearside of the road to indicate an obstruction. The drivers of vehicles naturally tend to keep to the right of a red light, and to the left of a white light. Yet local authorities use red and white lights indiscriminately. Such misuse has caused many accidents.

Illuminated signalling devices as fitted to cars could be standardised and their use made legal. As it is the law only recognises the hand signal. A summary of this debate is to be received by Lord Leathers, the Minister of Transport.

Lt.-Col. Charles Jarrott gave some interesting views on the early days of cycling and motoring, and dealt with the tests conducted at Blackheath by himself and Col. Holden during the last war on the colours of lights. He thought that pedestrians should wear white arm-bands. Dudley Noble dealt with Continental lighting, and spoke with favour upon the lighting of the Antwerp-Brussels roads which are illuminated by sodium and mercury vapour lamps. The present war has shown the value of searchlights, and he thought that these could be used in country districts. Light towers which floodlit particular districts could also be employed.

Capt. Day thought that two headlamps were unnecessary. He had invented a system of lighting, making use of one headlamp, which had satisfactorily passed all tests, and did not dazzle. Unfortunately the war prevented its adoption.

Mr. H. Boon made some most interesting comments on dazzle, and methods of avoiding it, whilst Mr. Bowman asked why lights were always white, when yellow lights had yielded better results.

Mr. Richford thought that high light standards should be abolished, and that we should use divided roads with central lighting. He also thought that there should be some system of road markings indicating turnings. Another speaker thought that signposts should be illuminated.

Mr. C. G. Grey thought that orange lights were best, and that lights fixed lower down on the vehicle, as recommended by one speaker, would still dazzle. Greater use could also be made of polarised glass in avoiding dazzle.

The meeting unanimously passed the following resolution which has been forwarded to the Minister of Transport:

That this meeting of the Roadfarers' Club, representative of all types of road user, is unanimously of the opinion that adequate lighting of all roads should be the responsibility of a Government central authority, and not left to local councils, in order to secure uniformity of lighting over the whole country; and that such a scheme would eliminate the dazzle problem and enable drivers of vehicles to use the very minimum value of lighting. Two low-wattage lamps indicating the width of the vehicle and showing forward are all that is necessary.

Mr. R. Sparks asked what efforts the Road Research Laboratory at Harmondsworth are making in the direction of road lighting. There are Home Office regulations regarding factory lighting—why not for roads?

Recognition

THE Roadfarers' Club has received a letter from Lord Leathers, Minister of Transport, stating that he will be pleased to receive from them memoranda on the subjects on which they debate and any resolutions which they pass. New members include: Brig.-Gen. Critchley, Sir Albert Atkey, Urban Taylor, Will Hay, Lt.-Col. Mervyn O'Gorman, Rex Coley, H. Morgan, Rev. B. H. Davies (*Ixion* of *The Motor Cycle*), and F. R. Hook.

The next meeting takes place on Friday, April 16th, when the subject will be "Road Accidents." The hon. sec. is R. A. West, 32, Elm Bank Gardens, Barnes, S.W.

Cyclorama

By H. W. ELEY

Aker Bridge, near Bangor, Carnarvonshire.

Tamworth Castle

RECENT business took me to the old town of Tamworth, in Staffordshire, and I took the opportunity of looking over the Castle—an ancient place indeed, for it was built originally by Offa, King of Mercia. I found it full of interesting relics, and in one of the many rooms there is a fine collection of stuffed birds. It is a place with a great history, and occupies a fine, commanding position looking over the wide river. In the town I paused and gazed for a while on the statue of Sir Robert Peel. A modern policeman stood nearby, and I fell to wondering whether he realised that he was known as a "Bobby" just because of the famous man commemorated by the statue. "Bobby Peel" was the virtual founder of our police force, and the first men enrolled were soon dubbed "Bobbies."

Inside the ancient castle I had visions of warriors looking through the slits in the mighty stone walls—scanning the horizon for the sight of a foe; I thought of the days when England was divided into kingdoms, and Mercia was one of the proudest. Outside in the street I was brought back to modernity—and boarded a bus with a modern, pretty, trouser-wearing conductress who exchanged jokes with an American soldier.

Pump Stealing

I AM told that in some areas there is a bad epidemic of "pump stealing." Now it is a particularly shabby trick to steal a pump from a bicycle—the sort of thing that "is not done." The punishment for offenders who are caught should be sharp. But the wise cyclist will take no risks, but see that he removes his pump before he parks his machine. Or—perhaps better still—lock it in some way to his mount, so that it cannot be removed.

Old Books and Periodicals

WE are asked to do many things these war days—save coal, save money, switch off lights, dig our gardens more intensively, and do without anything we do not really need. And we are asked to do something else—asked by no less a personage than the Prime Minister himself. Mr. Churchill recently addressed a very special appeal to *cyclists*, asking them to look out books and periodicals for the Forces. Could there be any finer bit of war-work we could do? All over England, in lonely camps, in hutments, in billets, there are lads who have insufficient reading matter. And on *our* shelves, in *our* attics and lumber-rooms, there are books which we shall never read again ourselves, but which would give pleasure to many a lonely soldier lad. Hunt them out! Do it now! Those old novels, those old magazines will be a boon to many men in His Majesty's Forces.

Magic in a Map!

TO anyone who loves the countryside, and touring or tramping, there is no more treasured possession than a map. By the fireside one night recently, I pored over an old ordnance map, and lived again some of the good rides, and walks, I had done in the English shires. I browsed over Buckinghamshire, and memories came crowding in of good rides through the Chilterns. I recalled a "high tea" I once had in a cottage near Wendover, and wondered when I should see such piles of bread-and-butter and cakes again—or such "lashings" of home-made jam! I sauntered through Suffolk, and had good memories of Clare, and Long Melford, and the "Constable country" in the Stour valley. And I rode, in fancy, down Devonshire lanes sweet with the scent of primroses. My eye roamed over Essex, and I loved again those delightful place-names which abound in this county so near to Mother London. Away up to Lancashire, which also has its pleasing place-names—as witness "Charnock Richard." But I finally came to the conclusion that no county can boast sweeter village names than Cornwall—with "St. Just-in-Roseland" as perhaps the loveliest of them all. There's magic in a map!

London Memories

SOME little business reorganisation has brought me back to London—and after an exile of three years in the provinces I am finding new delights in the "big village." Is there anything in the world so unique, so "belonging," as the subtle smell of a London street? I sniff the air as I descend from the train at Euston—and there it is—the indefinable, alluring smell of London Town. True, it is a London which badly needs a coat of paint. It is a London with ugly, unhappy gaps in the familiar streets. But it is the only London with history in its stones, and with the old irresistible call to all its children. I have promised myself many treats—visits to some of the remaining City Churches; visits to some of the old taverns, where the shades of Dr. Johnson and his cronies still haunt the ancient rooms, and make the very taprooms places of history and legend and literature.

Road Casualties

THE latest figures in connection with road casualties make very disturbing reading. The black-out may have a lot to do with the still alarming figures but, whatever the cause, all must deplore the sad toll of the road—and all must play their part in trying to better a sorry situation. In the month of November, 681 persons were killed on our roads, and 12,480 were injured. Deaths in the black-out numbered 342. Now, this figure appears to be less than half the corresponding figure for November, 1940, but it must be borne in mind that now we have far fewer vehicles on the roads. The urgent need is for still greater care; for a greater realisation that lives are precious.

Winter Compensations

AS I write, a rapid thaw follows a short, sharp period of frost. There is a melancholy drip-drip from the trees, and the lawn on which I look out is a thing of patches—green showing through the melting snow. A disconsolate blackbird hops under the laurels, and two sparrows fight for the crumbs on the bird-table. It looks as if the afternoon will be foggy. Altogether, a day for the fireside, a pipe, and a book. I stretch out my hand for my old tobacco jar, glance at the book-case, and wonder whether George Borrow, or Mr. Pickwick will be the better fireside companion. Borrow wins, so, with pipe going well, I settle down for the rolling road, the windy heath, and all the winning ways of the care-free Romany.

This handy little three-wheeler serves a useful purpose in London, transporting parcels of hospital essentials.

Cavendish, Suffolk. The interesting church dates mainly from the late 15th century.

Around the Wheelworld

By ICARUS

Believe It or Not!

THE Cumber cycle shown in the illustration was the machine on which C. A. (Bath Road) Smith beat the Brighton coach record in 1890, his time being 6 hrs. 52 mins. 10 secs. This record was beaten by Edge by 1 min. in 1892, and C. A. recaptured it in 1893, in the time of 6 hrs. 6 mins. You will observe that the machine has large section pneumatic tyres and a nice bent frame, which must have warped and twisted and wasted a considerable amount of power. Notice also the elegant saddle, and the flat handlebars, which to-day are favoured by some riders. The Cumber cycle was famous in its day. They were made at All Saints' Road, Westbourne Park, London, W. I wonder how many modern riders could push (that is the operative word) that machine to Brighton in 6 hrs. 6 mins.?

Road Accidents in 1942

THE road accident figures for December, 1942, were the highest for any month of the year, totalling 780 killed and 12,842 injured. These figures compare with 1,024 killed and 18,300 injured in December, 1941.

Since the war the December accident peak has been more pronounced as a result of black-out accidents; and last December nearly three-quarters of the pedestrians killed, other than children, lost their lives during the hours of darkness. Fatalities to children, including cyclists, numbered 109, and, in addition, 1,650 were injured.

The total number of lives lost on the roads of Great Britain in 1942 was 6,926. Although this shows a decrease of nearly one-quarter compared with 1941 (9,169), the improvement is not so great as might have been expected, having regard to the fewer vehicles on the road. It should be remembered also that in the early part of 1941 the danger of road accidents was increased by heavy enemy air raids, especially at night, and the consequent hurry to get home.

During the year 1,315 children were killed, as against 1,462 in the previous year. A possible cause of the high proportion of accidents to children is that many parents are now engaged in war work and find it impossible to exercise the same supervision as they would in normal times. In such cases the instruction of children in the correct use of the roads is especially important. Arrangements should also be made, wherever possible, for children to be escorted by neighbours.

The following figures show the trend of road accidents during the war years:

	1939	1940	1941	1942
Total all persons killed	8,272	8,609	9,169	6,926
Total child pedestrians	850	972	1,231	1,112
Total child pedal cyclists	184	205	231	203

Cycling Without Lights

UNTIL the shortage of cycle-lamp batteries is made good, it has been suggested to the Home Secretary by the National Committee on Cycling that the police should exercise a wise discretion in refraining from prosecuting cyclists who ride without lights.

"We welcome," said Mr. H. R. Watling, chairman of the committee, recently, "the action of those police authorities who, after satisfying themselves that there is a real shortage of batteries in their districts, have not only refrained from instituting prosecutions but have been sufficiently business-like and helpful to make representations to the proper authorities.

"The shortage is not, in fact, the fault of those immediately concerned. I am satisfied that the Board of Trade are doing their best in very difficult circumstances and so are the battery manufacturers. As for the cyclists, few of them would risk riding without a light unless compelled to do so. If they do not cycle they have either got to increase the existing congestion of other means of transport, where there is any, or they must just walk—and thus lose valuable working hours.

"Neither of these alternatives is in the national interest. Most cyclists are already tired enough with war work and their spare-time Civil Defence duties. In a single week recently 600 man hours were lost in a factory near London because men and women were late on account of the battery shortage. All things considered, the best solution while the shortage lasts is a recommendation from Mr. Herbert Morrison to the police, thousands of whom are themselves cyclists, to exercise a wise discretion."

Since the issue of this announcement a statement has been issued in Parliament and I understand that reasonable supplies of batteries are now available.

Lunch Paper—24 Tons

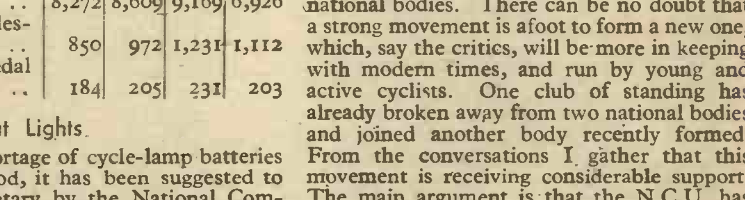
THE paper in which Fort Dunlop workers brought their lunch to the canteen last year weighed more than 24 tons. It is a surprise in the total of 194 tons 7 cwts. and 2 qrs. collected there for salvage during 1942.

Daily papers and weeklies contributed, along with office paper, more than 58 tons, and there were close upon 102 tons of cardboard.

Apart from the waste paper actually collected, many more tons have been saved by straightening out old brown paper and using it again for wrapping, by the return of packing to suppliers, and by using the plain side of used stationery.

A New National Body?

DURING my social round of luncheons, a few dinners, and week-end runs I have listened to a good deal of discussion on the present disputes between certain clubs and national bodies. There can be no doubt that a strong movement is afoot to form a new one, which, say the critics, will be more in keeping with modern times, and run by young and active cyclists. One club of standing has already broken away from two national bodies and joined another body recently formed. From the conversations I gather that this movement is receiving considerable support. The main argument is that the N.C.U. has no control over mass-start racing on the roads, and therefore their bans on particular riders who take part in mass-start racing on the roads are illegal. If this movement grows it will weaken the existing national bodies. We must remember what happened with the old Road Racing Council, out of which grew the Road Time Trials Council.



The Cumber cycle, on which C. A. (Bath Road) Smith beat the Brighton Coach record in 1890.

WAYSIDE THOUGHTS

By F. J. URRY

Denham, Bucks. A view of the picturesque village street. On the right is the old Black Swan Inn.

Black-out Masks

MANY have been the criticisms, and much has been written on the subject of the feeble illumination allowed to the cyclist under the black-out regulations; and I am bound to confess there is justification for the complaints. Only those who are compelled to ride after dark—or before the break of day—can fully realise the discomfort of travel, and these are the folk loud in their demands for better treatment, justifying their complaints by the fact that motorists are given a much better deal in this matter of lighting. If anyone reading these notes disagrees with my opinion on this matter, I can only recommend him to make his own test anywhere, on any dark and dirty night, and I am certain the result will be, at the very least, a sympathetic feeling for the night-riding cyclist. Now, the Ministries of War Transport and Home Security recognised this fact nearly 12 months ago, and set to work to remedy it so far as they were able. They designed a funnel-shaped mask to replace the present regulations, which was to project a brighter beam forward so that the user could more easily pick up the kerbs, and sight a pedestrian or obstruction in time to pull up without the risk of collision. Interested cyclists tested this new design at the invitation of the Ministries concerned, and seemed reasonably satisfied, and as I know many of the men who were present at that demonstration, I have no doubt the new design of mask in its original form was an improvement on the old type. Well, something must have happened between the time of that demonstration and the issue of the blueprints for the manufacture of the new mask, some vital alteration which has made the mask nothing better than a delusion and snare, for it is no good. That is a very definite criticism, but it is true, being based on a series of trials with the new mask mounted side by side with the old one, and I say the old one wins hands down every time. It is a pity after so much time wasted, but it is true, and there is little more to say on the matter except this.

The Real Solution

THE old mask cost sixpence, Lucas' retail price, and within its limits it was effective and cheap. The new mask is not effective in its present design and would cost at least 2s. 3d. retail, a figure which at once damns it in the eyes of millions of riders, so in a sense it is a good thing it will not be marketed, anyhow in its present form. Now let me tell you this: When the black-out regulations for cycle head-lamps came into force I was using for my night journeys an old but very serviceable Holophote oil lamp burning an inch wick and giving a beautiful golden glow, mainly because of its excellent reflector. I did not like to spoil that reflector because it would be impossible to replace, the Holophote having gone out of production at least 25 years ago; so I just blacked-out the top half of the lens and carried on with a good mellow light that is never dazzling; and up to the moment I have not been challenged by authority for this slight evasion of the war-time lighting laws. Indeed, I think it would be difficult for the police to question my lighting shortcomings, seeing that at least half their own lamps do not abide by the regulations. That, however, is beside the point, for I should think, from my observations, half the night-riding cyclists are also black-out transgressors, as indeed am I, when the old oil lamp is in use. Taking these things into account, I see no good reason why the blacking-out of the top half of the lens—a very simple operation—and leaving the plated reflector alone, should not meet the needs of the cyclist and the wishes of the Ministries concerned. We should then be granted a "seeable" light at minimum cost and trouble, easily checked by the powers that be, and in my opinion generally satisfactory to all concerned. *And this form of black-out could be put into operation at once.* I make the suggestion—again after experience—convinced it is the right solution, and even if it were adopted, we, using battery lamps, would have a less dazzling light than the dynamo user, and far less than the motorist.

It Is Worth It

THE first month of the new year has flown, and in a few weeks we shall be looking for the first signs of spring, the lighter skies and those streaks of windy sunshine that stir the souls of men. It is true that we cannot get away from the war and all its implications, and the fact that we have to face a ghastly year of mounting tragedy with set faces and a grimmer determination than ever; but those of us who are still left in civilian life and still possess the ability to ride a bicycle are in a favoured position, and should be very thankful for the possession of our health and activity to do those things within our power to preserve it. I know I am, for never in my life have I been so thankful for the services my bicycles render me, and to many of my young friends with a few days of leave. Every week during the winter I have snatched a few hours to go wandering, hours that have been a comfort and a solace, and sent me back to work with a greater love for the pastime of cycling than I thought I could still acquire after over 50 years of riding. There is a quiet glow of glory in these journeys that can never be captured in a mesh of words and broadcast to the million; it is all so purely personal, depending on your loneliness or your company, the mood of the moment, the friends you visit, the unrehearsed welcomes of the wayside, and more than anything else that love of country inherent in most of us, but alas, only specialised in the too few. I sometimes wish I could tell people of all the things that hold me to this cycling game, such trivial things, that when I come to analyse them they are nothing but the stuff of dreams, yet their cumulative effect is a benison to the spirit and a halo to health. It isn't the distance I ride—that is moderating with the years—it is the touch of things seen and heard and scented, the impact of quick-changing loveliness, the pipes of Pan from the throat of a thrush and the deep diapason of a winter dirge through the bare woodland aisles. Go out, I beg of you, whenever you can; get fit for Easter —late in the calendar this year—and make the short break a pæan of praise for the freedom of the road, the only free man now wandering on wheels to be found thereon.

From a Centre

WHEN this war began I got into trouble with the younger generation for suggesting that before the struggle was ended accommodation for shelter and food would become difficult; and bicycles would be hard to get. There was nothing prophetic in that statement to anyone who lived through the last war, and I only issued it as a warning of what we should expect. As a matter of fact, we are, in the fourth year of the war, much better off as cyclists than was the case at the beginning of 1918, for the touring cyclist can still find accommodation in favourite areas, while the Youth Hostels and the British Restaurants have been of enormous aid to him. When and if I have a few days to spare this year—and I am full of hope—I shall make for a centre and gravitate from that harbourage. It is not the free-est form of touring, but it does give you the certainty of night accommodation, and leaves you unworried to spend the long evenings on the road with the knowledge that your bed is safe. It is true, too, that in many of these small places the food problems are not so pressing as in the larger centres, so that often enough, with a Thermos of coffee, you can fill your lunch bag with a mixed assortment of the dainties from the corner shop, and he is a poor wanderer who cannot persuade a cottager to provide tea, especially if you are prepared to supply the fragrant herb and the sugar, if any. This is the method I would recommend to the tourist, and a farmhouse is as good as—nay, better than—most harbours, for though the food there may be plain, it often tastes ambrosial to the townsman's palate; and the farm gets up early, which to me is a recommendation of considerable import. Don't give up the chance of a tour for the sake of a little trouble, for this perfect expression of a holiday is worth the effort to obtain it.

The Old Game

YOU may, of course, think the time of the year is inopportune to talk of holidays, and so, perhaps, it would be in the usually accepted sense of the term, but since pleasure cycling to me is always a holiday, however brief, then cycling and holidays are almost synonymous terms in my mind. That I presume is a condition that only grows as the habit of the game becomes part and parcel of one's life, when you have given yourself to it without knowing precisely when, or even possessing knowledge of the fact that it is so, until suddenly something happens and you are divorced from your bicycle for several days, and wonder what on earth you would do if such a condition lasted for the remainder of your existence. The fact is, I suppose, few people give themselves wholly to cycling in the sense that if all other leisure-time employment ceased, they would not find themselves effete, or lacking the wherewithal to taste the spice of life. I like other games, for they act as a background to the main picture of my life, and by indulging in them I discover, often rather surprisingly, how little variety there is in the playing of them in comparison. Maybe it is as well that a cycling scribe should be a cyclist, just that and little more, for if this love of the pastime had not happened to some of us, I feel that the merits, and especially the half-hidden merits, of silent wheel wandering would never have been told, feebly as we may interpret them. As it is, you have to put up with this old bore, and make the best of him, if on occasion "he babbles o' green fields," and has only the limited power to present in print all that he feels in mind. The inescapable fact is that my years are running out, and with that background of knowledge, the fragrance and beauty of these free hours I gather to myself along the road become infinitely precious. That is what cycling does for you and to you if you are loyal to its call; it becomes mellow and more splendid with the passing years, and into it merges a measure of gratitude for your activity and that cheerfulness which is the savour of living.

For the Future

SOMETIMES I wonder if all these random remarks I make on paper are read by the people to whom they are supposed to be addressed, and no sooner such a doubt enters my mind than I receive a batch of friendly letters from folk of whose very existence I was previously ignorant. That is always a heartening experience, particularly when some chance remark has touched a chord of memory in the heart of a lad far overseas, waiting for the day of his return to put into operation many of the things these notes try to suggest. Last Christmas I had dozens of letters from unknown friends in which I was gladly made aware that there are many riders after my own heart, and I go on my way rejoicing because it is so. I sometimes wonder if these epistles, with the personal touch cut out of them, could be printed as a testimony to cycling —not the bicycle or the rider—but the sport and pastime as it is seen and felt by these exiles from the land of their love. Cycling, as such, has never had enough publicity, probably never will have, owing to the cause of competition which must perforce mention names of makers. It is one of the reasons why I have always advocated a poster campaign on behalf of cycling—just cycling in all its phases, without the mention of a name or the suggestion of advertisement value that could be linked to a name. Obviously the trade would have to pay for such publicity, and up to the moment they have not seen the force of this argument, and why, I have never been able to understand. Perhaps, before the war, cycling was considered a joke, indulged in only by the impecunious, and those who seldom or never rode believed this to be true. Well, it isn't, and if ever the time existed to make cycling a habit for all and a joy for the majority, it is now and during the immediate future. Snobbery in the form of cash consciousness will surely die by the progress of social reform, and cycling will live on. Give it the good wine of publicity.

N.C.U. News Items

Third Party Insurance

THE N.C.U. announces that by arrangement with their underwriters N.C.U. Third Party Insurance now covers business riding, as well as riding to and from business and for pleasure purposes.

N.C.U. Overwhelmed

ALTHOUGH 1942 was a record for wartime membership, the first four weeks of 1943 have even eclipsed that good going, and the staff at Union headquarters are severely taxed to cope with the rush of applications that are coming in from all classes of membership. Applicants are asked to exercise patience, as it is quite likely that replies to them are a week behind time. All are being dealt with in strict rotation.

The Union would like to call attention to the fact that a number of postal orders are lying at the Union's offices sent in by applicants for membership who have failed to put their name and address on their application form or letter.

My Point of View

BY "WAYFARER"

Bicycles for Hire

THE advertisement of a Surrey hotel attracted my attention recently. The closing words were: "Bicycles and pony-trap for hire." Remarkable, isn't it? Probably, however, the younger generation of cyclists are quite unaware that the hiring-out of bicycles was once an important part of a cycle-trader's business. But to think of a hotel, in 1943, descending (I am sure that "descending" is the right word to use, though to my mind the movement is in the opposite direction!) to the provision of bicycles for hire!

Worthy of Note

FROM an article on "Re-grouping the Police" in *The Times* of January 16th: "When, after the war, the Defence Regulation under which the Home Secretary has acted is withdrawn, amalgamation will lapse—unless Parliament by legislation authorises its continuance." Here is the answer to the ignoramuses who say that cyclists will never escape from the ridiculous necessity of carrying rear lamps, and also to their forebears, the wiseacres who insisted that the old D.O.R.A. regulation to the same effect should have been continued after peace was re-established. The foregoing quotation is worthy of note—and of paraphrase—by the people who talk like parrots, or defective gramophone records, repeating themselves *ad nauseam*. None of the existing temporary legislation can be continued after the present emergency has passed *except by constitutional action in the Houses of Parliament*. And then, if the rights of cyclists are attacked, we shall fight. Make no mistake about that.

Mouth-organ Cyclists

DURING a conversation recently with a factory operative who is also a club cyclist, he spoke with some little acerbity concerning mouth-organ cyclists—those otherwise quite worthy young people who appear to think a trip into the country is incomplete unless they are armed with the wherewithal for adding to the world's already excessive clamour. The lad who was speaking to me put the thing this way: "I get all the noise I want here for eight or ten hours a day. When I go out cycling I want to travel in peace and quietness, so that I can enjoy the silence of the countryside, and hear the birds when they sing, and listen to the wind in the trees. No mouth-organ cyclists for me!" The complaint is not a new one. Mouth-organs are not everybody's "cup of tea," which is something for which to be profoundly thankful. Personally, if I never again heard one of these "musical" instruments, I would not shed a solitary tear!

"Holidays at Home"

THE suggestion of "holidays at home" has already been put forward for wholesale adoption (it is presumably hoped) in 1943, as in 1942. The question is not one for general discussion in these columns, and we must stick to that aspect which concerns us as cyclists. Let it just be remarked, however, that the Great Thinkers who would have the whole populace conform to their plan of staying at home for their holidays could do with one or two lessons in psychology, which would enable them to realise that public transport is not the only thing that matters—and that there is a tremendous bulk of transport other than the public type.

Turning to the purely cycling point of view, two facts at once emerge. (1) If it is necessary for us widely to adopt the "holidays at home" idea, then you and I can still have a jolly good time. On one of my vacations a few years ago, it was desirable for me never to be far away from home, and so I went out immediately after breakfast each morning and did a big ride, getting back in time for supper. It is open to question whether any other section of the community can extract so much value out of "holidays at home." In fact, I am sure that they cannot. To my mind, there is nothing like going right away, but if this cannot be managed, then a daily ride of anything up to 100 miles constitutes a very good substitute.

(2) But is it necessary for cyclists to follow the crowd—*if* the crowd takes any notice of the "holidays at home" cry? Most certainly not. As we do not normally use public transport, there is not the slightest reason in the world why our holidays should be varied from our usual method. On the other hand, having regard to the need for physical and mental reconditioning, so vital in these times, there seems to me to be every reason why cyclists should carry on with their normal holidays, with the proviso that they refrain from seeking train aid. It is also worthy of recollection that certain people in this country make their living out of catering for cyclists. Surely we can help them to keep the wolf from the door. We shall need them after the war, and we ought to do something to keep them in business.

Incredible

I HEARD the other day, at second-hand, of a lady who asserted that she had been fined for not dismounting from her bicycle at a "Halt" sign. Frankly, I don't see how it can be true, and I refuse to believe the story. If it were a fact, however, it appears to me that a very grave injustice has been done, and it is hard to believe that even present-day justices, thinking through the medium of their learned clerk, could do such a wrong. The intention of the "Halt" injunction is perfectly clear. So is its purpose. If you carry this new interpretation to its logical conclusion, then it would be necessary for every passenger in every motor vehicle to be disgorged on to the road at every "Halt" sign—which, as Euclid would have said, is absurd. Nor would the purpose of the sign be rendered more effective. On the other hand, great delays would be caused while people were leaving and entering their motor-cars. No. It won't do. The word "Halt" means "Halt" and nothing more. But it *does* mean "Halt!"

Nonsense Verse

I HAD occasion recently to criticise a poetic effort on the part of one of our cycling "legislators," who was intent on discouraging enthusiasm in cyclists, and I did so in very frank terms. The only sort of enthusiasm which should be toned down is that which expresses itself in enormous mileages—cycling for the sake of cycling—and which inevitably burns itself out in a very short time. But this "poet" was anxious to take the top layer off all enthusiasm, and he did not seem to mind to what lengths he went to achieve his outrageous purpose. Thus in one nonsense verse you were warned against being rapturous over the surrounding scenes lest you skid on wet leaves. It may be unusual, but in the course of a long cycling career I have never known of any skidding through this cause. (A professional writer has since come in on the same wavelength, and—at the end of December!—has spoken of the danger of wet leaves as a skid agent. Evidently his calendar needs attention, because at that time of the year leaves and blackberries vie with one another at the scarcity counter. They are simply not there.) Returning to our nonsense poet, he also warned cyclists against the folly of giving all their attention to the woodlands and the hedgerows in case they were floored by frozen ruts: also to beware of enthusing over the sunset in case they should hit a motor bus. Stuff and nonsense—which a little practical acquaintance with cycling would have avoided.

Notes of a Highwayman

By LEONARD ELLIS

ONE of the best-known touring spots in North Wales is, of course, Lake Bala, or Llyn Tegid, as they say in Welsh. It is a beautiful sheet of water, perfectly natural and probably the largest in Wales. It is about five miles long and nearly a mile across at its widest part. It is interesting as the birthplace of the River Dee, which flows away at the north-eastern end, wanders through the lovely Vale of Edeyrnion to Corwen and thence to Chester and the sea. It is a splendid centre for touring, as many roads radiate from the little market town of Bala situated at the northern or lower end. Three roads go northward and join the Holyhead road, or A5, at various places, and another goes south-eastward to Llanfyllin over the celebrated Milltir Cerig, or Stony Mile. There is a road along each side of the lake so that it is possible to cycle all round it. From the southern junction of these roads there is another that goes southward to Dolgelley. There is another celebrated rough road leaving the Dolgelley road near the south end which includes the Bwlch-y-Groes, or Pass of the Cross, reaching a height of 1,790ft. at the summit.

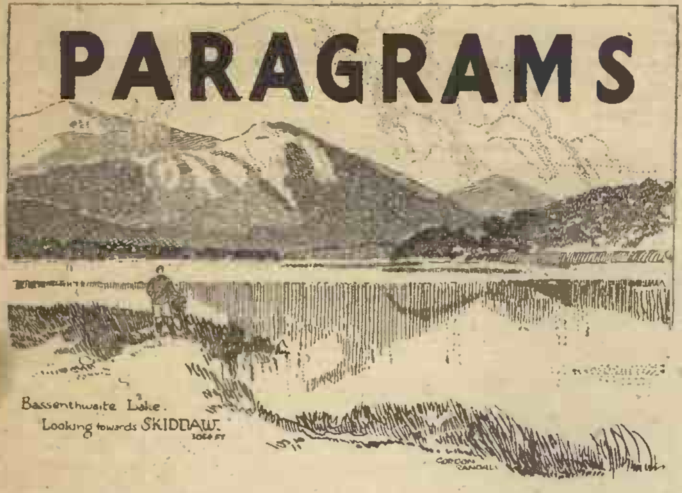
Further Touring Routes

THIS is a grand, wild road of very rough surface and full of adventure. As we leave Bala going southward we follow a road cut in many places from the mountain side and hanging over precipices. Beyond the summit we drop rapidly into the Valley of the Dovey by way of Dinas Mawddwy, a charming spot on the Welshpool-Dolgelley road. Just beyond the summit there is another rough road, scarcely more than a track, that goes off to the east and eventually brings us to the head of Lake Vyrnwy, an artificial but lovely lake, supplying Liverpool with water. Bala town is pleasant enough to stay in but has little of history or of interest. If there is no history, there is plenty of legend surrounding the lake. A local superstition says that the old town lies somewhere in the middle of the lake. It goes on to prophesy that the lake has already swallowed Bala and will in the fullness of time swallow also Llanfor, a village nearly two miles from the banks. The old legend says that many years ago there lived a happy and contented community who drew their water from Gower's Well.

The Legend af the Lake

THIS well had a spirit who was apt to get very angry if the well were left uncovered at night. The villagers realised the importance of keeping the spirit good-tempered and appointed a guardian, whose sole duty it was to cover the well every night as soon as the villagers had retired. One night he failed in his duty, while joining in some celebrations. Too late the villagers tried to cover the well, but it was hopeless. Water was pouring from it in a great flood and nothing could stop it. The water rose and flooded the streets, entered the houses, woke the inhabitants and soon chaos reigned. They fled to escape the water, not forgetting to try to punish the guardian, but he also had fled, more in terror of the villagers than of the water. It was the water, however, that punished him, as he was swallowed up in the flood and was never seen again. In the morning the people shivering on the hillsides saw a vast lake where there used to be a village, and they do say that on stormy days the water seems to ooze up at the lower end of the lake as if the old well is still gushing and as if the spirit is not yet appeased. Some folk still believe that on a very clear and calm day, when the surface of the lake is quite unruffled, the chimneys and roofs of the old village can still be seen at the bottom of the lake.

Bala: the birth of the Dee.



Well Done, Dulwich!
OF the 47 members of the Dulwich Paragon C.C. in the Forces, 17 are serving overseas.

Loch Fyne Ferry Stopped
THE ferry across Loch Fyne, between St. Catherine's and Inveraray, has been stopped.

Travel Publicity
THE colour films of the Scottish Y.H.A. have now been shown to audiences numbering 10,000 in all.

Track Dress Permitted
SCOTLAND has decided to allow dark track dress in time trials, as well as tights or shorts and black jackets.

New Hostels Guides
THE Scottish Y.H.A. is to publish new guides to Loch Lomond and the Trossachs, and to the Border Country, this year.

New Hostels for 1943
NEW hostels are to be opened in 1943 by the Scottish Y.H.A. at Cove, Kingussie, and Alltsaigh (Loch Ness).

No Standard Handicaps
A SCHEME of standard handicapping, proposed by the Mid-Scotland T.T.A., has been rejected by the Scottish Amateur C.A.

War-time Championship for Scotland
AT its meeting recently, the Scottish Amateur C.A. decided to hold a war-time emergency championship over 25-50-100 miles.

Award to C.T.C. Member
LEADING SEAMAN R. W. LEE, of the Cyclists' Touring Club, Kidderminster Section, has been awarded the D.S.M. He is a gunner in the Merchant Navy.

Appointed Auditors
GEORGE R. HERD, the timekeeper, and Harold Briercliffe, Glasgow cycling journalist, have been appointed auditors to the Scottish Amateur C.A.

No More Publicity
SCOTTISH time trialists have rejected a plea from Dundee that more publicity should be allowed to announcements of forthcoming open events.

Tradesmen's Baskets Allowed
ALTHOUGH the Government has banned the making of some wicker baskets, baskets for tradesmen's carrier cycles are not included in the order.

Advocates Motor Roads
SPEAKING at a road safety exhibition in Glasgow, Tom Johnston, Secretary of State for Scotland, advocated the building of special motor roads when the opportunity occurs.

Glen Etive for Nation
GLEN ETIVE, which runs down from Rannoch Moor to Loch Etive, has been presented to the nation. Part of the glen will be devoted to cattle-raising.

Young Price in Navy
HARRY PRICE, junr., son of Harry Price, the founder of the Scottish Amateur C.A., is now serving in the Navy. Both the Prices are members of the Cambuslang C.C.

Aspden — Sergeant-major
HARRY ASPDEN, former R.T.T.C. North District secretary, has been promoted to sergeant-major. He is serving with a Royal Engineers unit in Scotland, and retains his interest in cycling.

Successful Appeal
THE Chief Constable of Salford recently appealed to cyclists to take more care during peak traffic periods, and since then only one cyclist has been held responsible for an accident.

Cycling Vicar Gains M.B.E.
THE REV. J. N. SYKES, 56-year-old vicar of a Stepney church, has been awarded the M.B.E. During the severe raids of 1940-41 he cycled about the East End doing first-aid and rescue work.

Lack of Batteries
OWING to lack of batteries, a large London area factory reports that 600 man-hours were lost in a recent week. Workers using bicycles to reach the factory could not buy batteries for their lamps.

Forth Road Bridge
DURING February representatives of the Edinburgh Town Council, and the West Lothian and Fife County Councils, met in Edinburgh to discuss the question of a Forth road bridge as a post-war project.

Harry Price Resigns
OWING to pressure of work, Harry Price, secretary and founder of the Scottish Amateur C.A., resigned at the recent general meeting of the Association at Bo'ness. New secretary is Stanley Telford, 26, Bouverie Street, Port Glasgow, Renfrewshire.

Invitation Events
AN innovation this season in Scotland will be the holding of invitation events at 25 and 50 miles. The Scottish Amateur C.A. executive will select 20 riders to ride in each of these events, which will be held at the end of the season.

Fife Champion in Middle East
JAMES WALKER, former Fife cycling champion, is serving at present with the R.A.F. in the Middle East. Not far away, and also serving with the R.A.F., is John Walker, his brother, who was also a keen time trialist and official.

Massed-start Proposal
A PROPOSAL that massed-start racing should be permitted under the control of the Scottish Amateur C.A. was turned down at the Association's recent meeting. It was pointed out by the chairman that such a proposal would involve changes in the constitution, and before this happened clubs and associations should be able to examine the proposition in full.

Time-trialist's Mileage
D. K. HARTLEY, Dukinfield C.C., who put up some outstanding rides in 1942, cycled no fewer than 12,077 miles during that year. He is a police constable.

Girls for the Addiscombe
ADDISCOMBE C.C. now admits girls to full membership. Previously they were eligible for associate membership only.

Died in Italy
PROMINENT member of Wessex C.C., and consistent rider in 24-hour events, L. E. ("Ted") Vahey died while a prisoner of war in Italy.

Wisbech Wheelers' Loss
STATED to be the first person in Wisbech to own a bicycle, Mr. U. D. Palmer, vice-president of the Wisbech Wheelers, has died. He was 75 and cycled to church when he was married.

Old Timer's Death
STATED to have won over 200 trophies during his career, Walter Popplewell, well-known racing enthusiast during the days of H. L. Cortis, has died. He was 87 and lived at Ipswich, where he was stated to have been the first person to ride an Ordinary.

Club's Revival
THE Lanarkshire Road Club is to be resuscitated. Pre-war it was one of the most prominent of Scottish clubs.

Barnesbury's Loss
A FORTNIGHT after his wife gave birth to a son, the death was announced of Arthur Cheetham, Barnesbury C.C., as the result of enemy action at sea. His wife, Ethel, is a member of the Barnesbury Elite Ladies' C.C.

Camden Wheelers Active
ALTHOUGH Camden Wheelers have over 54 members in the Forces, including former Secretary Tom Brown, now in Persia, they have an ambitious programme in hand. The club secretary, Reg. Dilliway, is only 15 years of age.

In Italian Hands
FRED GILLHAM, Wisbech Wheelers, is a prisoner of war in Italy. Several of the club's members were posted as "missing" at Singapore, and no news of them is yet to hand.

Champion in India
GEORGE ROSS, former champion of Liverpool Century Road Club, is now in India with H.M. Forces.

Hampshire Road Club's Innovation
HAMPSHIRE Road Club's annual prize distribution took the form of an "American Lunch." Tea was provided but food had to be taken.

Bon Amis C.C. Activities
ALTHOUGH the Bon Amis C.C. was not formed until after the outbreak of the war, it has 75 members, of whom 40 are serving with the Forces.

No Change
NO change is reported in the officials of the old-established Cheshire Road Club, which has been faithfully served by zealous officials for some years.

Seen by the tourist. The tablet on the birthplace at Bello Mill, Lugar, Ayrshire, of William Murdoch, inventor of gas lighting. It was erected by the North British Association of Gas Managers in 1913.

Clarion Training Centre
JACK TAYLOR, West of Scotland Clarion C. and A.C., and Scottish all-round champion, has set up a training centre in Glasgow for Clarion riders. The move is part of the Clarion C.C. campaign to stage a come-back in Scottish racing circles.

Unique Fixture
A LOW-GEAR 25-mile time trial held on Christmas Day attracted 37 enthusiasts. D. Ford, London Clarion, did fastest time with 1 hr. 10 min. 31 sec.

Massed Racing in Scotland
DUNDEE and District Time Trials Association are pressing for massed-start racing in Scotland. West of Scotland Clarion C.C. oppose any move to have "Clarion," either nationally or locally, involved in helping the new British League.

PARAGRAMS

(*Continued from previous page*)

Thorpe (Jnr.) in R.A.F.

CLIFF THORPE, younger brother of Len. Thorpe, famed Barnet C.C. time-trialist, is now with the R.A.F.

Death of Old "Finsbury-Parker"

MAJOR PERCY L. BREYSIG, founder member, 60 years ago, of the Finsbury Park C.C., and club champion in 1887, has died. He was 76 and a pioneer military cyclist. He had seen active service in Egypt and Palestine.

Leicestershire's Loss

SHORTLY after returning from training in the United States, Pilot-Officer J. Longstaff, Leicestershire Road Club, was killed in a flying accident.

More Youth Hostels

BIRMINGHAM Regional Group of the Youth Hostel Association states that two new hostels will be opened in the spring. One is at Corris, and the other at Ludlow.

Women Racing in Australia

MISS H. NORMAN has won the first South Australian State five miles unpaced road championship at Enfield, Australia, with the time of 15 mins. 35 seconds. It is reported that she intends to attempt to establish several unpaced women's records in Australia.

Northern Open Events

NO fewer than 21 open road time trials are scheduled to be held in the North District area of the R.T.T.C. this year. North Lancs are the biggest promotors.

Time Trial Association Disbanded

FORMED to meet war-time conditions, South Staffordshire Time Trials Association has been disbanded.

Barnesbury C.C.'s Fine Record

BARNESBURY C.C. has over 200 members on its books, 60 of whom are with the Forces.

News of Norman Hey

NORMAN HEY, well-known Bronte Wheeler and prolific pre-war time-trialist, has crossed "the line" three times. He is with the Royal Navy and says his journeys are akin to a Cook's tour!

West Hants Road Club's Loss

FRANK YOUNG, keen 24-year-old member of West Hants Road Club, has been killed in action while serving with the R.A.M.C. in the Middle East.

George Medal for Talbot Wheeler

SERGEANT P. PICK, Port Talbot Wheelers, now serving with the Royal Fusiliers, has been awarded the George Medal for disarming and capturing an escaped military prisoner who had fatally injured a military policeman and another soldier. Pick, with complete disregard for his own safety, entered a room where the man was hidden and disarmed him.

Bar for D.F.C.

WELL-known polo expert and enthusiastic time-trialist of Norwood - Paragon C.C., Flying Officer H. Berridge has been awarded a bar to his D.F.C. for devotion to duty.

Club's Innovation

JOHNSTONE WHEELERS, which presented each serving member with a gift of 10s., has elected Mrs. Graham as president.

Old Timers Pass On

E. A. LAMB, organiser of the Stanley Cycle Show from 1894-1910, has died. He was 83. The death is also announced of A. B. W. Whatton, at the age of 80, a one-time member of Cambridge University B.C.

Prisoners Together

THREE members of the Bec C.C., two of whom are brothers, are prisoners of war together in enemy hands. They are W. S. McKnight, C. Brigden and R. V. Brigden.

Tom Hughes of Wigan

THERE are few more enthusiastic veterans than Tom Hughes, of Wigan, who, although in his 77th year, managed to accumulate over 10,000 miles in a year. Since he passed his 60th birthday Tom has ridden no fewer than 169,488 miles. He has been a cyclist for 55 years.

Bidlake Memorial Prize

THE Adjudicating Committee of the F. T. Bidlake Memorial Trust met recently, and after full consideration resolved that no award be made in respect of 1942.

Club Notes

Another Tandem 50

DONCASTER WHEELERS have decided to hold a new tandem 50, on a holiday date.

Bo'ness Official in Forces

J. M'GREGOR, leading official of the Bo'ness C.C., of West Lothian, has just joined the Forces.

Lanarkshire Club Revives

THE Lanarkshire Road Club, formerly one of Scotland's leading bodies, has been revived.

Taylor Trains Novices

JACK TAYLOR, former Scots champion, is running a training school for novice cyclists in Glasgow.

Third Child for Record-Holder

MRS. P. SPELTINCKY, formerly Miss Peggy Hardingham, the record-holder, has just presented her husband with a third child. Both Mr. and Mrs. Speltincky are prominent South Midlands club riders, with the Nomads (Hitchin) C.C. and the Bedfordshire Road Club.

Killed in Motor-cycle Accident

TOMMIE McMURRAY, a leading Douglas C.C. (Glasgow) club rider of some years ago, has been killed in a motor-cycle accident.

Midlander a Prisoner of War

SERGT. J. VAUGHAN, of the Midland C. and A.C., is now reported a prisoner of war. He was reported missing from air operations in November, 1942.

Perkins Called Up

HENRY PERKINS, secretary of the Northants and District C.A., and also time trials secretary of the Bedfordshire Road Club, has reported for service with the R.A.O.C.

Seventy Members Away

THE Douglas C.C., of Glasgow, has over 70 members in the Forces, but those who remain are continuing the club's activities. The club will promote its open 25 and 50 events this season.

Goldberry Progress

DURING the past year, the Goldberry C.C., of Kilmarnock, made good progress. At its recent annual meeting the club decided to support massed-start racing, and also to promote an open 25 miles time trial this year.

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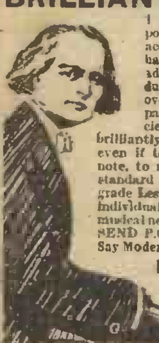

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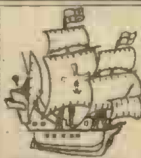

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