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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. SEPTEMBER, 1943 No. 120

FAIR COMMENT——BY THE EDITOR

Radio Research

MR. GARRO-JONES, M.P., Parliamentary Secretary to the Ministry of Production, recently delivered a most illuminating speech on Radio Research and Production, Before, During, and After the War. Research development and production are separate things, although inseparable, and Mr. Jones is of the opinion that research has its roots in university research, for modern science is the product of the wide curiosity which is the breath of life of the university. Modern engineering is based upon it, since is was born directly of the work of Clerk Maxwell, Hertz, Rutherford and others. Now, university research is very often conducted by amateur enterprise, which may, as was the case with Marconi, lead to the foundation of an industry which then founds in its turn its industrial research and development laboratories. Radio offers many examples of successful co-operation between the university, the independent amateur, and the industrial laboratory. The classic example is the valve invented by Dr. Ambrose Fleming, who, after Edison's fundamental contribution, produced the thermionic valve as we know it today, after industrial research by de Forest in America.

Research on the propagation of waves led to research on the ionosphere; research on the signal strength required to communicate through naturally occurring noise led to research on atmospherics. The Marconi research staff carried out a world-wide research on this subject, but the State had to provide facilities for an ever expanding group of sub-divisions, long-wave, short-distance propagation, short-wave, long-distance propagation, direction finding, and that great field of ionospheric structure which Appleton made so completely his own.

In the future there will come great contributions from the universities, from the laboratories of industry, and from amateur enterprise. But the very common general interest of all users in the result, the need for far-reaching experimental facilities, the need for close co-operation among research workers, the wide geographical spread of the areas over which observations and measurements have to be made, have made, and still make it essential for the State to give a helping hand.

In the years 1925 to 1935 the State contribution came through the Radio Research Board of the Department of Scientific and Industrial Research which was in full activity on a programme of work which centred on the effect of atmospheric processes on radio.

N.P.L. Standards

The National Physical Laboratory also did a vast amount of work in an active programme of measurement and the creation of standards. This system, richly productive as it was, became, as war approached, too limited in its scope. The imminence of war, and especially the emergence of radiolocation, led to a remarkable transformation in radio research activities. The radio laboratories of the Defence Services, understaffed, under-equipped, and under-financed, had done good work on the lines of development rather than of research, on equipment which, like much of the military equipment here and in Germany, became obsolete before the great clash came. Radiolocation, by far the most important national asset ever to emerge from the National Physical Laboratory, as a result of the efforts, not of one man, but of a large number of scientists, was a natural, but not inevitable, synthesis of technique. It revivified the laboratories of the Defence Services.

Now, many people advance the argument that the State should control all research, while others argue that the State should leave it to private endeavour. The development of radio is a conclusive refutation of both these arguments. Men work from varying motives. In this expanding world of knowledge we must harness to our scientific research all the motives and all the symptoms which have shown in the past that they can pull their weight. Only by so doing shall we maintain in peace what has proved to be Britain's great invisible export in war, namely, brains.

Young Scientists

Our radio laboratories today contain the cream of the country's younger scientists, and the universities which have temporarily lost them will be direct beneficiaries in the long run, for these researchers have learnt much that will profoundly affect for the better their outlook as university teachers.

The fertility of invention, the ingenuity of application, the battle of wits with the man on the other side which have characterised the growth of radiolocation, and which is still at its height, have reacted on the older and slower moving technique of radio-communication. The effects of radio in peace will be very great indeed. The steadily increasing utilisation of the shorter wavelengths, the increase of precision mechanical engineering in the electro-mechanical mixture of radio engineering, are now apparent to all.

The Radio Board under the War Cabinet is the supreme national authority for the formation and co-ordinative application of radio policy. It operates mainly through its two committees—the operational and the technical committee, and the production, planning, and personnel committee. The operational and technical committee provides a common meeting ground for the Serviceman and the scientist.

It is doubtful whether there has ever been in any other field of scientific endeavour co-operation so flexible and so productive between the minds of those responsible for forming and applying military policy and the civilians actually engaged in the laboratory. It is an essential part of the modern radio war.

We can indeed look forward to great developments in radio soon after the war closes.

"Refresher Course in Mathematics"

A reminder that we have recently published from the offices of this journal at 8s. 6d. (by post 9s.) a valuable new handbook entitled "Refresher Course in Mathematics." It is equally useful to the man who has forgotten his mathematical training as it is to the man who has never learned, and it takes the reader by easy stages from simple arithmetic to the calculus. Orders should be addressed to the Book Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Pre-war Position

In pre-war days the annual turnover of the British radio industry was about £25 million. About 80 specialist firms were engaged, most of whom were producers of radio broadcasting receivers—the output of which was about 1¼ million sets a year—and about 80 per cent. of the industry was devoted to this class of work. The remaining 20 per cent., mainly centred in a few firms, was devoted principally to the production of broadcasting transmitters, and communications equipment for marine use and for long-distance commercial radio services. In general, it can be said that nearly the whole of the effort was directed towards meeting civilians needs. There were some signs that the output of broadcasting receivers had approached, or had even passed, its peak (practically every home—actually 8,800,000—had a receiver and new models were therefore only required for replacements, or to provide additional refinements). A television service had been opened in London and there were signs of growing developments in this field, but the application of this service was still in its infancy.

The ratio of skilled to unskilled labour in firms producing radio broadcasting sets was of the order of 1:30 and the firms producing communications equipment was about 1:10.

Making an Epidiascope

Constructional Details of an Inexpensive but Efficient Instrument

By MORLEY HEDLEY

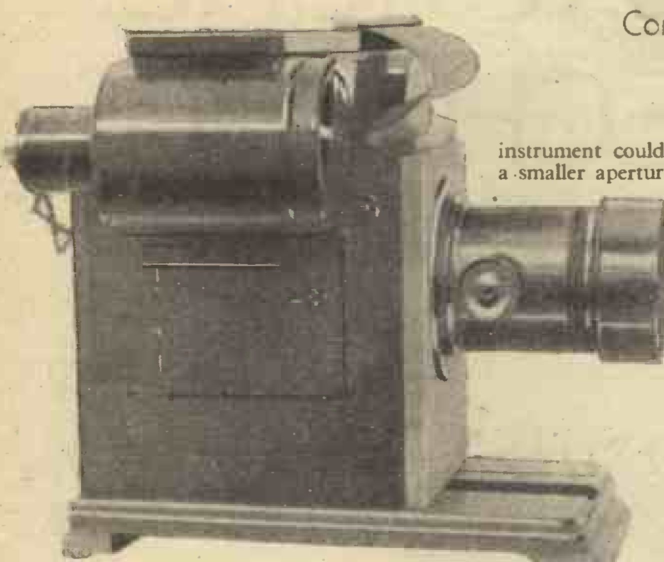


Fig. 1.—The finished epidiascope.

AN epidiascope is an optical instrument resembling a lantern designed to project the image of a flat surface on to a screen. Its manifold uses become apparent with a little thought, such as the screening of maps, photographs, illustrations from a book, fingerprints, postage stamps and many other things that come readily to mind.

Usefulness

Consequently, in these days, an instrument of this nature is in great demand, because not only are they used extensively for demonstration purposes to the armed Forces, they are also very useful for the same purpose in the Air Training Corps, the Home Guard, and many other organisations.

The difficulty experienced in obtaining an epidiascope, and the cost incurred, often prevents part-time organisations from enjoying the advantages of its use.

The epidiascope to be described was built for Home Guard use at a cost of under three pounds, and the lens accounted for two pounds ten shillings of that figure.

The Lens

Before embarking on the construction work—a lens is the paramount component—the limitations of the instrument must be understood. Even the most carefully designed and costly epidiascopes are unsuitable for demonstration before very large audiences. The principal limitation is the intensity of the illumination as the light is reflected light as compared to the direct illumination through a transparency in a lantern. Therefore a lens with as large an aperture as possible is necessary to collect the maximum amount of light from the object. Further, as the frame for the object needs to be a reasonable size to take picture postcards, etc., the lens has to be of long focus or the screened picture would be unduly large and the length of throw unduly short. The lens selected for this epidiascope is an old portrait lens, probably taken from an old whole-plate studio camera, and has a focal length of 12½in., the effective diameter of the lens is 3in., thus making the aperture f/4. The focal length of the lens should not be much less than 12in. for constructional purposes, but an effective instrument could still be produced with a smaller aperture of f/4.

Actually, the writer built the epidiascope before buying the lens, but it would be good policy to decide on the lens first.

Fig. 1 is an illustration of the completed instrument. It is constructed entirely of "bits and pieces," the main items being some scrap wood to make the box, two "Ostermilk" tins, two health-salt tins, some tinplate, a sheet of glass and a mirror.

Optical Design

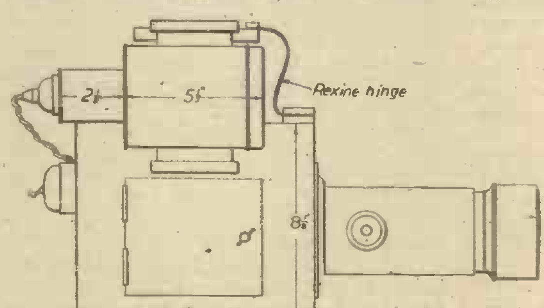
Fig. 5 effectively indicates the optical arrangement, and it will be seen that the object is placed at right-angles to the axis of the lens which collects light from a mirror inclined at 45 degrees to each. An ordinary mirror was used, but it was found to produce a faint double image due to reflection from the glass surface. It is therefore recommended to obtain a surface-silvered mirror from a photographic shop, such as is used in reflex cameras. Incidentally, an epidiascope is a reflex camera "in reverse."

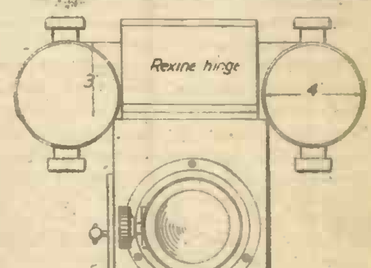
Construction

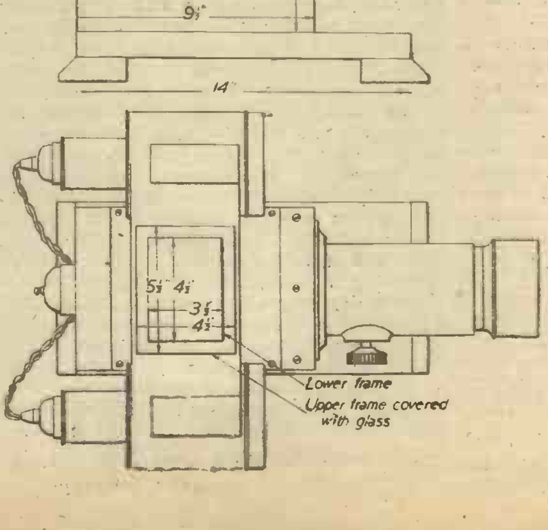
The drawings in Figs. 2, 3 and 4 show the main constructional details and give the principal dimensions. The tins make the lamphouses after removing the paint, cutting a hole in the bottom of the larger tin and soldering the smaller tin to it. A hole is then cut in the bottom of the smaller tin to take the bayonet lampholder. Ventilation is an important problem as the lamps get very hot. Short of forced draught, it is best obtained by drilling a series of holes in the upper and lower sides of the larger tins and covering them with light-traps of soldered tinplate. Failing having the lamphouses professionally stove enamelled, it is recommended not to worry about the appearance and leave them bright tinplate.

The lids of the larger tins can be removed to insert or remove lamps which should be 100-watt or 150-watt. The side of each larger tin is cut away to allow the light to reach the object and two crosspieces of tinplate 3in. deep join the two lamphouses together. These are soldered to a tinplate base which is screwed to the wooden box. In this tinplate base is cut a rectangular aperture about ½in. smaller all round than the size of the object frame. A tinplate top is then soldered on with a rectangular

This article was first published in our issue for December, 1942, which is now out of print. In response to requests from readers, including many in the Forces, we now reprint it.







Figs. 2, 3 and 4.—Side, plan and front views of the epidiascope showing the principal dimensions.

hole in it over which is fixed a sheet of glass on which the objective rests. A piece of thick plywood painted flat-black underneath is hinged by means of a flexible hinge of leather or rexine and rests on top of the objective, keeps it flat, prevents light from leaking and, being flexible, accommodates objects of varying thickness.

The main body is simply a wooden box on a baseboard and presents no difficulty even to a carpenter of the meanest ability. Keep the sides square with each other, cut a hole in front to accommodate the lens, a hole in the top over which is screwed the base of the lamphouse, and a door in the side to enable one to dust the mirror.

The mirror should be at 45 degrees, but it is simpler to pivot it at the top and make it adjustable. The mirror is clipped to a sheet of plywood, and the top either pivoted or hinged to the body of the box. A circle of wood is then screwed eccentrically to the side of the box and supports the mirror at approximately 45 degrees. An image is then projected on to the screen and the circle of wood is rotated until the image at the top, and bottom of the picture, is equally well defined. The circle of wood, which should be about 2in. diameter, is then screwed up tight in this position.

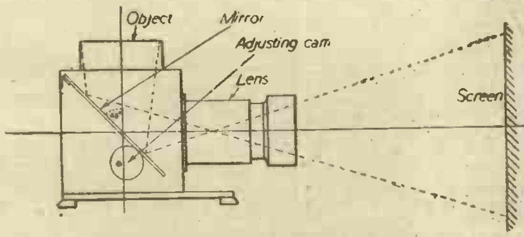


Fig. 5.—The optical system for the epidiascope.

The ideal method of focusing is by rack and pinion, or helical slot. These methods are often embodied in the lens housing. It is possible, however, that a lens might be used without these refinements. In that case a simple method would be to mount the lens on a piece of wood that slides in guides underneath the baseboard. A light trap such as bellows will then be necessary between the lens and body of the epidiascope. In any case the movement of the lens is very small, and a simple and effective replacement for the bellows would be two tins with the bottoms removed, one being a loose fit inside the other and a ring of felt or plush glued round the inside of one or the outside of the other to make a light trap.

Improved Pendulum Movement

A Method of Maintaining the Momentum of a Pendulum

It is realised that the synchronous motor has its limitations and is not all that we were promised and does not come up to expectations. If we use a pendulum we have the advantage that the clock will not stop with an instantaneous interruption in the supply. It is also possible to arrange for a battery to automatically come into use if the mains fail.

The accompanying drawing shows an original method of maintaining the momentum of a pendulum and operating the hands. It should be understood that the hands can be moved electrically, but for simplicity sake I have shown the mechanical method.

Fig. 1 shows the complete arrangement, and Fig. 2 the switch in detail.

Referring to Fig. 1, the pendulum 1 hangs from the support 3 through a suspension spring 2 in known manner; the lower end of the pendulum is provided with the usual bob 4. The driving rod is shown at 5 and is somewhat shorter in length than the pendulum; it swings on the knife edge of a bar 6.

The connecting member between the pendulum and driving rod consists of three parts, 7, 8 and 9. The part 7 is simply a U-shaped strip of metal having a bolt 10 fixed there across, the bolt passing freely through a hole in the pendulum. The open end of the strip may be connected by a rod indicated by 11 in order to balance the weight more evenly on the pivot constituted by the bolt 10. The part 8 consists of a ring through which is mounted a horizontal pin 12, carrying one contact of a latch switch. Soldered, or otherwise attached to the ring, are two screw-threaded rods 13 and 14. The rod 13 is screwed into the part 7. The rod 14 is screwed into the part 9, which consists of an internally threaded rod having a stop 15 at the other end thereof. 16 is a lock nut. The rod 9 passes freely through a hole 17 in the driving rod 5.

Pivotally mounted on the pin 12 is the contact 18. This contact consists of a strip of metal formed with a sleeve at the upper end thereof to pass over the pin 12, as shown more clearly in Fig. 2. The lower end of the strip has attached thereto a small metal plate 19, electrically insulated from the strip 18 is a counter-weighted lever 21; after this lever is fixed in the desired position it is soldered to the strip 18, so that it cannot move with respect thereto. The counterweight consists of a metal ball 22 soldered to one end of the lever 21. Co-operating with the contact is a latch switch. This consists of a cylindrical member 23, which is mounted to occupy the position shown in Fig. 1. The top of the member 23 is provided with a cover 24, having an opening through which passes the top of a contact formed by a bolt 25. The groove 26 shown in this bolt is simply for the purpose of holding lubricating oil. A spring 27 presses upon the bolt 25, the lower end of the spring being held by a screw-threaded key 28; by turning the key the pressure upon the bolt 25 can be adjusted.

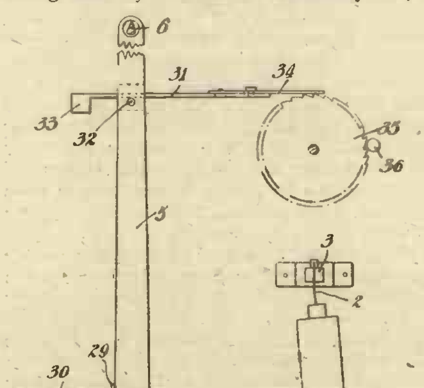


Fig. 2.—Details of the switch. *Fig. 1.—The complete arrangement of movement.*

An armature 29 is fixed upon the driving rod 5, and this is adapted to be attracted by an electromagnet 30. The upper part of the driving rod 5 carries a counterweighted lever 31 pivoted upon a pin 32 fixed in the driving rod. One end of the lever carries a counterweight 33, and the other end of the lever has attached thereto a pusher bar 34 the position of which can be adjusted. The bar 34 actuates a toothed wheel 35 in such manner as to rotate the wheel by an amount corresponding to one tooth upon each swing of the driving rod 5 to the right as viewed in the drawing. The wheel 35 is the actuating wheel for the clock mechanism.

An electric circuit is made which includes in series a source of power, the electromagnet 30 and the contacts 25 and 18. If the driving rod and pendulum are made of insulated material, it is only necessary to connect one wire to the metal part 7. The circuit is closed when the contacts 25 and 18 touch each other.

The arrangement works in the following manner. Assume that the pendulum 1 is swinging to the right. The connecting member will then also be moving to the right, and the stop 15 will pull upon the driving rod 5 so as also to make it swing to the right. With the parts in the position as shown in Fig. 1, the contact 18 will be hanging so that the counterweight 22 causes the lever 21 to bear upon the ring 8 as shown. On the return swing of the pendulum 1, the driving rod 5 will also return under its own swinging motion. As soon, however, as the contact 18 contacts the bolt 25, the circuit *through the* electromagnet 30 will be closed and the armature 29 will then be attracted. The electric circuit will only be closed momentarily, but the impulse will be sufficient to keep the parts swinging to and fro. When the armature meets the electromagnet, the driving rod 5 can swing to the left no further, but the pendulum 1 will continue to swing to the left to the natural end of its swing, the rod 9 passing through the hole 17. When the contacts 18 and 25 meet, the pendulum and driving rod moving to the left, the contact 18 forces the bolt 25 downwards as it passes over it. A good contact is thereby made.

After the pendulum 1 has completed its swing to the left it will swing to the right and in due course the stop 15 will meet the driving rod 5,

Making a Success of Photography

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

Harvest Scenes

FARMS where the crops are ready for cutting provide the opportunity of getting some harvest scenes, always a popular subject with amateur photographers.

Before giving hints on this subject I remind readers that during the month of September the light can vary quite an appreciable amount. I have recently been studying one or two exposure charts which I have found accurate in the past. June and July are generally acknowledged to be the months of the year when the shortest or fastest exposures are permissible; in August and September we must increase by allowing approximately 50 per cent., but when we get to October it is advisable to increase by nearly another 50 per cent., therefore as we pass the middle of September it is necessary to judge the light carefully and, if you have one, to use the meter frequently.

Cornfields

A field of ripening corn or other cereal is a glorious and pleasing sight to most people, and it is difficult for any amateur to pass without having a "shot" at it, but sometimes this shot has proved very uninteresting as a picture; it is lacking something to make it look real. I suggest that the result is "lifeless" and would be very much improved if there was a suggestion of movement; such a movement one can see when there is a slight breeze blowing across the tops and slightly bending the cornstalks in waves; to secure such a picture a fast exposure is, of course, necessary, and your position must be one from which your camera can see those waves of bending straws with the reflected light tone values easily distinguishable. I mean by this that the straws which are not affected by the breeze will be of a slightly lower key than those in the breeze, and if these distinctions are accurately recorded in the negative, by giving correct exposure, you will then have got something that will give you pleasure when you see the finished print. Another feature which I think is very necessary indeed in this subject is a cloud; a cornfield with a "bald-head" is decidedly unfinished, so do not be in a hurry, there are often days in this month when the clouds are of the fleecy and small type, and in any type of negative will prove of great value.

Harvest on the north coast of Cornwall.

Cutting the Corn

You may be able to find out from the farmer or one of the hands when the cutting is likely to start, and this will give you a chance to be on the spot when you can get another form of "life" into your shot. Again do not hurry; note the best position, so far as the lighting, and so as to get the horses with the reaper coming down the field towards you. Watch that corner where there is a picturesque gate or a small clump of trees, and try to figure out in your mind whether these would help in the picture if you shot just when the horses are turning round into the next straight run.

Do not take the scene when the horses are standing resting; you want action for such a scene, and a pair of horses will show this when they are drawing the reaper. I think that is one reason why a tractor does not lend itself to the pictorial in farming pictures.

The binding of the sheaves and stacking them are opportunities for including figures in the pictures, but a little thought must be given to having the farm-hand in the right position, try to remember that you are not taking a portrait, he or she is only an "incident" to the scene, and therefore must not be looking at you, but thoroughly intent on the job; by this means you will get action again in the result.

Farm Hands

If you should chance to be near the field when the hands are having their midday meal, and are sitting where you can get a background of the uncut corn or a few of the stacks, they can then pose, and you must produce a happy smile on their faces suggestive of a "pleased - with - their - harvest" expression.

A harvest scene in Bucks.

The last load is a very hackneyed shot. and it must be taken with the field as a background, showing that all the crop has been cleared, or when the load has reached the farm and is being unloaded into the barn. Do not hesitate to take one or two shots of the horses; they are usually of a very good class or breed, and a farmer generally keeps them in excellent condition, and he is proud if anyone shows interest in them. Be sure to promise him one or two prints and keep that promise.

Sheep Shearing

When you have made the acquaintance on your holidays of a farmer, you can often find out when other interesting work is likely to be done, such as sheep shearing, milking, potato clamping, fruit gathering and similar items of farming. I have always found these folk very friendly and quite willing to help me get a few photographs of the routine of farm life; obviously they do not like people trespassing on their grounds, but a friendly nod or greeting will break the ice.

Some of our English farmhouses are very old buildings, and I have been invited on more than one occasion to take a view of the interior of the living-room; for such you will require a tripod and a time exposure, as these places are, as a rule, very poorly lighted, but with a specially fast film, such as H.P.3, and a large stop, one to five seconds should be all that is necessary.

Fruit Harvesting

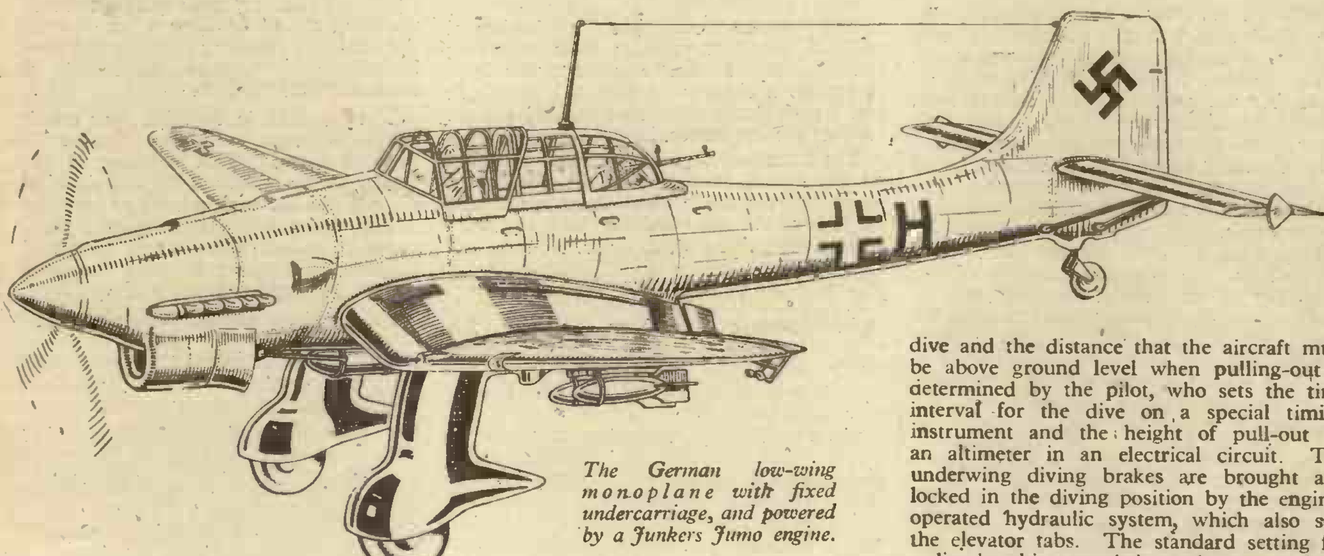
As regards the harvesting of fruit, such as pears, apples, plums, etc., should you by chance come to a fruit farm, you might be in time to witness the gathering; in some parts, especially where apples are grown for cider-making, the fruit is gathered in big piles near the trees and eventually carted away, but where the fruit is marketed for dessert you will find the picking is carried out very carefully in order to avoid bruising or other damage to it. After picking and examining it is packed either in flat boxes, crates or baskets, ready to send to the market or retailer. Choose a fine day and you will be able to collect a number of scenes of a very interesting and pictorial character.

In these days most of this work is done by female labour and with plenty of fun. Picking, cleaning and packing are all suitable subjects with the stack of crates or boxes as a background and, of course, the folks on the ladders should give you a very cheerful picture of life on a fruit farm at harvest time.

AIRCRAFT ON ACTIVE SERVICE

The Junkers Ju.87 Stuka

By L. H. HAYWARD



The German low-wing monoplane with fixed undercarriage, and powered by a Junkers Jumo engine.

THE Junkers Ju.87, "Stuka" dive-bomber, low wing monoplane with a fixed undercarriage, is manufactured by Junkers Aircraft and Motor Works, Ltd., at Dessau, and at many "shadow" factories throughout Germany. The Ju.87 aircraft at present operating with the enemy carry a crew of two, and are developed from a version which participated in the Spanish Civil War. The table below gives the leading particulars of the types now in service.

Construction

The fuselage of the "Stuka" is an all-metal structure with flush riveted, stressed skin covering, and is built in two halves, allowing equipment and accessories to be installed before the halves are joined along the horizontal centre line. The construction is extremely strong, and allows the machine to operate from rough emergency aerodromes. The tapered wings, with their square-cut tips, are each built up from two main spars covered with a metal stressed skin, flush riveted except on the underside. The centre section of the wings from the fuselage to the undercarriage struts has a downward slope or anhedral angle, and the outboard section has an orthodox dihedral similar to our Typhoon fighter. The wing flaps extend the full length of the trailing edge. The large, square-cut tail-plane distinguishes the Ju.87 from other German aircraft. An interesting construction item is the provision of quickly detachable panels, allowing rapid and thorough inspection of all controls, oil, fuel and coolant levels, drain cocks, bomb release gear and other items requiring maintenance.

Cockpit Design

The large cockpit cover extends over the pilot and gunner, as can be seen in the illustration. In the event of a crash or the dive forces pulling the pilot from his seat, he is afforded some protection by a large padded bar fitted in front of the instrument panel. The instruments fitted and the lack of a directional gyroscope indicate that the "Stuka" was designed generally as a short-range machine. To enable the pilot to see the country over which he is flying, a special glass panel is fitted in the floor of the cockpit.

Armament and Bomb Load

Two 7.9 mm. machine-guns are housed in the wings, and on early Ju.87 machines a single 7.9 mm. hand-operated gun was provided for rearward protection. On later machines a certain amount of armour plating is fitted to protect the crew and radiators, and a double 7.9 mm. hand-operated rearward-firing gun has replaced the single one. Two 110lb. bombs are carried under each wing and a 1,100lb. bomb is carried under the centre section of the fuselage.

Dive-bombing

Brakes designed to limit the speed of the aircraft in a dive are fitted under the leading edges of the wings. When a dive-bombing attack is made these brakes are turned through 90 degrees, so that they present a large surface area to the airflow and limit the diving speed to approximately 300 m.p.h. Without the dive brakes a speed in the region of 400 m.p.h. would be attained. For normal flying, the brakes are flush with the underside of the wing. The large calibre bomb is carried on a fork mechanism flush with the fuselage, and before being released must be swung away from the fuselage to allow the bomb to fall clear of the airscrew.

Special apparatus is installed that automatically assists the pilot in pulling the machine out of a dive. The angle of the dive and the distance that the aircraft must be above ground level when pulling-out is determined by the pilot, who sets the time interval for the dive on a special timing instrument and the height of pull-out on an altimeter in an electrical circuit. The underwing diving brakes are brought and locked in the diving position by the engine-operated hydraulic system, which also sets the elevator tabs. The standard setting for a dive-bombing attack is 50 degrees, and the aircraft controls are all marked to enable the pilot to set his machine for this diving angle. Indicator lines marked from 20 degrees to 70 degrees on the cockpit support rails must be lined up with the horizon by the pilot to correspond with the diving angle.

Pre-set Altimeter

The pre-set altimeter circuit closes and operates the bomb release gear when the pull-out height is attained, and the elevator tabs are allowed to go back to the normal flying position. The combined operation of releasing the bomb and correcting the elevator tabs tends to make the aircraft tail heavy and it begins to pull itself out of the dive. Control is regained by the pilot, who is then concerned with making his getaway at maximum speed. The undercarriage struts on later models are fitted with sirens that scream whenever the aircraft is put in a dive.

In Service

The "Stuka" was highly successful in breaking up the defences of Poland, Belgium, Holland and Greece, but its record of success was brought to an end when it came to grips with our Spitfires and Hurricanes. Large numbers have been shot down in North Africa, where they were used to attack our road convoys, bridgeheads and front-line positions. Many unsuccessful attacks were carried out by "Stukas" on the *Ark Royal*, and quite a number have been shot down over this country.

Next Month:

THE CONSOLIDATED CATALINA.

Type	Span	Length	Height	Weight Max. Load	Max. Speed	Range	Diving Speed	Motor Type	Motor Power
87.A	45' 4"	35' 6"	13' 11"	7 510lb.	199 m.p.h. without bombs	Approx. 400 m.	300 m.p.h. with Brakes 400 m.p.h. normal	Junkers Jumo 210C Liquid Cooled Inverted V	640 h.p.
87.B	45' 4"	35' 6"	12' 7"	9,370lb.	242 m.p.h. without bombs	Approx. 450 m.	300 m.p.h. with Brake 400 m.p.h. normal	Junkers Jumo 211D Liquid Cooled Petrol Inject.	1,050 h.p
87.D	45' 4"	35' 6"	12' 9"	9,500lb.	250 m.p.h. without bombs	Approx. 500 m.	280 m.p.h. with Brakes 420 m.p.h. normal	Junkers Jumo 211F Liquid Cooled Petrol Inject.	1,200 h.p

Our Busy Inventors

By "Dynamo"

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."

An Improved Comb

AMONG the current accepted applications for a patent in this country is a toilet requisite in the shape of an improved comb.

The general object of this invention is to enable the user to apply to the hair, rapidly, accurately and evenly, water, hair lotion, wave-set, tonic and colouring fluid.

A subsidiary object is to retain any liquid applied in excess, in order to spread it or work it into the hair with subsequent strokes of the comb.

Two series of teeth are provided. The teeth of one series extend laterally of the comb beyond the teeth of the other, at least in part, whereby liquid-retaining recesses are formed between the laterally-extended teeth of one series.

It is a feature of the comb to have teeth on its back to increase the capacity of the liquid-retaining recesses.

Reinforced Clothes

THERE has appeared an improved method of protecting the ends and the elbows of sleeves and other parts of wearing apparel which are especially subject to wear and tear.

This invention consists of strips and pads of leather perforated close to the margins for the purpose of easily affixing to the garment by means of cotton or thread.

The perforations will make it possible for the amateur tailor to ply his needle with facility and thus to reinforce his garments.

Life-saving Waistcoat

TO "those in peril on the sea," especially in these critical times, some form of lifebuoy is an absolute necessity.

In the past it has been proposed to make a life-saving waistcoat with Kapok between the inner and outer parts of the garment. Such waistcoats, however, are apt to become greasy and dirty. It is stated that they are expensive to clean. And while they are being cleaned, naturally they cannot be used.

At the present juncture it is desirable to have a plentiful supply of such waistcoats in good condition. This has moved an inventor to devise an improvement. His idea is a waistcoat with removable stuffing of some buoyant material. The inner and outer surfaces of the garment are connected along transverse lines to form pockets. The inside part is slit to provide openings through which the removable buoyant padding may be inserted into each pocket.

This appliance will enable shipwrecked mariners and passengers to keep their heads above water.

For the Wounded

THE stretcher plays an important rôle in the theatre of war. Its construction materially affects the comfort of the wounded.

A recent application for a patent in this country relates to wheeled stretchers such as are used by Army Field Ambulance Services when manual transportation of the wounded has to be carried out under difficult and arduous conditions.

The aim of the inventor has been a construction which is light in weight yet rigid and robust. His object also has been a stretcher capable of being collapsed or folded to small dimensions to facilitate storage and transport.

The device comprises a horizontal wheeled frame or chassis; arms extending upwardly and formed at their upper ends to engage a support; a standard stretcher; and legs beneath the frame making a rigid support for the device.

The arms and legs are pivotally mounted on the frame, so that they may be folded when not required. And there are means for locking the arms only, or both the arms and the legs, when the stretcher is not in use.

For Raising Wrecks

AN inventor has been devoting his attention to the subject of raising wrecks, and, as a result of his cogitation, he has devised a new method of bringing wrecks to the surface. He has evolved a speedy means of salvage by the use of lifting tackle which enables an elevating force immediately to be applied. And this method avoids the delay which may arise when salvaging by resort to tidal lifts by stages into shallower water or by expelling water from the vessel.

As the inventor points out, speed of operation is often a vital factor in salvage work of this description; it may effect the releasing of the crew of a submarine. He further states that, in such an emergency, it is possible by his method, in a case when the ship is submerged in water of a depth less than the length of the vessel, to lift one end above the surface and to hold it in that position to allow cutting through the hull. This, it is contended, can be done in a much shorter time than that taken by previous methods.

The lifting force applied to the cable employed is produced by inflatable floats lowered in a deflated condition from a salvage ship. These are inflated with air transmitted through a tube lowered with floats from the salvage ship.

Anti-Puncture Tank

IN aircraft a faultless fuel tank obviously is an essential factor. An inventor who has been investigating the matter states that metal fuel tanks of known make have a protective covering embodying a rubber with the property of swelling when exposed to the action of petrol or oil. Should the tank be pierced by a bullet, the rubber would swell and seal the leak.

The covering in question may consist of layers of sponge rubber having fabric between them. This covering is applied loosely to the tank, and the individual layers are not bonded together. The consequence is that, when a bullet pierces the tank, the petrol flows out between the tank and the covering, permeating between the layers of the covering and ultimately destroying it.

If, therefore, another bullet should pass through the contaminated area of the covering, the effect of the hydraulic pressure of the petrol, combined with the deterioration of the covering, causes it to split.

The object of the tank devised by the above-mentioned inventor is to provide a covering which, when pierced and sealed again by the effect of the outflowing fuel on the rubber, will withstand a further puncture near the previous one and once more form a fresh seal.

The new tank has a self-sealing protective covering with at least one layer of rubber which will swell. And it has also an outer layer of a material which will protect against contamination by externally applied fuel and give the covering the necessary mechanical strength. The layers are bonded together to prevent escaping fuel from seeping between them, and the covering is bonded to the tank by a special cement.

A Valentine tank leaving an invasion craft upon reaching a landing beach, and making its own smoke screen.

Steam Field Kitchen

FOR military camps there has been constructed a convenient steam field kitchen which is the subject of an application to the British Patent Office. By its means food can be cooked and water heated with a comparatively small quantity of fuel.

A feature of the invention is a special boiler whereby effective steam production is effected.

A further feature is the placing of ovens adjacent to the boiler to make use of any waste heat and also to conserve the heat in the boiler when the ovens are being fired.

Making Brick Incinerators

How Cheap and Efficient Incinerators for Garden Use Can be Made with Old Bricks

By "HANDYMAN"

THE disposal of garden rubbish is one of the problems which have to be tackled by the owner of a garden. At this time of the year garden refuse usually accumulates, and becomes a nuisance, and one of the best methods of getting rid of it is by burning it in an incinerator. Moreover, the ashes left from the burning of vegetable refuse, twigs, green wood and flower stalks form a good fertiliser for the garden soil.

The small incinerator shown in Fig. 1 is built up with 40 second-hand bricks which cost 5s. at a local builder's yard. In this incinerator all kinds of garden rubbish are burnt just as efficiently as in an iron appliance costing five times the price.

Having obtained the necessary bricks (there must be exactly 40), select a suitable flat piece of ground at the end of the garden farthest from the house, and arrange five of the bricks, as shown in Fig. 2. If you happen to have a piece of old tinplate of suitable size you can lay the bricks on this; if not, it can be dispensed with. Allow a space of roughly 1in. between the inner corners of the bricks, except at the opening at the front, and here a space 6in. wide should be left, as indicated in the illustration.

Fig. 1.—A small incinerator built with old bricks costing five shillings.

On top of each of these bricks another one is laid, and then across this second layer of bricks, over the opening, a piece of iron plate is placed. In the writer's case this consisted of a piece of stout tinplate, 17in. by 8in., folded on the centre line and hammered flat, making a plate 4in. wide. This plate supports the bricks above the opening.

The remaining bricks are carefully arranged, as shown in Fig. 1, starting with the one over the opening, and allowing five bricks for each layer. Leave an opening of about 1in. between each pair of bricks, as mentioned above, for ventilation purposes.

One advantage of this type of incinerator, with regular air opening, is that it burns equally well no matter in what direction the wind is blowing.

Alternative Type

If an incinerator of much larger capacity is required, the type illustrated in Fig. 3 can be built. Old bricks can be used, as before, and for this incinerator, which has capacity of approximately 5 cubic feet, 98 bricks will be required.

Fig. 4 shows how the first two layers (each of 9 bricks) are arranged in the form of a square, a space equal to the length of one brick being left at the front. Air spaces $\frac{1}{2}$in. wide should be left between the bricks, as indicated. Before placing the next layer of bricks in position, a piece of stout iron plate is laid over the opening, as in Fig. 5. Each layer above the second one consists of 10 bricks, and these should be carefully laid so that the bondings, or vertical joints, come as shown in Fig. 3. Vertical air spaces, at least $\frac{1}{2}$in. wide, should be left between all the bricks to ensure efficient ventilation.

To make a more permanent job the bricks can be cemented in position, and a good cement mortar for the purpose can be made by mixing 2 parts of Portland cement, 2 parts of sand, 1 part of lime, and 1 part of red clay. Add sufficient water to make a stiff mixture, and only apply the mortar to the horizontal courses between the bricks, leaving the vertical bondings open, as mentioned above, with the exception of the top layer, in which all the joints can be cemented.

When burning heavy rubbish it is sometimes necessary for proper combustion to maintain an air space below the rubbish, and one way of arranging for this is to place a couple of iron hearth trivets, of the pattern shown in Fig. 5, inside the incinerator for the rubbish to rest on. For ordinary light refuse this provision will not be necessary.

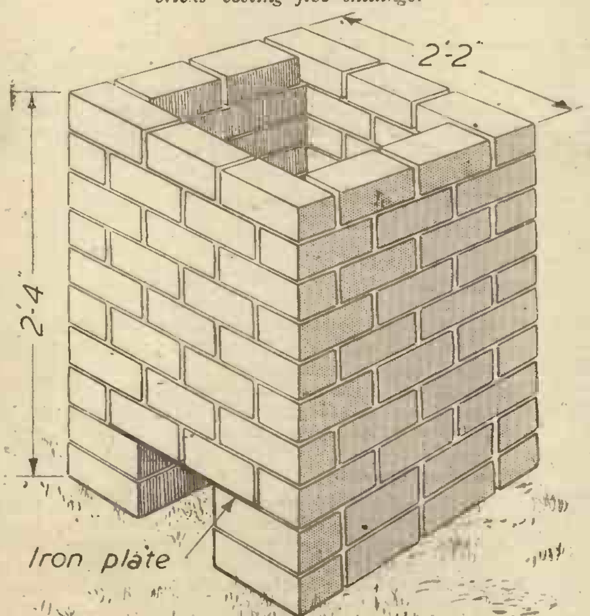


Fig. 3.—A brick incinerator of square shape.

Air Spaces

An important point to bear in mind when erecting a brick incinerator of either pattern illustrated is the necessity of providing for the air spaces at regular intervals between the bricks, as it is on this liberal ventilation that the efficiency of the incinerator depends. The draught orifices so arranged take full advantage of any wind that is blowing, and the increased draught caused by such wind expedites the burning process.

Finally, as a brick incinerator is not portable, and is rather an unsightly object from a garden-lover's point of view, it is a good plan to place it behind a screen of privet, or other shrubs, at the end of the garden to shield it from view.

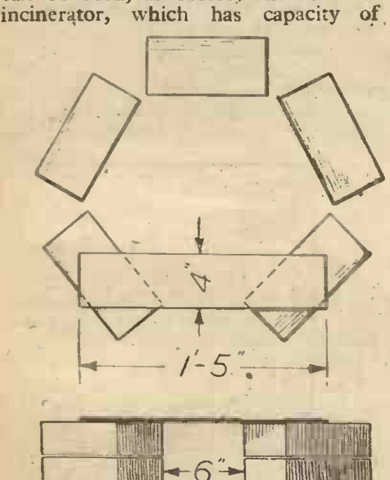


Fig. 2.—Showing how the bottom two layers of bricks are arranged.

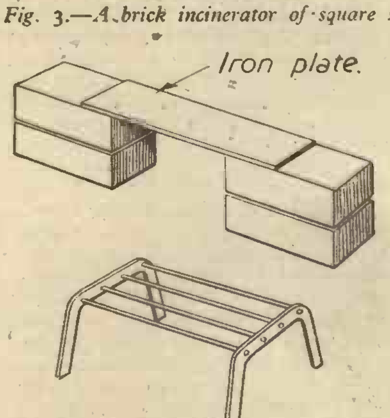


Fig. 5.—Iron supporting plate and improvised fire bars.

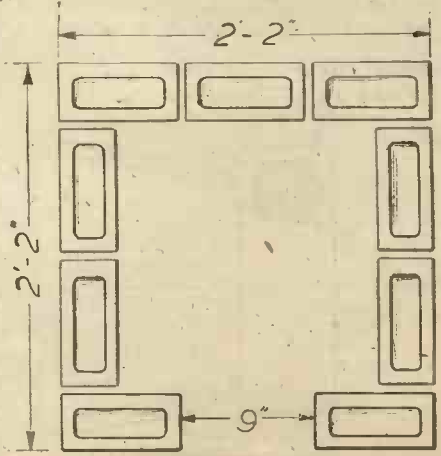


Fig. 4.—How to arrange the bottom layer of the square-shaped incinerator.

Aero-engine Cooling Systems

The Layout of the Various Systems, and How They Function

By T. E. G. BOWDEN

THE types of aero-engines in use at the present time may be divided into two main classes, i.e., air-cooled engines and liquid-cooled engines. Both these types are employed, and neither has succeeded in becoming superior to the other, although at certain periods in the last 20 years there have been definite tendencies to use one particular type.

Liquid-cooled Engines

Fig. 1 illustrates diagrammatically the layout of a typical liquid-cooled engine and the attendant accessories. The main items of equipment are as follow: (1) radiator, (2) coolant tank, (3) circulating pump, (4) thermometer, (5) engine jacket, (6) connecting pipes.

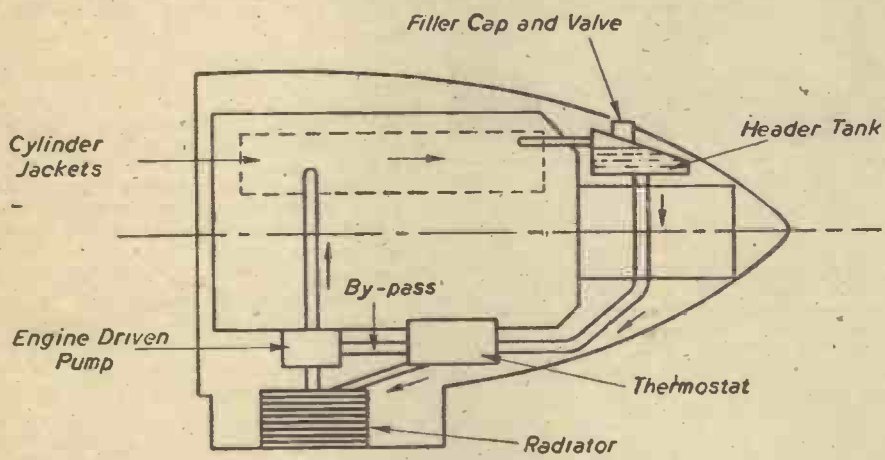


Fig. 1.—Typical liquid-cooled system.

By studying some approximate figures showing the loss in horse-power due to heat dissipation, the importance of efficient cooling will be realised. About 40 per cent. of the heat energy is dissipated via the cooling system, approximately 30 per cent. by the exhaust system and the remainder, i.e., 30 per cent., is dissipated as useful work. Thus it will be seen that of the total energy which is potentially available, only one-third is transmitted as actual engine power, which in turn is transmitted to the airscrew.

Header Tank

From Fig. 1 it will be noted that the coolant reservoir or header tank, as it is usually termed, is situated at the highest level of the system. The reason for this is to avoid airlocks occurring in the pipes and to provide a filling position. This tank is usually mounted above the engine reduction gears as indicated, although other positions are used for different types of aircraft. Aluminium is the material generally used for constructing header tanks, as it is easily worked into the rather complicated shapes that occur when the tanks are designed to fit into the position shown.

It is extremely important that a venting valve be incorporated in the tank to allow for variations in the air pressure which occur when the aircraft is being flown at various altitudes. If no valve were fitted and the aircraft took off at sea level and climbed to say, 20,000ft., the tank walls would collapse, due to the variation in pressure between the inside of the tank and the surrounding atmosphere. The valve usually takes the form of a spring-loaded valve set to operate at several pounds per square inch.

Cooling Liquid

The liquid used in aero-engine cooling systems is usually ethylene-glycol, which has a higher boiling point and a lower freezing point than water. The raising of the boiling point is important owing to the fact that at high altitudes the temperature at which liquids boil is lowered. A maximum figure of approximately 120 deg. C. may be obtained with a mixture of 30 per cent. ethylene-glycol and 70 per cent. water. A disadvantage incurred by using this fluid is the fact that rubber hose connections are liable to be attacked if they come in contact with the mixture.

Radiator

To lower the temperature of the coolant after it has flowed through the engine and the tank, radiators are fitted constructed in a similar manner to the motor-car type. These are usually situated underneath the engine together with the oil radiator. In certain aircraft, in order to reduce the frontal area and consequently the drag, the radiators have been positioned in the wing leading edge. A typical example is the Supermarine Schneider Trophy seaplane, in which the radiators were shaped to conform with the wing profile. The disadvantage caused by positioning the radiators away from the engine is the fact that excessive lengths of piping are required, thus increasing the possibilities of damage (especially in military aircraft) and complicating maintenance. If they are positioned on the engine mounting and the engine is to be removed, there are no coolant pipe joints to uncouple.

Thermostatic Control

When the engine has just been started and the coolant has not increased in temperature it is unnecessary to pass it through the radiators. To by-pass the fluid a thermostatic control valve is fitted as shown in Fig. 1, and when no cooling is required the coolant is led through a pipe to the pump which passes it to the engine.

Coolant Pumps

The type of pump usually fitted is the centrifugal design, which is driven by the engine. This pump functions in a similar manner to the centrifugal supercharger, i.e., fluid is flung outward by means of an impellor and passed via guiding vanes to the engine delivery pipe.

From the pump the coolant passes to the cylinder jackets and then flows to the tank. Special precautions have to be taken to ensure liquid tight joints, and usually spring-loaded glands are fitted to overcome expansion difficulties.

Evaporative Cooling

In this type of cooling system the water flowing through the cylinder jackets is subjected to a pressure greater than the normal atmospheric figure. The temperature is permitted to rise to 100 deg. C., and the steam produced is led to a condenser. The condensed water is then pumped back through the engine by means of a normal pump.

The advantage gained by using this system is the fact that smaller radiators may be fitted owing to the higher temperature of the water. Also there is the cooling caused by the latent heat of evaporation. This method has been utilised on airship engines, e.g., the *R.101*, which was fitted with diesel engines.

The condensers may be incorporated in the leading edges of the wings to reduce drag, although this complicates the design of the aircraft. Another disadvantage is that, owing to the high temperature of the water, the pump may not function very efficiently. The water tends to boil, and consequently the pump does not operate, due to vapour locks.

Air Cooling

At one period of aircraft design it appeared as though the liquid-cooled engine would

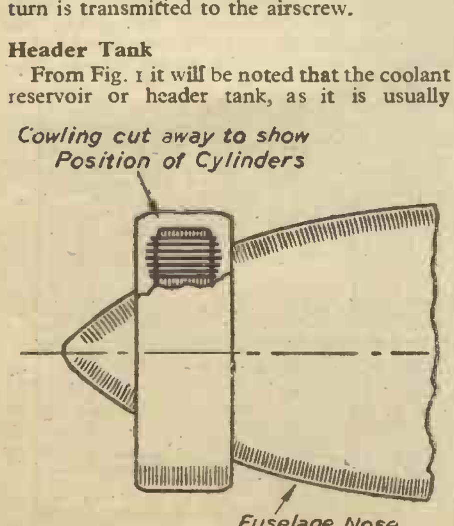


Fig. 2.—Townend Ring.

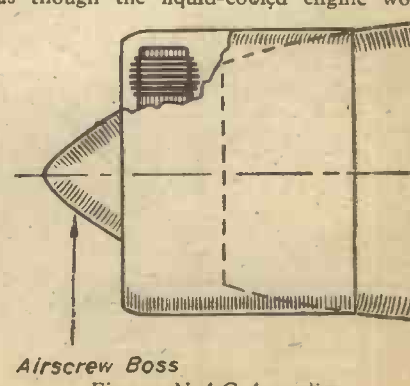


Fig. 3.—N.A.C.A. cowling.

reign supreme in high-speed types, due to the smaller frontal area. During the last few years, however, there have been great strides in the cooling of high-powered aero-engines by means of air, and at the present time there is very little to choose between the two types. There are two main classes of air-cooled engines, i.e., radial and in-line, both requiring different methods of cooling.

Townend Ring

In the case of radial engines the cylinders are arranged, as their title suggests, radially around the crankshaft, and in the earlier types of aircraft were left protruding into the slipstream. For the low powers developed and the low flying speeds gained this was quite all right, but as soon as both output and speed increased this method was found to be most unsatisfactory. The drag caused by the projecting cylinders slowed down the aircraft, and the airflow after it had passed the cylinders was extremely turbulent. The first practicable step to improve these conditions was the introduction of the Townend Ring. This is illustrated in Fig. 2, and, as will be seen, it consists of a circular cowling of approximate aerofoil section fitted round the cylinder heads.

By fitting this cowling the airflow is prevented from becoming extremely turbulent, and the cooling air is guided over the hot cylinders in a more efficient manner than is the result when no cowling is fitted. When the Townend Ring is fitted it has been found that the speed of the aircraft may be increased by several miles an hour, due to the reduction in drag.

N.A.C.A. Cowling

A development of the Townend Ring is the N.A.C.A. (National Advisory Committee for Aeronautics) cowling, which was originated in the U.S.A. This design is shown in Fig. 3, and allows a much more streamlined fuselage to be obtained. In the case of an aircraft fitted with a Townend Ring (Fig. 2) the fuselage lines are not aerodynamically efficient, but by using a N.A.C.A. cowling the gap is reduced by elongating the actual cowling. An elliptical section is used for the actual cowling in place of the aerofoil section. By using this type of cowling the maximum speed may be even further increased.

Controlled Cooling

To control the amount of air flowing over the cylinders hinged flaps are sometimes incorporated on the trailing edge of the cowling. These are spaced around the perimeter of the cowling, and are operated by means of a handle in the pilot's cockpit. The flaps or gills, as they are usually termed, must be open for running the engine on the ground to obtain maximum cooling. During the actual take-off and for climbing the gills are placed approximately half open, while for cruising purposes they are usually closed. For varying climatic conditions these general instructions will, naturally, be varied to suit the circumstances.

To guide the airflow around the rear faces of the cylinders baffle plates are fitted. Fig. 4 illustrates the function of these baffles.

An important point is the fact that the various accessories fitted at the aft end of the engine, e.g., generator, air compressor, etc., should be adequately cooled. If necessary, special ducts and baffles must be incorporated to guide a stream of cool air over these important accessories.

In-line Engine Cooling

In the case of in-line aero-engines, i.e., the type with the cylinders one behind the other, the shape allows a more streamlined cowling to be used than in the case of radial air-cooled engines. An opening is usually provided in the cowling nose and the air guided round the various cylinders by means of baffle plates. Gaps are left at the rear end of the cowling to allow the air to escape. A typical example of this type of cooling is the Gypsy Major engine installed in various De Havilland aircraft.

An unusual method of cooling was adopted in the case of the D.H. Albatross which was fitted with four Gypsy 12 engines. In this

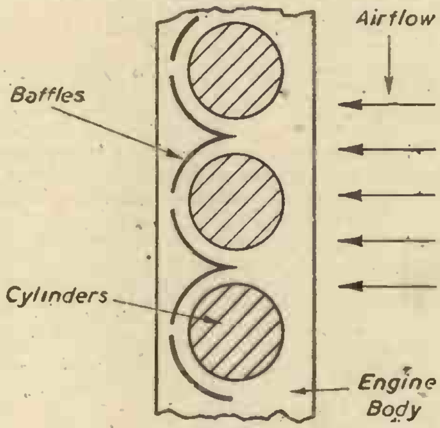


Fig. 4.—Baffle plates.

design the whole engine was completely enclosed in a very efficient cowling. Ducts for the cooling air were fitted in the wing leading edges and the air guided forward to the engines by means of large diameter pipes. After passing round the cylinders the air was allowed to escape from the lower side of the engines via controllable hinged gills. The gills, controlled by the pilot, allowed varying quantities of air to be passed to the engine without causing any great amount of drag. As in the case of the controllable gills on the radial type of aero-engine, the hinged flaps fitted to the Gypsy 12 engines were opened for take-off and climb and closed for normal level flying.

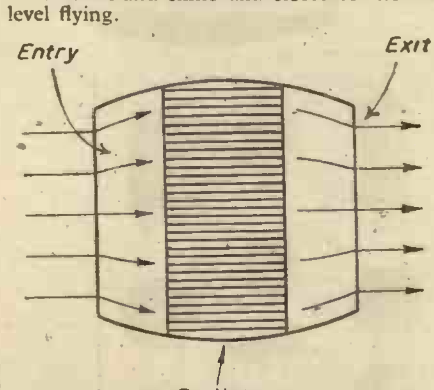


Fig. 5.—Ducted radiator.

The method described in the preceding paragraph enables a streamlined form, comparable with any liquid-cooled engine, to be obtained without the extra drag caused by fitting external radiators.

To improve the efficiency of the normal radiator system fitted to liquid-cooled systems, Duct Cooling has been evolved. As shown in Fig. 5, the radiator is situated in a duct which varies in width. The mouth is comparatively narrow, opening out to a maximum at the actual radiator and decreasing in width at the exit. The object of this shape is to slow down the velocity of the airflow passing through the radiator tubes so as to reduce the frictional losses and to absorb more heat. By narrowing the exit the air velocity is increased again and actually becomes greater than the velocity at the entry, due to the expansion of the heated air. From this last statement it will be seen that an increase of speed of the aircraft may be caused from the propulsive effect, and in actual practice this does occur.

A hinged flap positioned at the exit is fitted to this type of radiator to control the amount of cooling and is usually operated either manually or by means of a hydraulic jack.

The oil-cooling radiator is generally situated, in the case of liquid-cooled engines, adjacent to the coolant radiator and is constructed in a similar manner (see Aircraft Oil Systems—December PRACTICAL MECHANICS). In the case of air-cooled engines the oil radiator may be positioned in several alternate positions, e.g., either in the wing leading edge, as in the case of the Bristol Beaufighter, or mounted above or below the engine itself.

The question as to the choice of engine to be fitted to any aircraft, i.e., whether to use a liquid-cooled engine or one of the air-cooled types, is rather difficult. At the present time both are being equally used, and equally good results are being obtained. The U.S.A. appear to favour the air-cooled type for the majority of their aircraft, both fighters and bombers, e.g., the Grumman Martlet and Consolidated Liberator. English designers have used both liquid- and air-cooled engines for all types, but generally speaking bombers have had air-cooled engines, and fast single-seat fighters liquid-cooled engines.

Books Received

"On the Way to Electro-War." By Kurt Doberer. Published by John Gifford, Ltd. 204 pages. Price 2s. 6d. net.

THE basic idea of this interesting book is not to teach experts how to use electricity as a weapon of war, but to give the general public a real outlook on the possibilities which still exist in a vigorous exploitation of electricity in modern warfare.

"Engineering Inspection." By A. C. Parkinson. Published by Sir Isaac Pitman and Sons, Ltd. 164 pages. 155 illustrations, including index. Price 6s. net.

THIS is the second edition of a book reviewed in this journal some time ago. The chapters cover the Inspection Department; Limits and Tolerances; Metals; Mechanical Tests; Heat Treatment and Hardness Testing; Measurements; Micrometers and Verniers; Gauges; Measurement of Screw Threads and Gears; and Soldering, Brazing and Welding.

"Theory of Machines." By Louis Toft, M.Sc., and A. T. J. Kersey. Published by Sir Isaac Pitman and Sons, Ltd. 494 pages. Price 15s. net.

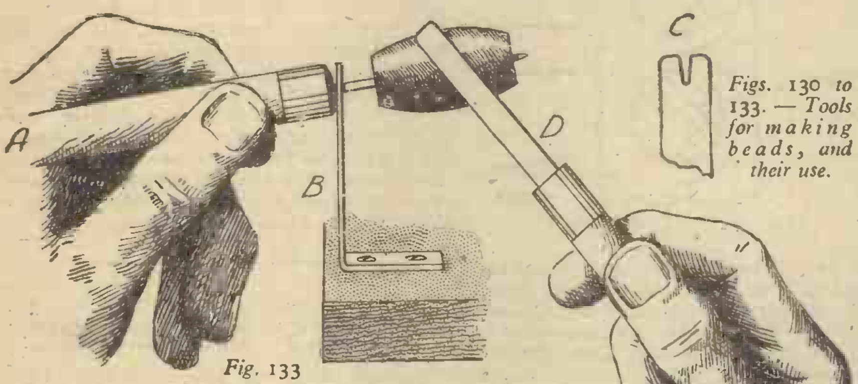
THIS book, which is a fifth edition, is written to cover the syllabuses of the universities in the subject of Theory of Machines. Many of the sections of the subject are treated in an original manner, and the connections between the various sections have been shown. Where several mechanisms act on a common principle this has been demonstrated. Much new matter has been added to this edition, including a treatment of free axial vibrations of a shaft carrying any number of masses, a subject which is of increasing importance in connection with crankshafts. Other new matter includes the general use of forced vibrations, the pendulum damper for reducing stresses due to harmonic disturbing torques, and an appendix extends the theory of worm gearing to include worm threads of trapezoidal section. The book can be commended to engineering students generally.

Toy Manufacture: Principles and Practice

Bead-making : A Xylophone : Diving Doll : And a Working Model Electric Locomotive

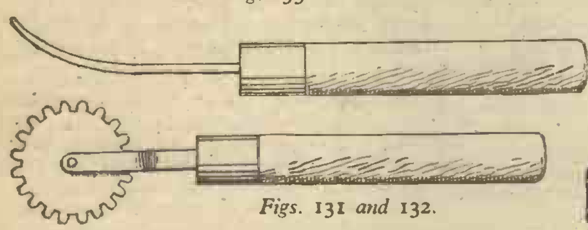
(*Concluded from page 378, August issue.*)

THE following information shows how beads may be fashioned from "plastic wood."



Figs. 130 *to* 133. — *Tools for making beads, and their use.*

Fig. 133



Figs. 131 *and* 132.

Fig. 130.

This preparation by itself is not easy to use as a modelling material, but in bead-making, if it be applied to a hard core, the difficulty to a large extent disappears.

Suitable cores may be made by breaking up the stems of clay pipes into suitable lengths. The stem should be nicked with a file, when it may be easily broken with the fingers. The ends, then, should be filed square. The tobacco pipe core saves the trouble of drilling a hole through the bead—it is already there (see Fig. 130).

The Packing Needle.—Few tools are needed for the work, and only such as may be made by the worker.

Fig. 131 shows a "packing needle" mounted in a wooden handle, useful for reeding, grooving and working into corners.

Fig. 132 is a clock-wheel similarly handled, that may be used for putting on milled edges, or for marking out "beading."

Fig. 133, which shows the operation of fashioning a bead, shows also the mandril on which the core is mounted (A); the rest (B), consisting of a brass strip bent at right angles and screwed to a wooden base, its top being shaped as shown at C; and the tool (D), which is a flat strip of clockspring handled in the same manner as the other tools.

How to Model the Beads.—The procedure of making a bead would be first to roughly model its shape upon the pipe-clay core with the fingers and then set aside to harden. This may have to be done in two or more stages if the bead is to be a large one, as recommended in the instructions upon the tube.

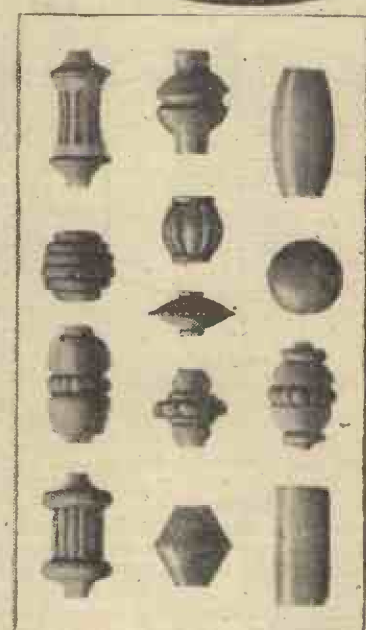


Fig. 134.—*Designs for beads.*

Plain Beads.—If a plain bead, as shown in Figs. 130 and 133, is to be made, the surface may be finished with the tool D, as shown in Fig. 133, applied whilst the mandril is rotated with the left hand. When set hard the bead may be smoothed with fine glasspaper.

Round and cylindrical beads may be fashioned in a similar manner.

In Fig. 134 are suggestions for beads, with surface decoration, that may be attempted after the making of plain beads has been mastered. The tool (Fig. 132) will be found useful in forming the re-entrant angles and reeds. Flutes and "beads" may be carved after the plastic wood has set hard.

Beads from Moulds.—Beads also may be applied by forming them in a small mould scooped out in the end of a piece of slate pencil. They will adhere without the use of an adhesive.

Having finished the beads "in the white," they may be coated with coloured enamels, or bronze powders, or gold leaf, on a basis of gold size. There is ample scope for tasteful work and originality in treatment.

Beads, as described, when made up into necklaces, may be mixed with smaller glass beads, and, in fact, have a better effect when separated in that way.

It is useful to remember that plastic wood adheres firmly to all surfaces, including metal and the fingers, so long as they are free from grease, and, therefore, that it is advisable to oil all tools. Fig. 134 illustrates some suggested bead designs.

A Xylophone

These instruments are made up in various ways as regards the arrangement of the notes. That illustrated is as good as any, and has the advantage that the notes are grouped on the same plan as those of the piano.

Fig. 135 shows the complete instrument in perspective, as seen from the front. It will be noted that the wooden slips are in two series, those corresponding to the black notes on the piano being on the upper level—see also Fig. 136.

The Case.—Before making the case it is well to determine the length of the slips. The instrument shown has a compass of two octaves, starting and ending with the note C. The slips may have the same section throughout, say 1¼in. by ½in. Cut the longest to give the note C when struck, its two ends being supported. This, of course, is a matter of trial. Now construct a diagram, as shown in Fig. 137, making C_2 half the length of C_1, and C_3 half the length of C_2. Join the ends of C_1, C_2 and C_3 with a smooth curve, which will then give the lengths for all the other notes.

It will be noted that 12 slips go to the octave. Those starred will be the slips for the upper series.

Marking Out the Notes.—Cut on this plan the notes will be approximately correct

Fig. 136.

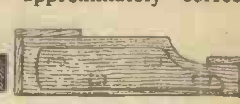


Fig. 138.

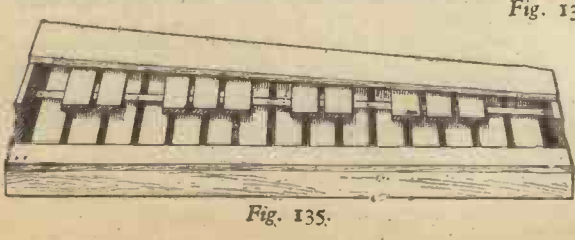


Fig. 135.

Figs. 135 *to* 138.—*Design for Xylophone.*

Fig. 137.

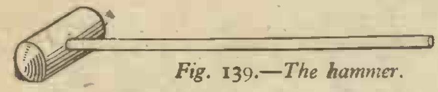


Fig. 139.—*The hammer.*

throughout the scale, but may need adjustment to exact tune, which means shortening to sharpen, and if too sharp, substituting a longer slip.

The case next may be taken in hand. Its construction is made clear by Figs. 135 and 136, the latter being a cross section. It may be made of ¼in. stuff throughout, glued and pinned.

Slots must be cut in the ends for the tapes on which the slips are to rest. The positions of these tapes are shown in Fig. 136. Fig. 138 is an end view, showing how the tapes are brought through the slots and glued down, after which a ½in. cover board may be glued over them as shown in this illustration.

The Tapes.—The tapes should be of linen, say ⅜in. wide, and they must be stretched quite taut.

Various methods are employed to fix the slips to the tapes. A simple and quite effective one is to drive a fine gramophone needle through each end of the slip, so that its blunt end is flush with the upper surface of the slip, and then it is a simple matter to space the slips by pressing the needles through the tape. Another method is to use an adhesive like seccotine or glue to hold the slips in place.

How the Xylophone is Played.—Fig. 139 shows the hammer with which the xylophone is played. Two of these will be required. The head is built up from three layers of sole leather, glued together. It is then pared to shape with a sharp knife and finished with glasspaper. A central hole is drilled, and the handle—a piece of ⅜in. dowel rod—glued into it.

Almost any kind of wood will serve for the notes, but a better tone is obtainable from rosewood. Good results, however, may be had with pitch pine and quite a passable tone from ordinary deal.

A Diving Doll

The uncanny, and apparently automatic, diving action of this doll (Fig. 140) makes it a most interesting toy. The doll should be a small celluloid one, about an inch or two inches high. They are obtainable at almost all toy-shops, and cost about twopence each. The dolls are hollow, and ordinarily float on their backs. To make your doll into a diver, however, it is necessary that the feet should be weighted so that it will float upright. The best way to do this is to screw a wood-screw into the sole of the feet (they are usually moulded in one). Choose a screw sufficiently heavy that the doll *just* floats in water, and the slightest extra weight would make it sink. By experimenting with different sized screws you will find one which makes the doll float in a state of equilibrium.

The best kind of " deep-sea " for this diver to work in is a wide-mouthed glass jar, which should be as tall as possible. A pickle jar is a good type to use. Fill it up with water, put the doll in, and tie a piece of thin rubber sheet (half an old balloon) tightly over the mouth. You will now find that a slight touch with your finger on the rubber cap will cause the diver to lower itself to the bottom, where it will stay until the pressure is removed. The explanation of the phenomenon is that the pressure created inside the jar acts on all sides of the doll, causing it to compress a little; the result is that the displacement of water by the compressed doll is less than what it was when it floated, and hence being comparatively heavier, the doll sinks. As soon as the pressure is released, the doll regains its original size and thus becoming lighter, rises.

Fig. 140.—*Diving doll.*

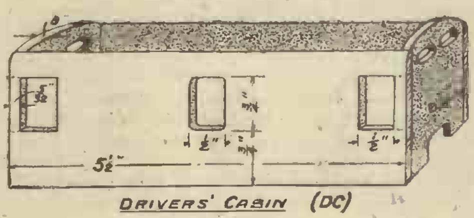


Fig. 141.

Such a slight movement of the hand is necessary to make the doll move that to the onlooker it appears to be acting of its own free will. Much amusement may be had by announcing that the doll will obey orders to dive or rise.

A Model Electric Locomotive

Thanks to radio, accumulators are common objects in many households. It is therefore a relatively easy matter to provide a 4- or 6-volt supply for running an electrically operated railway, and Figs. 141 to 148 show a design for an electric engine based on the L.N.E.R. experimental express locomotive brought out several years ago.

The Construction of the Model.—This involves very little metal work and the average amount of kit possessed by an amateur woodworker, plus the few tools essential to model railway builders, will be found sufficient for all the work its building necessitates.

The purchased components include a motor mechanism—two bogies (B) of the wagon or carriage type, four oval-headed buffers (BF), and two drawhooks (DH) and couplings.

The Motor Mechanism.—Mechanisms are obtainable separately to enable model builders to fit them into engines of their own design and construction, and the most suitable type is that having a permanent-magnet motor. The mechanism illustrated has four wheels about 1¼in. diameter coupled together, a geared motor, and a current collector complete. Everything is self-contained, and the motor will run quite satisfactorily without a body. The permanent magnet field simplifies the reversing. All that is necessary to cause the locomotive to traverse in the opposite direction is to change over the polarity of the supply current. Remote control to its fullest extent is therefore possible.

The Bogies.—Bogies (B) for the leading and trailing ends of the model are obtainable all ready for screwing to the under frames of the locomotive. In some cases, a supporting plate, which is fixed to the body of the vehicle, is supplied.

The Suspension of the Mechanism.—Before passing on to a description of the building of the body of the model, the sizes of the bogies and motor mechanism, which may actually be purchased, may be different to those illustrated. They should be laid over the

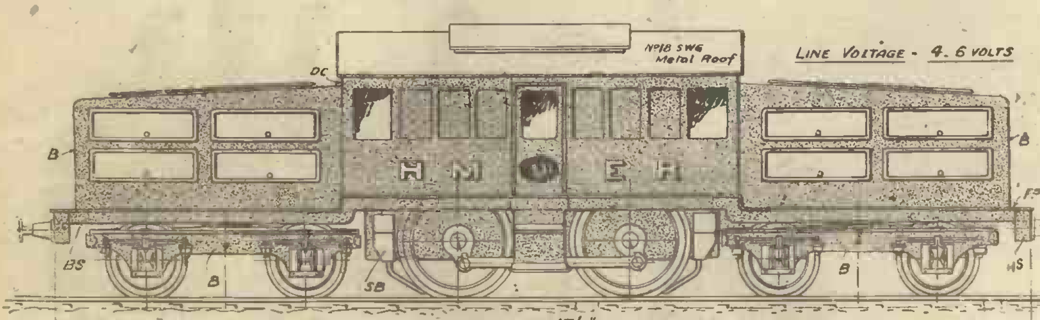


Fig. 142.

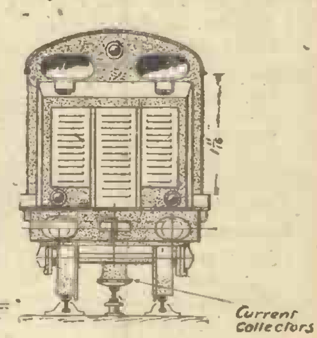


Fig. 145.

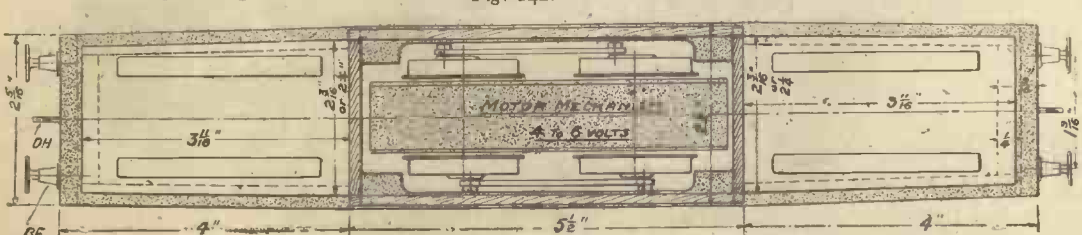


Fig. 143.

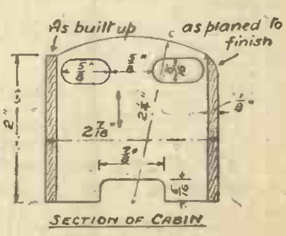
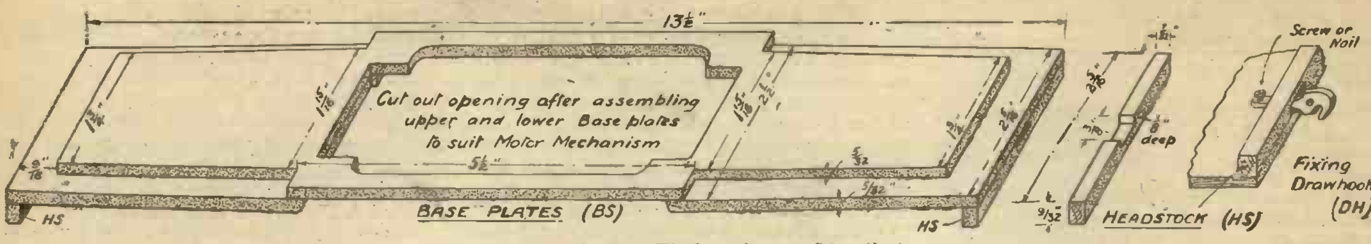


Fig. 146.

Figs. 141 *to* 146.—*Design for model electric locomotive.*



Figs. 147 and 148.—The baseplates and headlock.

drawing for comparison, and alterations in the length of the model may be easily made. The system of the suspension—articulation is perhaps a better word—is quite new. The bogies are arranged on plain central pivot screws, and the motor mechanism is slung on two swivel-links so that it is free to move sideways.

The Underframing.—The underframes (BS) of the model are made out of two layers of hardwood 5/32in. finished thickness. Plywood is to be preferred for the upper layer because of the relatively large hole necessary to clear the motor mechanism. The layers should be glued together, and be further secured by small ⅜in. or ½in. wood-screws. When this part of the work is done, two strips of 7/32in. by 9/32in. hardwood (finished sizes) should be planed up and notched in the centre to form slots for the drawhooks. These strips may be glued and panel-pinned on at the ends to form the buffer planks or hardstocks (HS). They may then be cleaned off flush and marked out for the screw-in buffers.

Driver's Cabin.—The central superstructure—the driver's cabin (DC) of the actual engine—is a plain box with rounded ends for the roof. The sides (⅛in. plywood) and the ends (3/16in. hardwood) are pierced for windows, and if plywood is not used for the sides, the end-windows may be cut right through, open to the ends, and a strip of wood ⅛in. thick and 5/32in. wide afterwards fitted in to fill the gap. The sides should be made quite square (2in. high), and when fitted up, the top edges may be planed off to the curved outline of the roof.

The ends have "look-out" windows. These may be formed by drilling adjacent 5/16in. holes and fretting or chiselling out the wood in between them to produce the shape of window shown in the drawings. The notch or gap on the bottom edge is provided to clear the swivel-links of the mechanism, and may be made to any suitable dimensions. When built up, the cabin should be glued and pinned down to the underframes. The metal parts may then be attached, and the model subjected to its preliminary trials on the track.

The Bonnets.—Attention should next be paid to the making up of the end bonnets (B). These are tapered both in elevation and in plan, and fit round the upper layer of the underframe floor. When finished, they form boxes with three-ply sides glued and pinned to ½in. tops and ends.

The Roof.—The cabin roof may be made out of any sheet metal—brass, zinc, or aluminium. Tinplate may be employed, but must be thinner than specified on the drawing.

(To be continued.)

The Jeep

Its Specification and Performance

MOST people in Britain are now familiar with that small, powerful vehicle used for general purposes by the U.S. Army, called the Jeep. It has proved to be one of the high lights of the Allied ordnance programme, and an idea of the respect with which it is regarded by the Axis may be gathered from the large reward offered by the Italian High Command to their soldiers during the North Africa campaign for capturing or destroying one. The reward equalled that for destroying an aeroplane and was twice that for a tank.

The specification of the Jeep is as follows:

Engine:
- 4 cyls., 60 h.p. at 4,000 r.p.m.
- Bore, 3⅛in. Stroke, 4⅜in.
- Compression ratio, 6.48 to 1.
- Torque (max.), 105 ft. lb. at 2,000 r.p.m.
- Fuel tank, 15 gallons.

Chassis:
- Wheelbase, 80in.
- Width (overall), 62in.
- Length (overall), 132in.
- Semi-elliptic springs.
- Brakes, 4 wheel hydraulic.
- Road clearance, 8 7/16 in.

Transmission:
- Syncromesh gearbox, 3 speeds and reverse.
- Tubular type propeller shafts.
- Main drive, hypoid gear.
- Dry plate clutch.

General:
- Maximum load, 800 lb.
- Trailer load, 1,000 lb.
- Road weight, 2,315 lb.
- Gross weight, 3,125 lb.

It might be added that, while the maximum load is given as 800 lb., in Russia it is being used for twice the specified load and a gun hitched on in addition. Furthermore, the trailer load is revealed as 1,000 lb., but the field tests show that the Jeep can pull 1,300 lb.

So successful has this vehicle proved in military circles that the U.S. Department of Agriculture has initiated tests to find out if it can be used on the land, for pulling ploughs and for general haulage. The four-wheel drive and plenty of power under the bonnet mean that it is almost unknown for a Jeep to stick in mud or on rough country. Speed it has in plenty—as we have seen on British roads.

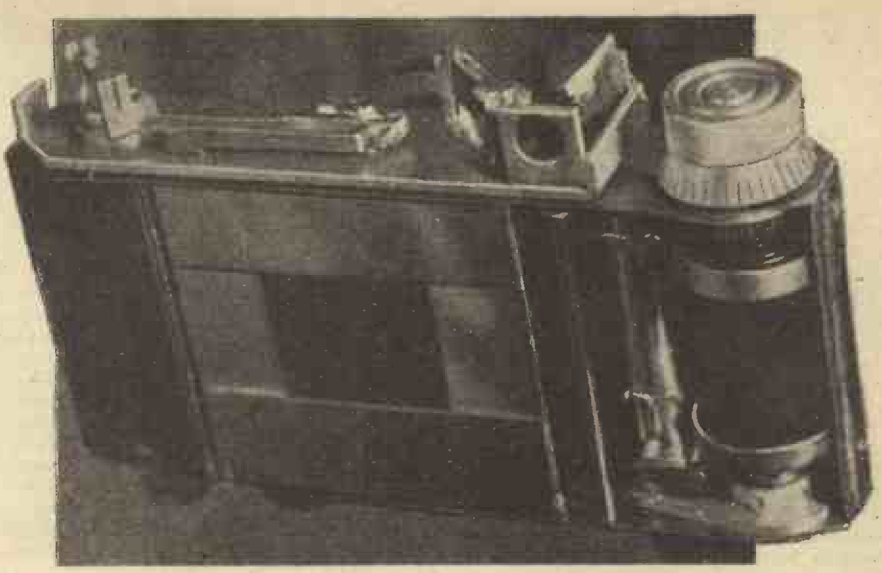
Originally designed by Willys Overland, the Jeep is now being turned out in large quantities in the States, by such manufacturers as Ford. It was originally intended as a general purpose vehicle for the Army, but it has exhibited such excellent all-round qualities that it is being put to most important uses. For the rapid movement of men with their equipment in difficult country it is obviously well adapted. It is interesting also to speculate whether the Jeep or its counterpart is to become a part of British national life after the war, for agriculture and building. There seems to be no limit to its uses with a modified body.

As a contrast reference might be made to a giant vehicle designed by the Le Tourneau Co., of Georgia, called the Tournapull. Powered by two 200 b.h.p. Cummin's diesel engines, the top of the cooling radiator stands about 8ft. from the ground. The pneumatic tyres are about 7ft. diameter, and the fuel tank holds 155 gallons. This giant of the road was designed for towing a 60 cubic yard scraper or excavator.

A "Jeep" during recent exercises for training U.S. troops in this country.

Making a Miniature Camera

(*Concluded from page 385, August issue*)



Three-quarter view, showing general assembly from the rear.

The Lens Mount

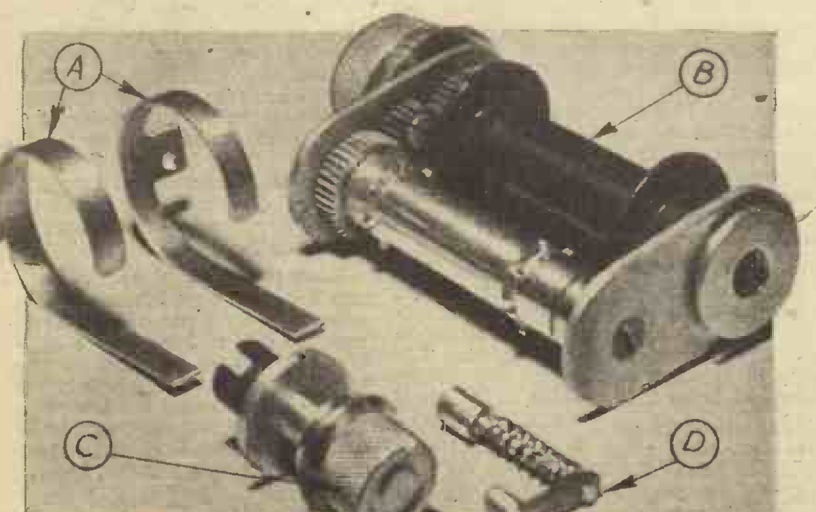
THE lens mount is made from the metal from a motor-cycle piston. It was an aluminium alloy of unknown composition, and is dealt with as follows. The piston is broken up into small pieces, remelted and cast as a simple tube about 3½in. long. The mould was extremely simple. A 4in. length of 1¼in. round mild steel was taper-turned so that it was 1¼in. one end and 1⅛in. at the other. This made the core. A 3¾in. length of cast iron drain pipe was bored out to an inside diameter of 2½in. for the outside. Both were faced off at one end, and for the casting they were placed concentrically on a piece of asbestos. Their weight was sufficient to hold them in position whilst pouring the metal. To prevent "cold shuts" thoroughly warm the core before pouring. Though this method is simple, a good casting, free from blow holes, etc., was obtained, and the quantity of metal in the piston was sufficient for a casting well over-size. Cut off 2½in. from the casting, this allows for 1in. in the chuck, and turn to size. The best finish was obtained with a tool having a fair amount of top rake, plus the application of a coolant. Face the end of the tube and bore out to fit the flanged mounting ring of the lens. Turn down to the outside diameter, turn the waist and the recess for the mounting flange. The distance between the front face of the lens mounting ring, not the front face of the lens mounting tube, and the film plane of the shutter must be the focal length of the lens, in this case 5cm., which gives a distance in this case of 23mm. between the front face of the lens tube and the underside of the bottom flange. A later paragraph deals with how to check and, if necessary, correct the focus, but accuracy in this dimension must be aimed at. Drill and tap the holes for the fixing screws for mounting the lens ring on the tube and the tube on the case. These were all tapped on the lathe—the tap being in the chuck and the work held against a face plate in the tail stock. This ensures that the taps go in true. Actually, all the tapping in the job was done in this manner for the same reason.

The Film Take-up and Exposure Counter

This is a unit complete in itself, and can be assembled out of the case. When assembling in the case the winder knob, exposure indicator and knob spindle are removed and replaced when the remainder of the unit is in position. The only fixing for the unit when in the case is the nut on the tripod bush, and this has prov:d to be sufficient. To save weight, aluminium is used throughout, with the exception of the idler wheel for which ebonite is suitable, and ensures the necessary silent running of the gears.

The two spindles are mounted between the top and bottom plates, 1/16in. thick, the top one of which also carries the idler wheel. These two plates are screwed with 4 B.A. brass screws to a ¼in. D rod, which is the spindle for the sprocket. There is no tendency for the plates to twist on the rod when the film is running across the sprockets. The spindle for the take-up spool runs between the pivot on the inside end of the tripod bush and the hole in the top plate, and a corresponding hole in the case. Both of these spindles have a total clearance of 1/32in. between the two plates to ensure easy running and to allow for any adjustment necessary for the straight running of the film across the sprocket.

The take-up spool was taken from an Ilford Cassette, but one can easily be made by soldering two discs on to the end of a piece of brass tubing having the necessary dimensions, and then cleaning out the holes at the end to fit the spindle and bush. It will be noticed that there are no springs or clips for fixing the end of the film to the spool. These were considered unnecessary, since it can be quite easily fixed with a short length of the thin adhesive tape that is put round the can in which the film is supplied. The spool is held in position on the spindle by the spool bush at the bottom. Make the bush first and then turn down to spindle until the bush will just push on.



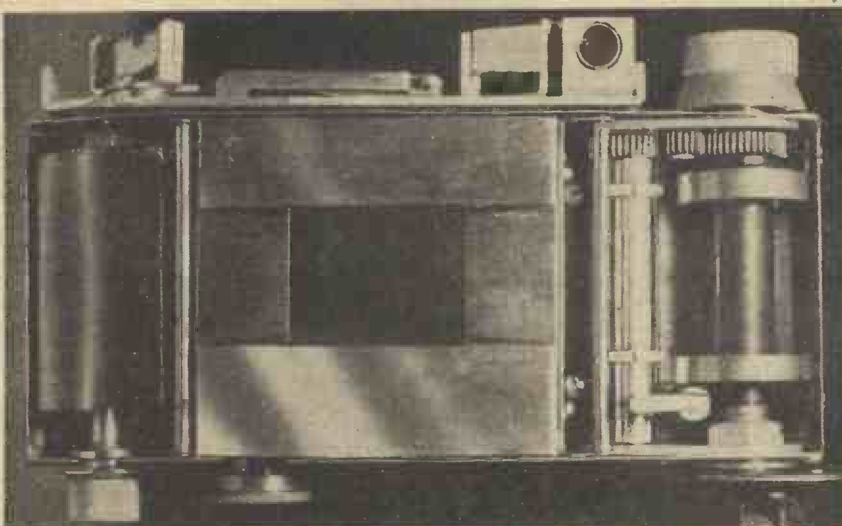
Components of the film take-up and exposure counter :
A. Film guides. B. Film take-up.
C. Rewind knob. D. Film stop release.

Cutting the Gears

The cutting of the gears and the sprockets presents no difficulty if the lathe is used as a shaper, and by using wheels with a suitable number of teeth on the chuck spindle for obtaining the necessary number of divisions. Fit a tumbler to engage with the teeth of these wheels, so that the chuck can be held securely in position. A 40-tooth wheel is used for the take-up spindle and the idler, having 40 and 20 teeth respectively. The 39 teeth gear was not so simple. For dividing that a brass plate ⅛in. thick was turned to 4in. D. and bored out to fit the chuck spindle, also having a key-way cut in it for locating on the spindle. The circumference was divided into three parts, and then each of these three parts was divided into 13 parts by trial and error. The diameter of 4in. is large enough for any error in the divisions to be neutralised on the gear being cut, which has a diameter of .585in.—a considerable reduction. Before cutting the teeth turn down the rod to the necessary diameters, but leave about 1/16in. on each side of the piece for the teeth. Fnish to the final width when the teeth have been cut. Make the cutter from a piece of ⅜in. diameter or square tool stool by grinding the cutting shape to an angle of 60 deg. Make sure that this is mounted in the tool post so that it is at centre height, and that the 60 deg. is equally balanced about the centre line. It may be necessary before grinding to bend the tool so that it clears the tail stock when in use. For cutting the aluminium and the ebonite only a small front rake is required. When cutting, do not cut each tooth separately, but take out one cut from every tooth, continuing until the crowns of the teeth just meet. There are seven teeth on the sprocket, this distance covering one exposure, and for this a 35-tooth wheel was used on the chuck spindle. This time leave two ribs standing when turning the main barrel down to 13/32in., again plus 1/16in. on each side; use three teeth for the gap, and leave two teeth for the width of the sprocket. These need only be shaped down to 1/64in. of the main barrel. This not only leaves a good finish, but means that only the perforated edges of the film touch the sprocket, leaving the picture area standing away. The exposure indicator can be divided into 40 divisions in the same manner, but this time use a knife edge cutter to get a thin line. The numbers are stamped on afterwards.

The idler wheel is mounted under the top plate on the centre indicated on the drawing. To ensure that it meshes smoothly with the two other gear wheels it pivots on a short tube which is held in position by a 10 B.A. screw having a head large enough to overhang the tube and hold the wheel in position. The hole in the tube is 1/32in. larger than the diameter of the screw. When the wheels are placed in position this screw is left loose, the idler is pushed into the other wheels until the teeth mesh smoothly and then the screw is tightened. This device is to overcome the difficulty of centring these wheels accurately.

The film stop is a straightforward turning job. The pin is aluminium and the panel brass. When soldering into the case the slot across the end in which the link fits must be horizontal so that the pin on the link engages freely with the hole in the sprocket.



Internal view.

Mounting the Cassette

The cassette is mounted between a pivot on the underside of the top, and the rewind knob. Turn the pivot to the necessary size, solder into the 1/16in. hole in the top of the case and clean down flush on the outside. The rewind knob spindle fits into a slot in the bottom of the case front and is held in position by the back. This is necessary because the cassette cannot be centred and mounted otherwise. The grubscrew in the knob (Fig. 3) is necessary because the thread on the spindle unscrews in the same direction as is required for rewinding the film into the cassette.

The film guides round the take-up spool and leading from the shutter roller are made of a strip of 26 S.W.G. brass 3/16in. wide. The purpose of these is to prevent the "spring" in the film from causing the perforations to relock with the sprockets and so jam the winding mechanism. The position of these, as shown in Fig. 1, is such that only the perforated edges of the film touch the guides. There is, therefore, no chance of scratches arising on the exposed negative because of these guides. Make sure that they are long enough to go well down between the two spindles. They are held in position by an 8 B.A. screw through the end of the case. When fitting these screws, screw the guides to a spare piece of metal that has the same thickness as the case end plus the lining and clean the ends of the screws down flush with the inside face of the guide. Then fit into the camera case when the winding unit is in place. This can be done by slightly opening the circular curve and then slipping the end of the guide in between the spool and the case. It won't go in without slightly distorting the shape, because there isn't sufficient clearance, but it can easily be pushed into shape when in position. Do not let the guides rub on the spool flange; this may prevent the spool from turning and so not take up the film—it's only a friction drive.

The Range Finder Case and Base Plate

An aluminium plate, 15/16in. x 1/16in., with the ends turned up at right angles, is screwed to the top of the front half of the case with two 8 B.A. screws and the collar 24 (Fig. 4) in which the pivot for lever 3 rotates. The back of the case shuts under this. The case is made to fit this plate and is ⅝in. deep. It is made of 22 S.W.G. brass, using the "block" method as for the main case. Make the top and the square end of one piece, and round this solder a strip long enough to go right round. The case is fixed to the ends of the base plate with 8 B.A. screws.

The "Foth" view finder was fitted in a cradle made from a strip of ½in. x 1/16in. aluminium folded so that the outside length is 15/16in. The eye-piece fits into a circular hole and the front into an open square. The inside of the case touches the top of the finder and holds it in position.

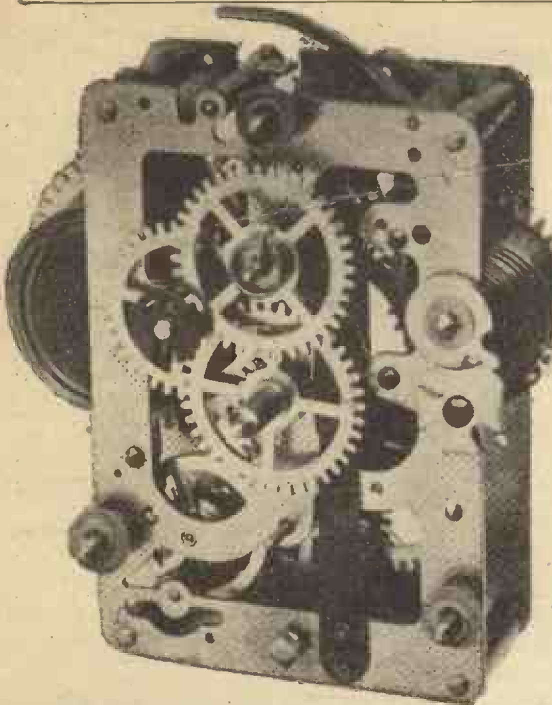
When the base plate is screwed to the main case, mark a line to correspond with the centre line of the lens on both the base plate and the range finder case. This is necessary because the setting out for the fixed and moving mirrors is done from this line. Mark the centre for the pivot of lever 3 and drill through both the base plate and the case with a 3/16in. drill. Make up the mirror holders from 1/16in. aluminium. The mirrors are mounted in grooves cut in the following fashion. Make a piercing saw cut down the centre line of each upright before it is bent, and clean out the corners with a wood chisel to leave a right-angled groove half the thickness of the metal deep. The aluminium will cut quite easily and leave a clean groove. Then bend the end at right angles. The ends of the mirrors are ground on a fine wheel to fit the grooves, and set with "Durofix." It will be noticed that each mirror is centred so that the front surface, which is the reflecting surface, is over the centre. By using unbacked mirrors, i.e., reflecting from the silver on the outside from the glass, the refraction, present when the reflection is through the glass, is eliminated. This in itself is not very important, but it is necessary to remember that the reflecting surface must be over the centre if the base line of the range finder is accurate in length.

When the base plate is set out, project the centre lines of the two mirrors and the view finder on to the main case, place the range finder case in position, and from these lines mark the centre lines for the windows. The window for the moving mirror should be the maximum size that is covered by the mirror. That for the direct line of sight under the fixed mirror will only be about 3/32in. wide on the centre line. This window is narrower because the angle of vision is considerably wider through the shorter line of direct sight than through the longer line of reflected sight. It is best to cut this window 3/32in. wide and then widen if necessary so that the field covered by both lines of sight correspond.

Range Finder Peep Hole

For the range finder peep hole drill a 5/32in. D hole on the vertical centre line of the fixed mirror, and with the horizontal centre line level with the bottom edge of the mirror. Drill the peep hole for the view finder as large as possible in the centre line of the finder. The size and shape of the front window of the view finder must be proportional to the area covered by the film opening in the shutter. The original picture size of the negative of the "Foth" was 4cm. x 3cm., but standard ciné film only gives a picture 2.8cm. x 3cm. unless the shutter blind and width of opening is altered. The width of the view finder opening is the same as the original window, but the height of the opening is reduced an equal amount top and bottom until it has a proportion equal to the negative size. When mounting the view finder, errors of parallax must be guarded against. They are most likely to arise when the vertical opening of the window is being masked by the case, so carefully check the fields of the finder and lens by placing a piece of ground glass, ground side towards the lens in the film position. Cement a piece of microscope slide behind all openings in the range finder case to exclude dust, etc.

Make the levers of aluminium and make sure that they pivot freely. File the bearing edges of levers 1 and 2 to knife edges. Also trnu the lead of lever 3 to a 45 deg. knife edge. This is necessary to prevent the levers changing their length when turned. On the end of lever 1 is a roller ¼in. D x ⅛in. This is held against the lens tube by a right-angled flat spring fixed under the top fixing screw of the lens mount. Lever 4 is held against the head of lever 3 also by a flat spring. Since the action of both these springs is in the same direction, the spring on the roller lever must be the stronger or the lever will not move forward when the lens is rotated for focusing.



Repairing Alarm Clocks—4

Alarm Actuating Systems

By G. F. LEECHMAN

(*Continued from page 370, August issue.*)

THE pivot-holes in the plates are cleaned out with the peg-wood, sharpened to a fine point after excess dirt has been wiped off. The peg-wood should be applied to these holes very thoroughly, and it is also used for cleaning the leaves of the pinions when the bar-type or lantern pinions are not used. The pivot-holes should be perfectly smooth inside and truly round; if they are badly worn it may be possible to close them sufficiently by using a hammer and punch round the worn side so as to make the holes too small, when they can be reamered or broached out to the correct size. When the pivot-holes are too bad for this method to be applied the only alternative is to cut away part of the plate and soft solder a new piece in—everything having been taken off the plate first, of course, except perhaps the four pillars. The new piece is then drilled to take the pivot properly, the exact position being checked by means of guiding lines lightly marked on suitable parts of the plate, these having been carefully graved in before the old hole is cut out. (*We disagree: Has not our contributor overlooked bouchons? ED.*)

The clock being now completely dismantled and partially cleaned, the work of reassembling may be put in hand, particular attention being paid to the various alarm-controlling devices, which will be considered next.

In the ordinary type of alarm clock little variation is to be found in the systems upon which the alarm depends. A separate spring, usually smaller than the main spring, drives a coarse 'scape wheel, either direct or through one intermediate wheel and pinion, and the 'scape actuates a hammer by pressing alternately on two pallets which are placed at the base of the hammer rod or stem, thus driving the hammer to and fro in a similar manner to that in which a pendulum is kept moving. The hammer is arranged to knock against a suitably placed bell or gong or sometimes merely against the case of the clock. This constitutes the almost invariable system, but very occasionally, chiefly in bijou or boudoir alarms, where a small, compact design is desired, the second spring is dispensed with and the main wheel used to drive both the train and also operate the alarm. This is accomplished by hooking the outer end of the spring to the wall of the barrel which contains it and hooking the inner end to the arbor which carries a large wheel similar to the cover of the barrel. The wheel drives the alarm 'scape wheel, but it cannot turn until the appropriate time, when it is released, and the inner end of the main spring is permitted to drive it round a few times, and the alarm sounds; soon, however, it is brought up by a special stopping arrangement, so that the arbor is again held motionless while the outer end of the spring continues to drive the barrel and train. On winding, the first turn or two winds up the alarm end, returning the Geneva stop to its original position, when the rest of the turns are devoted to the normal winding of the clock.

Method of Release

The actual method of releasing the alarm at the required time is always the same—one of the wheels of the train or motion work (usually the latter) turns another wheel (the alarm wheel) once in twelve hours, and through the centre of this wheel runs a spindle (from the back of the clock, where it carries the set alarm stud in most models), which passes through the face where it carries the alarm hand. This spindle is pierced above the alarm wheel by a stout pin driven very firmly in and bearing upon the "wall" on the alarm wheel which has been mentioned some way back. The alarm wheel runs fairly loosely on the staff and is held up against the pin by means of a long, straight steel or brass spring under it. As the alarm wheel is slowly turned, the pin approaches and finally falls into the recess which is cut in the wall, thus allowing the wheel to rise perhaps $^1/_{16}$in. or $^3/_{32}$in., the spring, of course, follows it, and in so doing moves out of the way of a small trigger, which up to then was pressing lightly against it in an endeavour to move back and forth with the hammer, which is now freed. In some better models the alarm hand is placed with the other hands in the centre of the dial and the set alarm stud is placed to one side at the back of the clock, on the other end of a spindle which turns the alarm wheel by means of a small gear wheel engaging with the teeth on the circumference of a much larger wheel immediately behind the face. This wheel then lies above the alarm wheel and has a recess in it, into which a protuberance on the alarm wheel will fall at the required time, when the alarm wheel will rise, as before, lifted by the long spring which releases the alarm trigger when it moves, its end being bent over to engage the trigger securely.

This covers the release of the alarm—in general the more immediate desire is to stop it quickly and effectively. This may be accomplished by hitting it with a hair brush or other missile, but the makers usually provide an alternative which consists of a device to interfere with the free movement of the hammer or its staff. Generally this latter has a second trigger projecting from it which may be engaged by pressing a stud; sometimes the stud is concealed in the handle, so that turning the handle down depresses the catch, or it may press down on a small plate the turned-over end of which catches in the alarm 'scape wheel teeth. A slight turn of the alarm winding key causes this to disengage again when it is lifted and kept up by a light spring. In the older models (and in a few newer ones) the noise is simply stopped by causing the lever to catch in the stem of the hammer, whether it projects through the case to ring a bell at the top or is inside and strikes on a "back bell" or gong arranged in the case. In all cases it must be remembered that a very slight interference with the movement of the hammer or triggers will make the alarm stop or be unreliable; in order for it to function, the pallets must clear the tips of the teeth of the alarm 'scape wheel, but also, they must just clear it and no more, if a brisk action is to be obtained so that the one pallet is engaged immediately after the release of the other; therefore any slight impediment may cause a stoppage by preventing the escape from taking place, and on this account it is necessary to avoid even the slightest bending of any trigger or the hammer stem (particularly when removing the movement from the case), as, though apparently roughly finished, they are actually very precisely set and may be troublesome to readjust if they have been distorted. Sometimes the hammer will operate while the movement is out of the case, but not on replacing it and testing the alarm. This will generally be due to one of three causes: either the hammer at one end of its stroke may press too heavily on the case or bell and must be bent back from it a very little; or else the case causes the position of the hammer rod to alter slightly so that it comes into contact with some part of the movement from which it springs clear when taken out again; or else, finally, there is some projection in the back of the case such as a stud or screw or the nut on a bolt which comes in the way when the clock is assembled; these troubles must be dealt with according to the circumstances.

Intermittent Alarms

Some alarms are fitted with another device which causes the warning to sound intermittently—that is, it repeats itself after an interval of silence every few minutes. This is accomplished by arranging a long arm to press very lightly against a small ratchet wheel on the staff of the third wheel in the train, this wheel usually turns once in eight minutes, and if there are eight teeth on the ratchet the long arm will be moved to one side every minute, and as it moves over it will release the hammer, but it soon returns, impelled by a light spring, and re-engages the trigger so that the alarm will be stopped until the next ratchet tooth moves the arm over again; a minute or so later an additional arm holds this trigger out of action, when the usual steady alarm effect is required. We thus see that there may be as many as five or six triggers controlling the alarm—one to set it off at the required time, another to stop it as necessary, one to produce the intermittent effect, another to cancel out that; possibly a fifth to silence the warning entirely on days when it is not needed, and finally one, not yet mentioned, designed to prevent the alarm spring from unwinding too far. This last is easily accomplished by arranging for the outermost coil of the spring to press on the wire trigger when the spring has run down as much as the clock-maker considers advisable; alternatively the same danger (i.e., that the expanded spring may interfere with one of the wheels of the train, thus causing the clock to stop) may be avoided by arranging a stud to prevent the spring from expanding in a certain direction, as was explained in the same connection when dealing with the main spring. It must, however, be noted that in one particular make a totally different device is employed, consisting of a roughly triangular piece of steel which will be found hanging comparatively loosely at the top of the pillar nearest to the alarm spring; at first it may appear to the inexperienced that the clock has been incorrectly assembled, but this is practically never the case, no matter what part may be suspected, and it will be found that with regard to this particular safety device that when the spring has almost run down it will engage the metal stop quite effectively, causing all the apparent looseness to disappear.

Reassembling

To commence the work of reassembling, take the lower plate, that is the one that has the centre wheel pinion or staff still in it, or if that has been removed, the one which carries the motion work, hands and face, and, holding it in the left hand, place the great wheel (which carries the mainspring) in position with the end of its arbor in the appropriate hole, which has previously been lubricated with a very small quantity of clock oil, applied with the end of a clean piece of wire or something similar. If the main spring is not on the arbor, it should be next loosely placed in position, the inside end having been carefully bent so that it will readily and firmly engage with the hook on the arbor. Care should be taken that the spring is not put on upside down—the correct way can easily be ascertained from a scrutiny of the direction in which the hook will pull when driving or on winding up, since the ratchet will only allow the arbor to turn in one direction. Great difficulty may be experienced in persuading the main spring to take up its proper position—the best way is not to try to force the outermost coils into place, but to leave them loose or even to open them out still larger and concentrate upon the inner coils; without too much distortion allow the rest to arrange itself more or less as it wishes, that is either around the pillars and centre staff or else drawn out well clear of the rest of the clock. If the end has a riveted loop, it will be necessary to place this over the correct pillar, usually the one farthest from the escapement, but if the end has only to be hooked on it may be left until later, otherwise the spare part of the spring, being drawn out into a long loop, must be handled with care, not only to avoid kinking the spring, but also because it is liable to suddenly curl over and snap down on the fingers with the suddenness and effect of a good rat trap! A little later, when the top plate and some of the train wheels have been assembled, the main spring may be comfortably worked into place simply by winding it up in the normal manner; to force it into place previously not only requires some experience, but may also cause damage to the centre pinion.

The alarm spring is dealt with in exactly the same way after the alarm wheel is placed in position, and the top plate is now taken in hand; it must be placed, usually, first over the centre staff so that this goes through the correct hole, then the two arbors of the springs and the alarm setting spindle are guided through their respective holes, the two arbors and centre spindle should be given a little oil, but the alarm setting spindle should never have any. Working the top plate down, the four pillars should go readily into place, but if they do not, the cause of the obstruction must definitely be found. There are only four items which can be causing the trouble, either one of the two arbors (frequently the plate catches on the shoulder immediately below the threaded portion—which takes the key—usually when the spring tends to pull it sideways), or else one of the two pinions, so that there should not be much difficulty in locating it. Here it must be mentioned that it is sometimes required to place a spring and washer or other fitting on the set alarm spindle *between the plates*, so this must be done before proceeding to secure the plates by means of the four nuts. Of these, those which are nearer the escapement are screwed up, but not tightly, while the other two are left extremely loose. Next comes the alarm 'scape wheel, and in order to get this in it will very likely be necessary to push the alarm spring to one side, so that it must be left loose. The alarm 'scape wheel pinion must, of course, engage with the teeth of the alarm wheel, and the 'scape wheel cannot be put in upside down since the teeth must lie where they will not come in contact with the alarm spring and where they will engage the pallets of the alarm hammer. This should be put in next, great care being taken not to bend any of the alarm-operating triggers as already explained. Some little ingenuity may be required to get this into position, but, with patience, it will finally be found to slip into a position in which it is obviously correct. The alarm spring may now be wound up and guided finally into place inside the retaining stud if one is fitted, when the alarm hammer should operate effectively. Should the alarm silencing device consist of a small plate pressed down by some form of push-button, the plate should be put in next, and any other fittings which belong at this end of the movement ought to be assembled correctly before turning attention to the other end. The general principle is to work in a way reminiscent of an oyster complete with both upper and lower shells, which correspond to the upper and lower plates of the clock; at one end the oyster has a hinge, which is represented by the two nuts, which are screwed down more tightly—the other end may be taken as the opened side of the oyster, which is the proper place to work, putting in those pieces which go farthest in first. When the alarm end of the movement is assembled all four pillar nuts are temporarily tightened and the operations tested as far as possible. This being satisfactory, the four nuts are loosened again, but those which are at the end which has been completed are left only a little loose, while those at the escapement end are slacked right back, so that we now have what corresponds to the open mouth of the oyster at the opposite end to where it was.

Assembling Train

The third and fourth wheels of the train are now assembled after a little oil has been put on the centre wheel pinion—which is already in place—and in the pivot holes of the third and fourth wheels (at both ends of each), as well as a drop round the centre wheel staff near each plate, so that it will work its way into the holes here as well. The centre wheel is designed to run only friction tight on its staff, whereas the other wheels are made dead tight; the reason for this is to enable the hands to be turned to any required time by means of the set-hand stud, which is, of course, mounted on the centre-wheel staff, where it projects through the back of the clock, the minute hand being fixed on the other end. Obviously, if the centre staff were tight in the centre wheel, it could not be turned without driving the whole train, even if the escapement were out, and then only by forcing the great wheel and main spring round as well; this should explain that it is necessary to get the oil only where it is needed and not where the friction-tight surfaces should be in contact, since we require to have plenty of friction there (as we do also on the set alarm staff or spindle, which we have already said should have no oil), otherwise we may have trouble should any very slight friction occur in the motion work, for instance, since the hands might not turn regularly owing to the centre wheel and pinion turning on the staff instead of carrying it, by means of the friction, round with them. The third wheel may have at one end the small spur or ratchet wheel to work the intermittent effect if this is provided in the model, otherwise the third wheel can be identified by the position of its pinion, which must, of course, engage with the teeth of the centre wheel. Put the pivot farthest from the pinion into its hole, keeping the plates sufficiently far apart so that nothing is bent or strained, holding the staff firmly in the small pliers or strong tweezers, and gently guide the other pivot into place, closing the plates a little after it is in to prevent it from coming out again. Deal with the fourth wheel in the same way, and also the 'scape wheel, always putting the pinion end in last. Sometimes the 'scape wheel pinion is just half-way along its staff, and one cannot say whether to put the wheel itself up or down; in this case study the balance wheel—it can easily be seen which way up this goes from a consideration of where the end of the hair spring has to pin in on the plate, and this will show which way up the lever must go, and hence the position of the 'scape wheel is determined. When the 'scape wheel is in all four pillar nuts are again screwed down moderately firmly and the train is tested by putting the stopper bar in place through the fourth wheel, so that it will not come into contact with any teeth—particularly those on the 'scape wheel—and winding up the main spring a little. The wheels should run quite freely when the bar is removed, and if immediately they stop the 'scape wheel travels for a turn or two in the reverse direction, the train may be considered perfect. On the other hand, if any irregularities are apparent, either to the eye or to the ear, the cause should be ascertained and dealt with according to the circumstances, as already explained. Place a little oil on the pinions, when all is as well as possible, and run the train again to let the oil be carried round. Do not put too much oil—a slippery surface at the bearing points is all that is required, and too much oil only gathers dust and grit in time. The great wheel arbor carries the greatest pressure (excepting that on the ratchet) and requires a considerable amount of oil, so does the centre wheel), the third requires less and the fourth less still, as the load is so much reduced. The 'scape wheel teeth theoretically require no oil; they would run perfectly dry with no appreciable friction if conditions were ideal, but in practice this is not so—consider a pane of glass in an empty house, whether this be in town or country, in the course of a few weeks the windows will become very dirty, covered with a film of sticky, smoky dust. Actually a similar accumulation tends to form inside our watches and clocks.

(*To be continued*).

Engineer-built Houses of the Future—8

(Continued from page 375, August issue.)

External Walls : The Banks and House Financing

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

EXTERNAL WALLS of engineer-built houses may be designed to accord with several main principles, all of which should satisfy the following essentials (1) to (14); (1) to (12) were explained in detail in the July issue, and (13) and (14) will be described in this issue: (1) stability; (2) durability; (3) transportability; (4) resistance to moisture penetration; (5) thermal insulation; (6) avoidance of vermin infestation; (7) economic initial cost; (8) economic maintenance costs; (9) speed and ease of erection; (10) lightweight; (11) good appearance; (12)

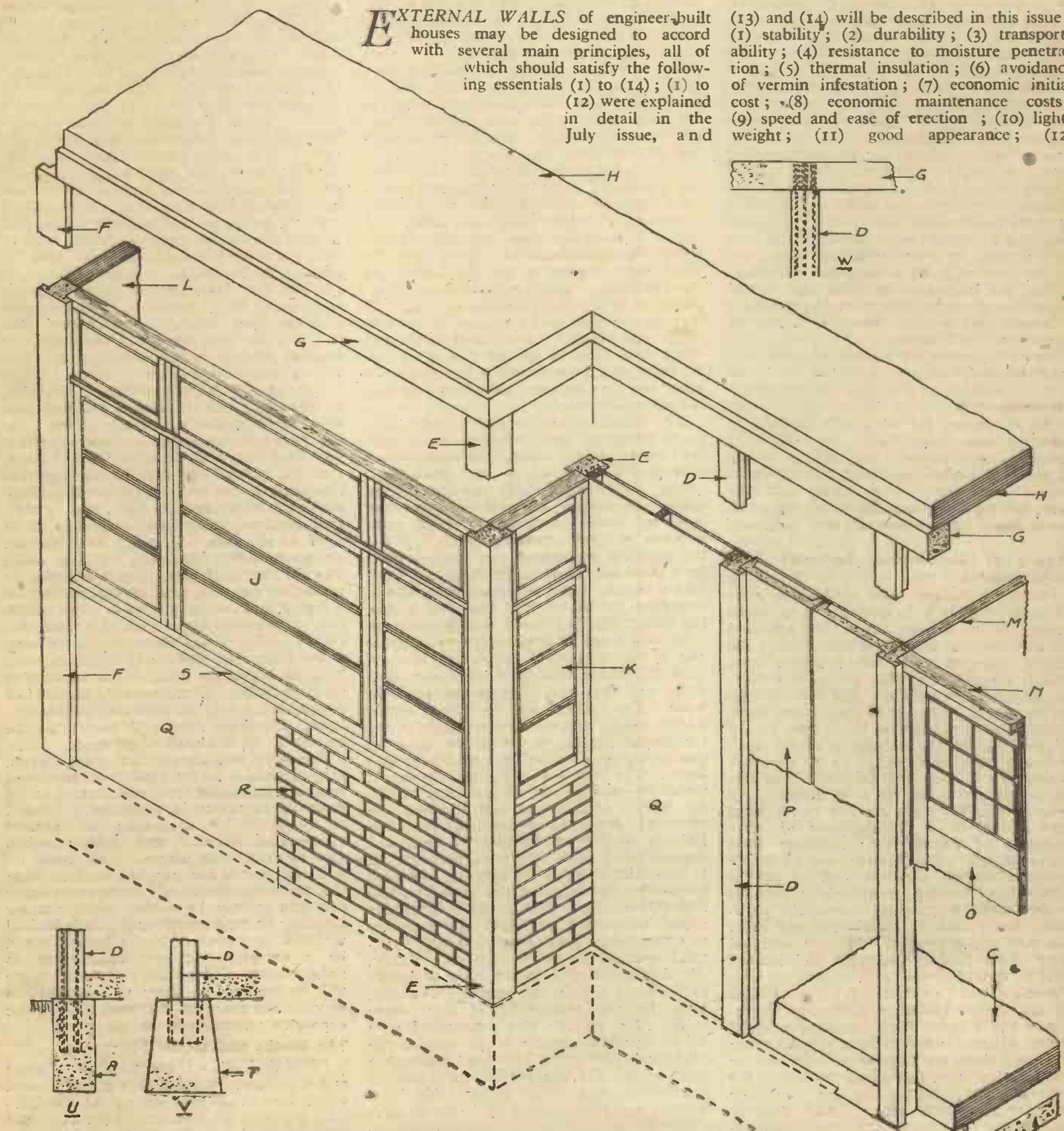


Fig. 41.—Methods of constructing pre-built external walls to ground storey. A—Continuous concrete base. B—Surface concrete. C—Pre-built ground storey floor panels. D—Reinforced concrete T post. E—Reinforced concrete posts suitable for internal and external angles. F—Reinforced concrete post next party wall. G—Reinforced concrete pre-built beam. H—First storey floor units. J—Window of any suitable design in wood or metal. K—Side window to bay. L—Party wall. M—Partition. N—Head of door frame. O—Door. P—Concrete wall panels. Q—Pre-built wall unit covered with any one of a number of modern materials described in next issue. R—Imitation brick panel. S—Sill of window. T—Pier base. U—Anchoring reinforced concrete post down to base by means of rods let down into base and grouted. V—Anchoring reinforced concrete post down to base by letting post into large socket in base and grouting. W—Fixing post to beam by means of reinforcing rods extending into holes in beam and grouting from top.

resistance to fire to a reasonable extent; (13) acoustical insulation; and (14) avoidance of condensation.

Acoustical insulation is exceptionally important as it means embodying principles and details of construction which will ensure that (a) rain beating against the thin structure of the walls will not be heard inside the house—of course, the sound of rain beating against glass cannot be avoided unless "double windows" are used—and (b) sounds will not be easily transmitted through the main structural framework or panelled or other units and cause inconvenience. Acoustical insulation is now a fairly well-known science of building and will be dealt with in this series. Some opponents to pre-building or prefabrication are too prone to advance theories about pre-built houses being noisy and resonant; theories which cannot be substantiated by scientific and practical facts. Ordinary pre-war type of houses with brick walls, timber floors and plastered ceilings by no means conformed to even the elementary laws of acoustics; timber floors with certain hard plaster ceilings are like drums, and many one-brick-thick party walls were so badly constructed with many joints not flushed-up or filled with mortar that the only prevention to sound penetrating through the walls is two thicknesses of plaster and wallpaper.

Avoidance of condensation on walls is a subject which requires particular care, and may be avoided by the choice of proper wall coverings or finishings. It is certainly rather difficult to prevent a certain amount of condensation on surfaces in bathrooms, sculleries, washhouses, etc., but it is not difficult to ensure the fairly rapid dispersal of the moisture and to ensure that the surfaces, pipes and metalwork, are not spoilt or damaged by corrosion or other influences.

Types of Traditional External Wall Structures

Before describing those methods of construction which I believe will find much favour in best housing circles, it is advisable to endeavour to show how ridiculous is the antique type of brick wall—a subject upon which the Editor of this journal has often expressed strong opinions. The pre-war type of house with its one-brick-thick heavy walls, timber floors, and tiled or slated roof, caused a total load on the foundation of the main external walls of from $1\frac{1}{4}$ to $1\frac{1}{2}$ tons per linear foot of wall, and the majority of this load was caused by the wall itself. *As a general rule the walls are five to six times too strong, twice the thickness of saner methods of construction; anything from three to eight times heavier than an amply stronger enough pre-built wall of any of the various classes of materials; requires exceptionally heavy bases, transmits needlessly heavy loads on foundations, and soaks up rain like a sponge!* I have designed very many timber structures and houses, and by careful designing in accordance with American and Continental practice adjusted to suit British loading requirements a two-storey house meets every structural essential if its external walls, which support floor and roof loads, are constructed with 4in. by 2in. studs at 18in. centres (or greater) in the ground storey, and 3in. by 2in. at similar centres in the first storey. And there is seldom any need to use any larger scantlings as posts to support ends of beams. The above facts should prove very significant to designers of engineer-built houses.

Types of Engineer-built External Wall Structures

It is probable that the skeleton structural framework system of external wall construction will be preferred by many designers, and also that the Platform frame system will be favoured. These are shown by Fig. 41. The skeleton structural framework consists of steel, reinforced concrete or timber posts at centres decided on a well-considered dimensional standard system to suit loading and materials used for the panel units. The posts are intended to carry the main structural loads of floors and roof, and also to secure the panel units which, owing to their having little load and wind pressure to resist, may be of very light construction. The feet of all posts rest on and are anchored to the bases or beams at ground-floor level, and the heads of the posts support a beam which rings the building at first-floor level. It is, of course, of vital importance that the posts at bottom and top are connected to the bases and beams so as to avoid any movement or pivoting; methods of connecting are shown by the details.

The Platform system—which differs from the "balloon" which is described later—allows definite and level platforms or stages at ground, first-floor (and other floors) and roof. As examples, the base and ground-floor is completed up to a level, then the walls and partitions in ground storey, and the first-floor is completed and form a level platform on which operatives can work in erecting the walls and partitions in the first storey and provide a level from which any other storey work or the roof can be erected. In other words, the system is like piling one large box on the one below and finishing the pile with a roof.

The Balloon system consists of continuous posts extending from foundations to roof, with all horizontal beams at first and other floor levels connected to the sides of the posts. This system eliminates the need of special lengthening joints in the posts and joints to obviate any tendency of the posts to rotate or move at certain points, but has the probable disadvantage of causing posts for a two-storey house to be about 18ft. long, which may be rather awkward to handle in transport and to erect. Apart from this, the system will find favour in many quarters.

At this stage it is necessary to compare one of the structural differences between thick and heavy traditional brick and stone walls and thin and light-weight pre-built walls. The former relies to a great extent on its weight and gravity for stability and for lateral support at points to cause its slenderness-ratio to be kept within certain limits. The latter—the thin and light-weight structures—cannot rely on gravity or weight for general stability and must therefore be anchored down to bases and braced-in laterally to prevent collapse by dead and superimposed loads, and wind pressure. It is interesting to study the difference between permissible slenderness-ratios of brick walls and timber walls. The L.C.C. by-laws give sound information, and it is only necessary to quote salient data to enable a vital structural essential to be understood. Firstly, the slenderness-ratio is the ratio of length to thickness, and in the case of an external wall the slenderness-ratio of any storey height of a wall or pier constructed with bricks or plain concrete is the ratio of the effective height to the horizontal dimensions lying in the direction of the lateral support determining such storey height. No load-bearing wall constructed with bricks or plain concrete may have a slenderness-ratio exceeding twelve; but as the storey height of a wall with proper lateral support at its top may be considered for the purposes of the by-laws as equal to only three-quarters of the actual height the slenderness-ratio of 12 is in effect increased to 16.

Engineer-built Houses

Timber posts may have a slenderness-ratio up to 40, but I advise limiting this to about 32 for ordinary structural purposes.

Steel and reinforced concrete may have much higher ratios than brickwork.

The above information goes to prove that brickwork is in many ways uneconomical, and that great stiffness, combined with slenderness, is ensured by the use of steel, reinforced concrete and timber.

A study of Fig. 41 will give an impression of how slender external walls may be buttressed by return walls to bay windows, party and flank walls and internal partitions and which must be secured properly to each other to ensure adequate stability; such stability being increased to a very considerable extent by the horizontal ring of beams at first-floor level, and by the first-floor itself. Just as traditional methods of construction with brickwork have the main return and cross walls and partitions bonded together, so must a light pre-built structure and its main skeleton framework be designed and constructed to resist all vertical, horizontal and inclined forces, and to prevent any tendency to overturn or in any way distort. External walls must be designed to withstand a wind pressure of not less than 15lb. per foot super acting at right angles to the surface of the walls; this pressure often occurs in this country, and if the whole area of a wall is taken into account it will be found that many tons pressure must be resisted.

Fig. 42 depicts several broad principles of designing the structural posts in the skeleton framework of main external walls and panelled units fitted between the posts. The next issue will explain in detail various types of external and internal coverings and finishings to the walls, methods of making the joints water and air tight, and systems of thermal and acoustical insulation, all being subjects of great importance and interest. As for the broad principles, it will be noted that the structural posts, apart from being of reinforced concrete, steel or timber, may be arranged in a variety of ways to give external and/or internal narrow pierced or panelled effects. This causes an æsthetical contrast to the usual flush surfaces of traditional wall building, a contrast which will lend itself to pleasing design. There are good methods of design, which will be explained in the next issue, where the structural posts may be entirely in the thickness of the walls.

Windows and doors, and their frames, may generally follow traditional designing and constructional principles, subject to probable variations in finishings. As will be manifest by examining the general illustrations, all door and window frames may be very easily secured to the posts.

If any unit of the panelled work between the structural framework becomes seriously damaged it may be readily taken out for repairing or replacement, and if it is desired to build an extension to the house, it will be a comparatively easy undertaking to remove some of the units and posts; there will be no need to shore up long lengths of walls and cut away brickwork and execute expensive making-good to old parts.

The Banks and House Financing

FINANCING of engineer-built houses and traditional houses is now receiving, and will receive in the post-war period, considerable attention by commercial interests, and it is of vital importance, in the national interests, that the subject of financing be understood much better by the "man-in-the-street" and the "woman-in-the-home" than it was in pre-war days. There are considerable differences in the methods of financing by building societies and the banks, and these methods may have important influences on engineer-built houses.

The banks of this country conduct their business in accordance with codes of practice which are not only honourable but equitable to their customers and themselves. *When money is borrowed from a bank at 5 per cent. interest it is 5 per cent. per annum computed on the daily debit balance —a perfectly fair transaction based on what is ordinarily understood as 5 per cent. per annum. Before borrowing money from a building society on its "5 per cent. scale" it is advised most strongly that information be sought as to how the interest is computed. It is probable that the borrower will be told that the interest is added, at the commencement of each year, computed on the capital outstanding. This financial juggling boosts up the 5 per cent. to something greater than 5 per cent. per annum if compared with the bank method of computation.* It is nearly 6 per cent. on a 15 years' period and more if less than such period.

The above different methods of interest computation provide an opportunity of giving examples:

If £500 is advanced by a bank it will probably be found that the capital *may be repaid by equal monthly payments over a period which may be assumed as 15 years, and that the* interest *at 5 per cent. per annum on balance of capital outstanding at the end of each month be paid at the end of each month*—I refer below to this method of repayment of capital and interest. *What I particularly want to stress is that the* average *calendar monthly repayment of capital and interest is about £3 16s. 4d., and that the total amount of capital and interest involved at the end of 15 years is about £689.*

If £500 is borrowed from a building society under the "5 per cent. scale" it will be found that the constant monthly repayment of capital and interest is £4 0s. 5d. per calendar month, and the total amount which the society would receive at the end of 15 years is £723 15s.

The boosting up of the 5 per cent. must be considered with the utmost care; over a 15 years' period it amounts to nearly 6 per cent., but the difference this makes is apparent by the above examples. For lesser periods it will be more.

FORMULA A shows how to calculate the total amount of capital and interest which would be paid to a bank at the end of a given number of years at any specified rate of interest per annum based on the daily debit balance system of computation of interest.

FORMULA B shows how to calculate the true interest per annum over a given number of years if the amount on the outstanding balance of capital is added at the beginning of each year during which interest and capital are repaid by monthly instalments. This formula also shows how to calculate simply the total capital and interest which would be repaid over a given number of years.

The principle of bank financing of housing properties will probably be found to vary rather considerably with building society principles. Whereas the latter by the methods explained in the May issue do not *normally* advance much more money on house property than banks are ordinarily prepared to do, the pool-system with collateral security permits the advance of a very high percentage, which is not always to the advantage of the borrower. Banks will normally grant advances which are considerably less than is possible with the building society pool-system and generally a little less than the ordinary 80 per cent. straight-advances of the societies. This, of course, means that banks are of no use to any person who is compelled to resort to the worst form of "never-never" or "long-sentence" financing of a house. But if any man or woman who wishes to purchase a house has a little capital in cash or in securities, then my advice is "go to the bank," and it will be found that a considerable amount of money will be saved by doing so, and the greatest security will be ensured.

Do not overlook the important point to which I have referred in a previous issue that engineer-built houses will probably be only two-thirds the cost of the traditional house. This alone will reduce the amount of money to be found for the preliminary operation of the bank method of financing.

Let the "best ropes to pull" be now explained. It is not possible for me to predict what the banks will do in the future in connection with financing engineer-built houses; but an indication of how they operated or intended to operate just before the war should be an excellent pointer as to how they may cause their great organisation and vast resources to be of benefit in the best material interests.

I will explain the subject of bank financing of a house in a "homely" practical way. Bear in mind that I am only making statements based on information which I believe to be very sound, but that there may be little variations after the war. (1) Banks will only advance to their customers. Many people appear to have a totally wrong impression about a bank—they view it as a financial octopus which charges for cheques, charge unfairly for keeping accounts, and divulges secrets to all and sundry, including the income-tax authorities, and that "it's much better to keep the spare money in the Post Office." The bank only charges for the 2d. stamp on the cheque, but not for the cheque itself. If there is a reasonable credit balance, say, generally about £100, and there is not a large volume of cheques paid in or out, then there will probably be no charges; if the credit balance is low, say, £25, and just a few cheques, etc., are paid in and out, then the charges may be about £1 a year. As to divulging secrets, the bank is bound to secrecy. As for it being better to keep *savings* in the Post Office, this is quite true; banks normally are for current transactions and convenience, and even they have their savings system which pays the same interest on deposits as the Post Office does.

(2) A bank will welcome any person, whether craftsman, "black-coat," shopkeeper, industrialist or professional who is honourable and recommended, even if with only about £25 to deposit, and that person will always find the bank is a strong, good friend, always ready to do good business at "1d. in the £1 per month," to help them to pay their overheads and profit.

(3) If a freehold engineer-built house is to be sold for £650, and the prospective purchaser has only £150 to "lay down," then it will be probably found that a bank, if they are reasonably satisfied that the house is worth about £650, will be prepared to advance £500, repayable as capital and interest as follows over a period of, say, 15 years. In 15 years there are 180 months, and £500 divided by 180 = say, £2 15s. 6d. monthly repayment of capital only. If the interest is 5 per cent. per annum, this equals 1s. per £1 per annum, or 1d. per £1 per month, and at the end of each month the bank will charge 1d. for every £1 capital; consequently, when the first repayment is made, there will be £500 at 1d. per £1 interest, which is £2 1s. 8d., making the total repayment *£4 17s. 2d.* The second month's repayment will be £2 15s. 6d., plus interest on £497 4s. 6d., which is £2 1s. 5d., totalling *£4 16s. 11d.* The third repayment will be £2 15s. 6d., plus interest on £495 9s., equals *£4 16s. 9d.* And so on, the interest dropping about an average of 2¾d. per month, or 2s. 9d. per year.

The building society repayment is constant at *£4 0s. 5d.* per month, which is less than the above bank repayments; but do not overlook the vital point that the bank repayments are falling by 2s. 9d. each year, and in 6 years (6 × 2s. 9d. = 16s. 6d.) the bank repayment is about the same as the society's, and immediately after is less, and as the remaining 11 years roll by it is very considerably less, the last repayment being only *£2 15s. 9d.* instead of *£4 0s. 5d.*!

(To be continued)

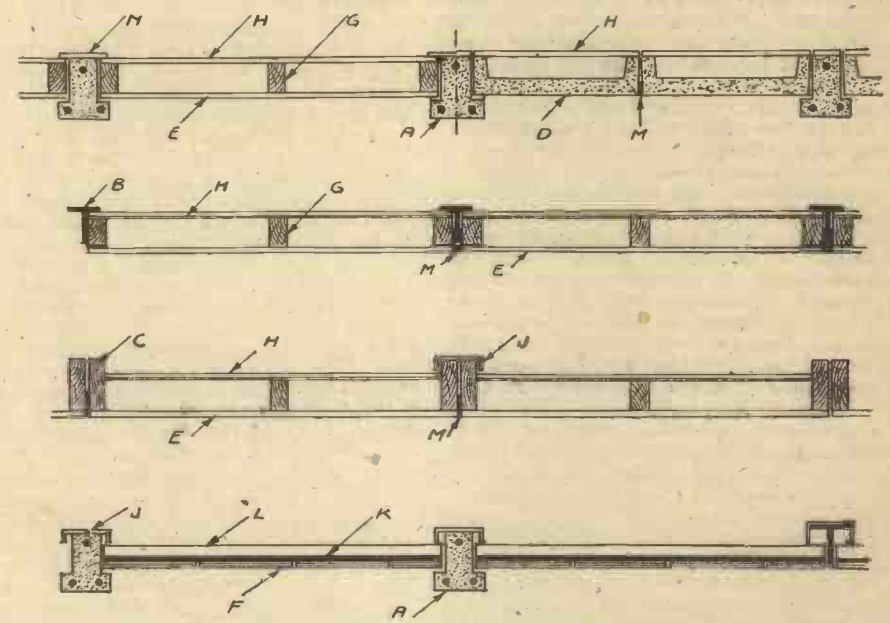
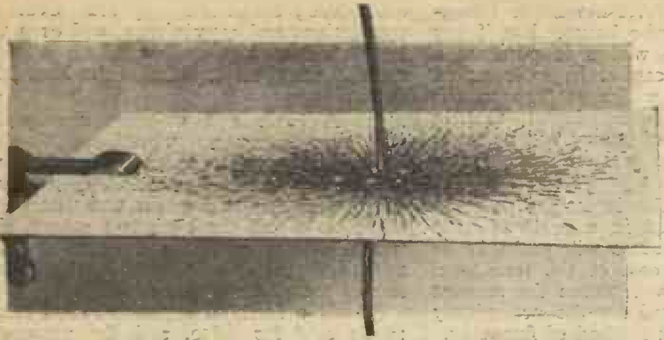


Fig. 42.—Various types of external wall construction comprising skeleton structural frame and panel units, all pre-built

A—Reinforced concrete T post. B—Steel T post. C—Twin timber posts. D—Concrete wall panels. E—External wall covering. F—" Brick tiles." J—Pre-cast cover. K—Waterproof bedding. L—Light framework. M—Waterproof joint. N—Cover strip.

The Mystery of

Modern Views on an Age-o



A clear demonstration by means of iron filings of the electro-magnetic field surrounding a wire carrying a current.

DESPITE more than a century and a quarter's detailed study of magnetic phenomena, in spite of the close, concentrated and unremitting attention which has been given to the subject at various times by some of the world's most renowned physicists, science has not as yet obtained a perfectly clear and satisfactory insight into the true nature and significance of magnetism.

In the phenomenon of magnetic attraction and repulsion there still exists a considerable aspect of mystery concerning the essentials of this age-old and widely recognised invisible force. We still do not know for certain the essential difference between, say, a bar of steel which has been magnetised and a similar metal bar which has not been imbued with the magnetic force. To all outward appearances, both bars are alike. They may, indeed, be identical in chemical composition, but, as we all know, they differ profoundly in regard to their attractive properties.

Most of the fundamental facts about magnetism were detailed by William Gilbert, the celebrated physician of Queen Elizabeth's time. Gilbert, for instance, discovered that every magnet had a "north" and a "south" pole. He found that like poles of a magnet repel each other, whilst unlike poles attract each other. He realised that the earth itself acts as a huge magnet, but when he came to explain the cause of the magnetic force he found himself entirely at a loss. All Gilbert could say was that the mysterious force of magnetism was apparently the exclusive property of iron and magnetic iron oxide, the latter constituting the "lodestone" of the ancients.

At a much later date experimenters realised that Gilbert's classification was rather too narrow, and it came to be recognised that the metals nickel and cobalt, which are, chemically, closely related to iron, must be classed as magnetic substances, for, like iron, they were found to show pronounced magnetic properties. Almost within our own time, the Heussler alloys, which are alloys of tin, copper and manganese, were discovered to be strongly magnetic. Apart from the above metals, however, all other materials are either feebly magnetic or entirely non-magnetic.

For the above reasons, therefore, materials nowadays are put into one of three categories as regards their magnetic properties. Strongly magnetic substances are said to be *ferro-magnetic*, that is to say, to possess the magnetism of iron compounds. Feebly magnetic materials are said to be *paramagnetic*, whilst substances such as bismuth, antimony, tin, glass, asbestos and so forth, which are essentially anti-magnetic or non-magnetisable, are termed *diamagnetic*.

Ferro-magnetism

For practical purposes, only ferro-magnetic substances need be considered, for the magnetic capabilities of many of the paramagnetic materials are so feeble as to be almost non-appreciable.

It is a well-known fact that the magnetic property of iron disappears almost completely when the metal is heated above 780° C. This is explained by there being two varieties of iron, the one *alpha* iron and the other *gamma* iron. *Alpha* iron is the variety of the metal which exists at temperatures below 780° C. It is strongly magnetic, but when its temperature rises above the 780° C. mark, the *alpha* iron is automatically converted into *gamma* iron, which is paramagnetic, that is to say, only feebly magnetic.

The essential difference between *alpha* and *gamma* iron is one of atomic arrangement, and for this reason it might be conjectured that magnetism is intimately concerned with a special spatial arrangement of iron atoms, and of a similar arrangement of the atoms of iron's closely related metals, nickel and cobalt. However, in considering this tentative explanation, we are confronted with the undeniable fact that many compounds of iron, such as iron chloride, iron sulphate and red iron oxide, are only paramagnetic (i.e., feebly magnetic), whilst iron carbonyl is actually diamagnetic, or anti-magnetic. Additionally, there is the fact that the Heussler alloys, which do not contain any iron, cobalt or nickel, are intensely magnetic in their properties.

For these reasons we cannot say that magnetism is purely a phenomenon related to a special arrangement of iron atoms or of atoms of cobalt and nickel. Whilst certain arrangements and configurations of the atoms of these elements certainly render the magnetic effect readily obtainable, they cannot necessarily be the actual cause of the magnetic phenomenon. For such a cause, therefore, we must look farther.

One of the earliest scientific theories of magnetism assumed that the behaviour of a bar magnet was merely the result of each individual particle of metal being imbued itself with magnetic properties.

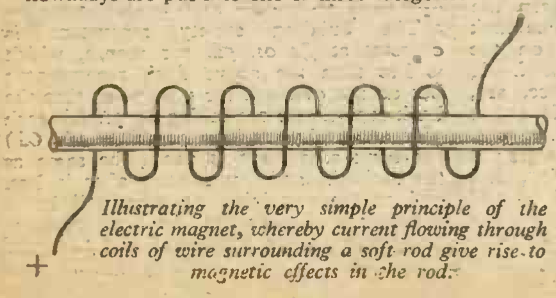
In an unmagnetised iron bar the individual iron particles, although they are imbued with a magnetic polarity which is permanent, do not manifest the magnetic effect in the mass because the various polarities of the particles are so much jumbled up that they become neutralised. When the bar of metal is magnetised, it was supposed that the individual metal particles are, as it were, combed out and straightened, all their "north" poles being made to lie in one direction. Thus, according to this theory, the mass effect of magnetism is obtained, for the metal bar itself then develops a clearly demonstrable magnetic polarity, its "north" pole attracting the "south" pole of another magnet and repelling the "north" pole of the latter.

There may be a certain amount of truth in this "molecular" theory of magnetism, for undoubtedly the individual grains of a metal bar show as much magnetic polarity as does the metal bar itself. One can magnetise a single iron filing almost invisible to the eye so that the filing will manifest a "north" and a "south" magnetic pole. Actual size or dimensions, therefore, have little or no connection with the actual causative factor of magnetism.

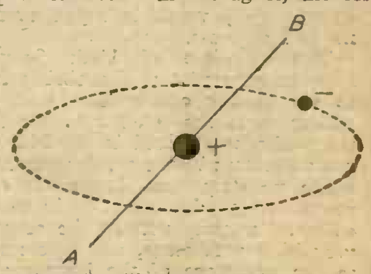
"Fluid" Theory

Another early theory of magnetism postulated that magnetism was a sort of invisible fluid which was capable of permeating substances. This fluid was capable of being conveyed from one substance to another. Thus, when a bar of iron is stroked with a magnet, the former

One of the world's earliest electro-magnets. It was constructed by Dr. William Henry, of Albany, New York, in 1830, to demonstrate conclusively the production of a magnetic field by electrical means.



Illustrating the very simple principle of the electric magnet, whereby current flowing through coils of wire surrounding a soft rod give rise to magnetic effects in the rod.



Diagrammatic illustration of an electron revolving in its orbit around the positively charged nucleus of an atom. The whole arrangement constitutes an effective gyroscope, which causes the atom, as a whole, to spin on its axis AB, and thus to set up fields of force which are supposed to give rise to magnetic effects.

Magnetism

ld Phenomenon

acquires some magnetic properties, due to the escape of the magnetic fluid from the magnet into the bar of iron.

When, however, with the advance of experimental science, it became apparent that no such thing as a magnetic fluid exists, the effect of the transference of magnetism by the repeated contact of one bar of iron with another was explained by the previously mentioned "molecular" theory of magnetism which asserted that the individual metal particles were all combed out in the one common direction by the stroking process, with the result that the bar of metal began to manifest the mass polarity of its individual particles.

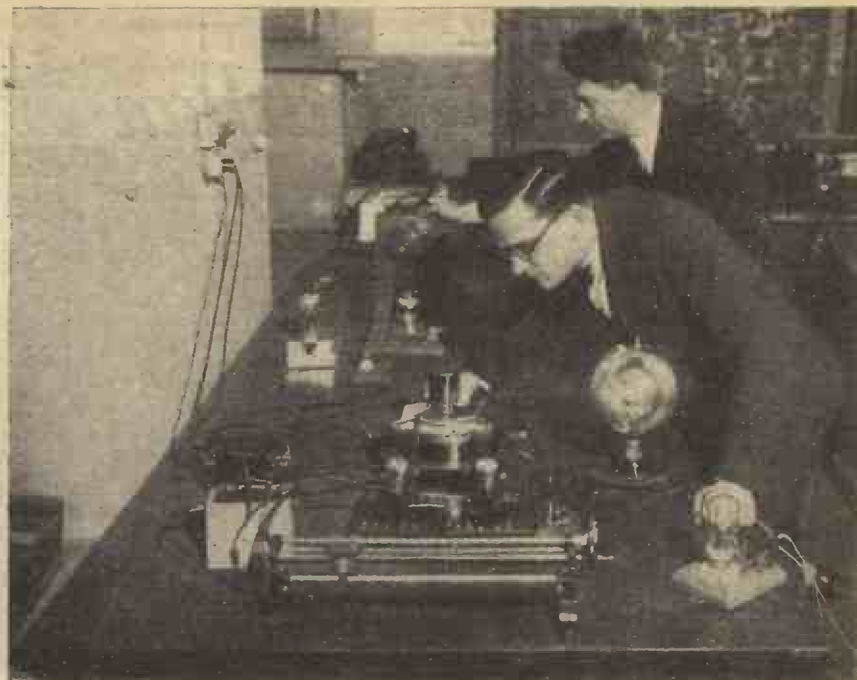
Such an assertion, it must be observed, has never been disproved, and it is still offered to the student in textbooks dealing with the subject. Clearly, however, such a theory hardly grapples with the actual causation of magnetism.

The point at issue, therefore, is this: what is the true nature of the magnetic effect, and from what fundamental causes does it arise? Is magnetism a phenomenon connected with the nature of atoms or with merely their arrangements in space? Alternatively, is magnetism, like electricity, a sub-material affair, and, if so, why does it only manifest itself in connection with the metals iron, cobalt, nickel and a few other alloys?

Our approach to problems of this nature must be through the well-known phenomenon of electro-magnetism.

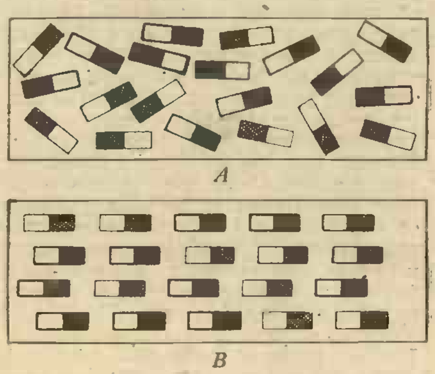
More than a hundred years ago an English experimenter, William Sturgeon, succeeded in producing the magnetic effect by electrical means. Over a straight iron bar he coiled about twenty turns of insulated copper wire and sent a current through the coil so made. Sturgeon found that so long as the current flowed, the iron bar exhibited magnetic properties. In this way the world's first electro-magnet came into being. A direct connection had been established between electricity and magnetism.

The magnetic needle—one of the first discovered manifestations of magnetism.



Making delicate measurements of the strengths of magnetic fields in an electrical research laboratory.

Modern science has shown that an electric current consists essentially of an orderly stream of negatively charged sub-



Illustrating the older "molecular" theory of magnetism, which attributed the magnetic effect in a bar of iron to the mass alignment of the individual particles constituting the bar. A represents the individual particles in an unmagnetised iron bar. There the magnetic polarities all neutralise one another. B represents the aligned particles of a magnitised iron bar. All the polarities of the individual polarities lie in the same direction. There the iron bar manifests the mass magnetic effect of these polarities.

material, particles called "electrons." When an electron moves, its motion is made manifest to us as an electric current.

Now, an atom comprises a central nucleus of material which contains the greater weight or mass of the atom. Around this central nucleus revolve at varying distances one or more electrons. The motions of the electrons in their orbits or paths around the central nucleus of the atom constitute, in reality, an electric current flowing perpetually in a more or less closed circuit. It is this electronic motion which, according to modern views, is supposed to underlie the phenomenon of magnetism.

Consider, for a moment, a single electron revolving at high speed around its central nucleus. The arrangement constitutes an excellent gyroscope, and just as a mechanically working gyroscope tends to rotate as a whole upon its own axis, it is conjectured that the electron mechanism of an individual atom tends, owing to this ever-present gyroscopic action, to impart a spin to the entire atom itself.

Modern theories assume that the paramagnetic or feebly magnetic condition of bodies is the normal state, and that the ferromagnetic and diamagnetic states are abnormalities. The paramagnetic effect, modern theories contend, accrues from the effect of existing magnetic fields upon the spin of the atom caused by its system of rotating electrons. In some special instances, however, the atom system opposes the inductive effect set up by the rotating electrons and the applied magnetic field and so neutralises it, whilst, in the case of ferromagnetic materials, exactly the opposite takes place, the result being an actual electro-inductive building-up of the applied magnetic field. Such atoms, when gathered into clusters or molecules, develop polarities, with the resultant magnetic effects.

It seems fairly evident that magnetism is inseparably connected with electricity, although, of course, magnetism is not actually electricity itself. An electron is to be regarded as a unit or a particle of negative electricity. What actually this almost inconceivably minute electrical particle consists of is totally unknown. Some scientists conceive it as comprising a localised formation or an area of strain in the ether of space. Hence, they say, whenever electricity is present, there is a strain or a series of strains in the ether.

If electrons are not in circuit motion, the ether strain is more or less stationary. Since, however, magnetism seems to result always from electricity being in motion, it has been conjectured that magnetism is fundamentally a manifestation of a drift or a displacement in the ether. Such a condition of affairs, highly mysterious and, perhaps, unknowable in detail as it may be, constitutes the fundamental essence or cause of that highly problematical localised sphere of influence which we term the "magnetic field," and which we make visible by means of iron filings scattered around a magnet and in various other ways.

Masters of Mechanics—89

Jonathan Hulls

Some Light on the Obscure Career of Jonathan Hulls, the World's First Steamboat Inventor

JONATHAN HULLS is one of the hidden inventors of history. The mists of obscurity which, in the many-sided records of mechanical creation and discovery, have so frequently enshrouded the lives of lowly and often luckless inventors have, perhaps, never so completely enveloped the life-career of an original genius as they have done in the strange case of Jonathan Hulls.

That Jonathan Hulls was a man of first-rate initiative and creative originality is undoubted, for it was in his brain that the practical details of the first serious attempt to propel a boat mechanically took shape. But Hulls lived at the wrong time for the essential success of his project. His efforts were spasmodic ones. He had few supporters and, apparently, little money. The greater number of his countrymen in those days were not mechanically-minded. Perhaps, for them, invention still smacked of the Devil. At all events the few isolated inventors of the period got nowhere with their schemes. Hulls' efforts at the steam-propulsion of boats met merely with local ridicule. A doggerel verse which presumably originated in the locality of his birthplace asserted that:

Jonathan Hull,
With his paper skull,
Tried hard to make a machine
That should go against wind and tide:
But he, like an ass,
Couldn't bring it to pass,
So at last was ashamed to be seen !

This rural ditty, which was circulated with mirth and merriment, attained an almost traditional status, it having been remembered and recited down to times almost within living memory.

Scanty Details

Who was this Jonathan Hulls, the man with the "paper skull," the individual who was clearly of too inventive a mind for his local compatriots ? That is a question to which the history of invention has not, as yet, supplied any satisfactory answer. There are no available details concerning the life of Jonathan Hulls, although there appears to be no reason why a thorough and a painstaking investigation into the genealogy and the local career of this man should not be rewarded by the disclosure of at least a number of further particulars of importance concerning him. But, for the present, Jonathan Hulls, or, rather, the life-career of Hulls, is an unsolved mystery. Only the peculiar piquancy of his somewhat romantic attempt to render a boat capable of going "against wind and tide" has penetrated down to our present time.

It is certain that Jonathan Hulls was born in the Gloucestershire village of Campden in the year 1699. The close of the seventeenth century, which coincided with Hulls' obscure birth, was a period of economic prosperity and settlement in England. The Civil Wars which had raged during the middle of the century had long been over. The country had had decades of peace. Craftsmanship was apparent on every side and what few manufactures there were in England were being carried along at a contented, jog-trot pace.

In 1699 the Royal Society, the parent of all British institutions, had been in existence for nearly 40 years. A new spirit of scientific inquiry was beginning to stir abroad. Men began to perceive that it was readily possible, with the expenditure of a little ingenuity, to devise ways and means of accomplishing a variety of different aims and objects. Thus invention—practical, utilitarian creativeness, as opposed to the fantastic moonshining projects of an earlier age—began gradually to assert itself.

We know nothing of the antecedents of Jonathan Hulls, of his boyhood days, of his upbringing and education. One can hazard a guess that he was of the country gentleman type, for no poorer individual in those days had the financial wherewithal, to say nothing of the necessary leisure and knowledge, to dabble in inventive projects. If, therefore, this assumption is correct, Hulls must have been given a sound schooling in his younger days, although when subsequently the question arises as to how Hulls first came to be associated with matters mechanical, creative and inventive, the industrial historian of the present day must put his hands up and confess complete ignorance.

There is a record of Hulls having married in the year 1719, at which time he would hardly be out of his teens, but, apart from that detail of personal history, we know nothing more about this peculiar individual until he comes into the full focus of our view in 1736. We find him, in this year, making large models of river vessels with the object of causing them to propel themselves "against wind and tide." Exactly how Jonathan Hulls, in his inland village of Campden, first became interested in the steam-propulsion of boats and, indeed, in the possibilities of applying the power of steam in any other respect, is quite a mystery. One may only surmise that the worthy Jonathan was an individual of wide reading and that, possibly, he may have had some seafaring experience.

A close-up of the engine of Symington's steamboat, "Charlotte Dundas" (1801.)
(From a Science Museum model.)

Blasco de Garay

Hulls was not actually the first man to conceive the project of propelling boats without oars or sails. As far back as 1543, it is recorded that one Blasco de Garay, a Spaniard, contrived, at Barcelona, the propulsion of a vessel without sails or oars by means of "a large kettle of boiling water"! So far as can be ascertained from the existing record, the ingenious Blasco's steamer (if it ever actually materialised at all) must have embodied some form of steam-jet propulsion which its inventor, in all probability, garnered from a perusal of the ancient and semi-fantastical works of the celebrated Hero, of Alexandria, for we are told that the 1543 steam-vessel contained no moving machinery whatever.

Apart, however, from this isolated instance connected with the Spaniard, de Garay, no record occurs of the application or the projected application of steam power to the propulsion of sailless vessels. Consequently, Jonathan Hulls, the nowadays obscure Gloucestershire man is, in reality, to be hailed, not merely as an unusually original inventor and contriver, but as an individual of even more fundamental import, since it was he who gave the first practical expression of an entirely new scheme of things.

Hulls patented his mode of steamboat propulsion on December 21, 1736. Early in the following year he published a small treatise on his invention, which work he adorned with the not exactly brief title of *Description and Draught of a New-Invented Machine for Carrying Vessels or Ships out of or into any Harbour, Port or River Against Wind and Tide, or in a Calm; for which his Majesty has granted Letters-Patent for the sole benefit of the Author for the space of Fourteen Years.* This rare book was reprinted in 1855.

Essentially, Hulls endeavoured to make use of a Newcomen engine as the power-producer of his vessel. When Thomas Newcomen, the one-time Dartmouth iron-monger and blacksmith, invented his slow-working "atmospheric" engine in 1705, Jonathan Hulls would be only five years of age. It is not known whether Hulls knew Newcomen personally, for the latter died in 1729, seven years previous to Hulls' experiments in steam-vessel propulsion. Hulls, however, must have been well aware of the Newcomen engine principle, and it has been suggested, also, that he must have been well acquainted with the steam experiments of the Frenchman, Dr. Denis Papin, about 1690, for his mode of obtaining motion from his engine seems to have some connection with the Papin experiments.

Steamboat Engine

Be the above as it may, Hulls certainly made himself the first practical experimenter in steamboat propulsion. His experiments and trials in 1736 were carried out on a quiet stretch of the River Avon, at Evesham.

His Newcomen engine was fitted in a small towing vessel which was connected by means of a rope to a towed vessel of larger size. A couple of small paddle-wheels at the stern of the towing boat were secured to a common axle or paddle-shaft. The motion of the engine was communicated to this paddle-shaft by means of a rope which passed over a pulley. This motion was maintained and continued during the return stroke of the engine's piston by the descent of a weight into the river, which weight was elevated by the power-stroke of the piston. This was certainly an ingenious method of converting the rectilineal motion of the piston-rod into the required rotary motion for the turning of the paddle wheels, and the description of this project in Hulls' patent at once stamps the inventor as being an individual of singular ingenuity. It would seem that in Hulls' actual trials he employed a towing vessel fitted with two Newcomen engines secured abreast in the centre of the boat. Each engine drove its own paddle wheel.

Had Hulls hit upon the fundamental notion of a crank on the paddle shaft, his project, despite the obvious unsuitability of the slow-moving Newcomen engine for the purpose, might, relatively speaking, have been startlingly successful. As it was, however, Jonathan Hulls' steamboat attempt comprised little more than the first practical but, for the greater part, unsuccessful essay in a field of applied steam power which was, in after years, to become of towering significance and importance.

Hulls himself waxed quite lyrical in his published description of his steamboat invention. Says he:

> The work to be done by this machine will be upon particular occasions, when all other means yet found out are wholly insufficient.
>
> How often does a merchant wish that his ship were on the ocean, when, if she were there, the wind would serve tolerably well to carry him on his intended voyage, but does not serve at the same time to carry him out of the river he happens to be in, which a few hours' work of the machine would do.
>
> Besides, I know engines that are driven by the same power as this is, where materials for the purpose are dearer than in any navigable river in England; therefore experience demonstrates that the expense will be but a trifle to the value of the work performed by those sort of machines, which any person that knows the nature of those things may easily calculate.

It would appear that Hulls made his steamboat trials at Evesham in the presence of quite an assembly of witnesses. Whether he had any assistants or otherwise at these trials we do not know. We do know, however, that the Evesham trials were unsuccessful and that the spectators derided the inventor over them. When the eager Jonathan pulled his steamboat to the river bank to endeavour to remedy engine trouble, the cry went up: "A failure, a failure!"

Possibly Jonathan Hulls inwardly realised that his steamboat project was, indeed, a failure, so far as its working aspects were concerned, for, although he does not seem to have taken to heart the derision with which his attempts at steam navigation were greeted, he did not continue the trials, so that, before long, the Hulls patent of December 21, 1736, became almost completely forgotten.

It has been averred in this connection, however, that William Symington, the Scotsman, who, on account of his successful steamboat of 1789, has been called the "Father of Marine Engineering," was aided in his work by suggestions which he gained from a study of Hulls' pioneering experiments. Likewise, it was partly to Jonathan Hulls and his inventive project that Erasmus Darwin, the doctor-poet of the eighteenth century and grandfather of the more famous Charles Darwin, was alluding when he penned his prophetic lines:

> Soon shall thy arm, unconquered steam, afar
> Drag the slow barge or drive the rapid car.

The fact that Jonathan Hulls' trials failed in any practical sense to "drag the slow barge" apparently did not damp down the ardour and enthusiasm of this individual in other directions. For instance, Hulls invented a machine for weighing gold coins quickly and for testing their soundness.

Calculating Rule

Then again, in 1753, he patented a sort of calculating machine for mensuration purposes. Of this device, he published in the following year (1754) a full description in a pamphlet entitled *The Art of Measuring Made Easy by the Help of a new Sliding Scale.*

Shortly afterwards, there appeared a little treatise by Hulls on the subject of malting. *The Maltmaker's Instructor*, as this work was entitled, probably had a greater circulation than any previous written work of Hulls, and presumably its enterprising, ingenious and not unversatile author must have known something about his subject in order to compile this early technical treatise.

But *The Maltmaker's Instructor* constituted the last published work of Jonathan Hulls. It appeared about 1755, after which time Jonathan leaves once and for all the platform of publicity and celebrity on which he had appeared at various times since his steamboat experiments and forthwith becomes lost in the ocean of contemporary humanity from which he never afterwards seems to have individually emerged.

We do not know when or where Jonathan Hulls died nor where he lies buried. If he had any family, the individual members thereof failed in any lasting manner to distinguish themselves. Jonathan Hulls, therefore, still remains one of the most curious and the most mystifying characters of inventive history. Yet the practical significance of his unsuccessful conception of a steam-propelled river and sailing vessel must not be under-rated, for by that one brilliant and, perhaps, in some respects, whimsical stroke of inherent genius, Hulls managed to raise himself and his memory to the position of a world pioneer who initiated a subject of invention which, years after his death, succeeded in revolutionising the face of civilisation.

World of Aviation

The New Halifax : Secret 'Plane Fuel : Torpedo Fighter 'Plane : Glider Crosses Atlantic

The New Halifax

A NUMBER of improvements have been carried out on the Halifax, and the latest version has a transparent, turretless nose, which is of entirely new design, also, the motor nacelles have been modified, and a four-gun Defiant-type dorsal turret. These improvements have added to its speed, which is officially given as 254 m.p.h. at 12,000ft. 1,280h.p. Rolls-Royce Merlin 22 motors are fitted to all new Halifaxes.

Secret 'Plane Fuel

IT is reported that the Universal Oil Products Company have succeeded in producing a new aviation fuel which they have named Dixane. The fuel, as with other high octane aviation fuels, is made up of carbon and hydrogen, and has a character all its own. Two carbon atoms are grafted into the structure of certain hydrocarbon compounds.

The atoms, it is stated, are hooked together in a peculiar way which hitherto was unattainable. This new molecular structure is accomplished by the use of a catalyst discovered in Universal Laboratories. The octane rating of Dixane is exceedingly high, and the fuel also possesses a peculiar property of increasing the octane rating of fuels in which it is blended out of proportion to its own. At the moment it will probably be used as a blending fluid.

The name Dixane gives no clue to the chemical composition of the fuel, which is a military secret.

A Torpedo Fighter 'Plane

THE Bristol Beaufighter has been operating for the past few months as a torpedo-carrying fighter. Once the 18in. torpedo has been dropped (it is carried externally under the fuselage) the machine reverts to its old rôle as a long-range fighter.

Its armament consists of four fixed 20mm. cannon fitted in the fuselage floor, and six .303in. Browning machine guns mounted four in one wing, and two in the other.

Glider Crosses Atlantic

A TWIN-ENGINED Dakota 'plane recently towed a fully loaded glider across the Atlantic. The 3,500 miles crossing was completed in the flying time of 28 hours. It marks another important step in the progress of aviation.

The glider has a wing span of 84ft. and was built by an American. This is what the pilot of the glider says about flying. "The glider must be flown all the time. There is no automatic pilot and the pilot must not take his eyes off the tow-rope or tow-'plane."

Heston Racer

TWO of these aircraft were being built when war broke out and only one was finished. Unfortunately it crashed on its flight trials and no speed records were broken. Fitted with a Napier Sabre engine, this aircraft was designed to attack the world's speed record standing at 469 m.p.h. The span was 32ft. and the loaded weight 7,200lb. Wood was used for the majority of the structure, the control surfaces being metal with fabric covering. In order to reduce the drag incurred by placing the radiator under the engine as in other aircraft, an unusual method was adopted. The radiator was positioned under the fuselage aft of the wing, and the air, after it had passed through the radiator, was ejected via streamlined openings at the rear of the fuselage. Efficient streamlining was thus obtained. A fairly high wing loading of 43lb. per sq. ft. was used and an extremely good finish obtained on all the external surfaces.

IT'S A SMALL WORLD!

"Motilus" Describes More Interesting Mechanical Miniatures

An Author and His Railway. Another Example of the Use of Models in Training the Services. An Ingenious Model for the Bathroom

Baileys Railway

LAST month the whole of my article was devoted to a very complicated piece of professional model making. This month I return to the efforts of the amateur model maker, and first of all would like to mention a book entitled *The History of Baileys Railway, Ltd.*, which is the story in 49 pages of the model railway of a 13-year-old boy—Master Peter Bailey, of Dursley. The book is written by Peter Bailey himself, and the excellent photographs illustrating it were taken by his father, but again printed by himself.

The chapters are headed: I, Our Early Stages; II, The Beginning of Baileys Railway, Ltd.; III, The Attic in the Early Part of the War; IV, The Beginning of Room D; and V, Our Best Year, 1942. There are 14 photographic illustrations, and several line diagrams illustrating the growth of the railway.

Peter Bailey tells in detail how the railway began in the early 1930's with a simple 4-4-0 clockwork *Duke of York* engine and two carriages. It was in 1937 that he and his brother, who is joint owner of the railway, decided to lay out the railway permanently on their attic floor, and it became a permanent feature screwed to the floor. They prepared a track layout in room "A" and when the holidays came were soon running a second track in room "B." In this room they introduced many lineside features and it began to fill up and had nowhere to expand but into room "A" where the other track was laid, so two tunnels were made through the wall. A plan of the railway in January, 1939, shows the two attics "taken over" entirely for the railway, which has lineside features like jungles, a zoo, a tank, goods sidings and a passenger station.

Early in 1939 the boys purchased a point which they used to make a triangle to get a branch line going down parallel to the stairs, and they cut a new tunnel to let the railway into yet a third room—room "C"—passing "en route" an aerodrome and harbour, with terminus goods and passenger station. Room "C" was made their office headquarters spread out with all their railway books, and throughout 1939 they concentrated in buying goods rolling stock for their railway. However, the office had to be taken down, as they wanted to "advance" again, and another hole was made in the wall to make a curve round through room "C," which came out again and across the stairs by means of a bridge and through another tunnel to room "B." The narrator naïvely writes: "The bridge really stopped people coming up the stairs as they did not like climbing over it. But we took it down every night so as not to cause any inconvenience."

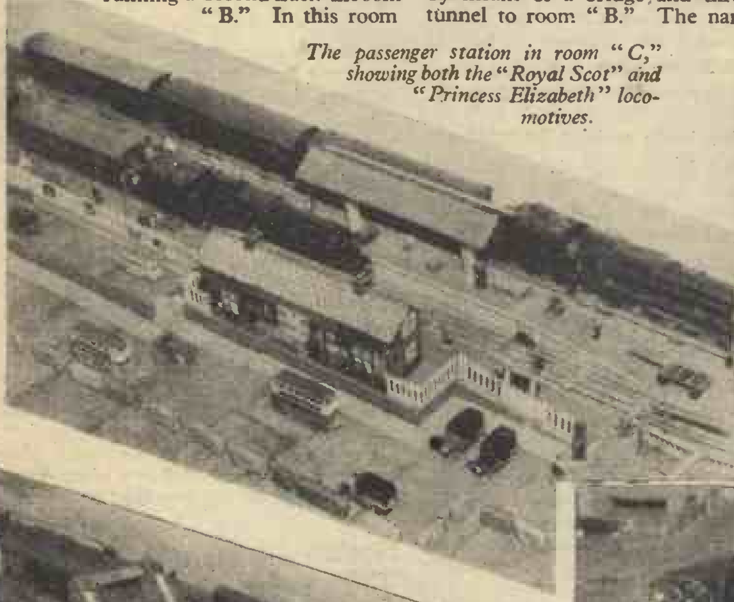
Lineside improvements introduced about this time were a house made of stone bricks in room "C" and a beautiful garden alongside, a garage, a new aerodrome—this time a military one with hangars for 'planes and a control tower, also a fort with men drilling in the field, and a farm.

In July, 1941, they first began to lay track in yet another room—room "D," (which was already "full up" with a bed, washstand, wardrobe and "all sorts of junk," according to the author), but a clear space was made for a triangular piece of track.

In December they "took over" room "D," and the railway then occupied four rooms!

The story then arrives at "Our best year so far—1942," and the chapter commences: "The first few days of 1942 saw great changes in the attic, when we had a scale model (Bassett-Lowke) *Princess Elizabeth*—a 4-6-2 with a very smart L.M.S. tender. This engine was accompanied by 10 new 3ft. curves, for the outside track in room 'A,' so *Princess Elizabeth*, which would not run very well on 2fts. was able to show its real form."

The outside track was relaid in room "A" and then a cable to feed the track across the room for the inside circle. Room "D" and the tunnel were a great success, and



The passenger station in room "C," showing both the "Royal Scot" and "Princess Elizabeth" locomotives.

Baileys Railway, Ltd.—a general view of the Bassett-Lowke passenger station in room "A." This is an admirable example of the way a model railway enthusiast may specialise in lineside features. Lotts bricks were used for the houses, etc., and Dinky toys where suitable.

A view of the goods yards and sidings of one of the chief goods depots of Baileys Railway, Ltd. This shows the variety of equipment and accessories collected. Left is the Lionel 2-4-2 locomotive with 12 wheel circular tank tender, in the centre the B-L 4-6-2 "Princess Elizabeth" hauling an express goods train, in the background the "Royal Scot" and on the right-hand the six-coupled tank No. 5374. The horse wagons, horses and figures, the lorries and the milk churns, etc., give the depot a very busy and lifelike appearance. (Above) A novel container for bath salts the woodworker can construct.

before long two more rails were extended down in room "D" to get a larger loop in. In February, 1942, the *Princess Elizabeth* and their tank locomotive were sent back to Bassett-Lowke's for repairs and, on their return, all records were broken when seven and a half hours were spent in the "railway rooms" with the engines going really well; the *Princess Elizabeth* doing 207 rounds, the *Royal Scot* 193 rounds and the tank 120, as well as the Lionel model they possessed, 103 rounds.

Some of these engines have not been mentioned before, but at the end of the book Peter Bailey gives "Facts and Figures of Baileys Railway, Ltd." with a list of all the engines and rolling stock. They have six engines, the *Princess Elizabeth*, the B-L *Royal Scot* and tank, and a B-L 4-wheeled tank specially adapted for service on the sidings, an American Lionel engine and one "old locomotive" loaned by "the president" (whom, I take it, is his father). They have nine carriages, including a B-L dining car and 50 trucks, while the length of track is over 245ft., made up of two circles, one 61ft. long including loop and sidings, and the other 184ft. long. Electricity for the whole of the track comes from the mains via a transformer of American design, and two automatic circuit breakers are installed, which automatically cut off the current if a truck should derail or a short circuit occur.

Also the chief goods carried by Baileys Railway, Ltd., are timber, cabledrums, sacks (3in. by 2in. made of cloth and stuffed with paper or "conkers"), lorries, cars, Castrol barrels, gravel, boilers, tins, animals, coal, batteries and milk cans. Quite a busy concern; and the railway's general manager, Master Peter Bailey, also mentions that more than 3,000 rounds were run on the inside circle during 1942, "but 1943, say our special correspondents, will be an even better year." I am sure it will and I wish such an enterprising firm every success.

In his preface the author pays tribute to his brother, M. F. Bailey, and his friend, A. Thomas, also the president for his kind help in many ways, and Mrs. Bailey "for the free run of her attics," and Mr. Holmes for assistance in electrical matters.

I think he voices the opinion of many readers when he writes: "I think model railways is a jolly good hobby, and we have always taken great care of our models, especially engines (the tank hasn't a scratch on it after four years running) and that is how we have such a nice lot of rolling stock and other features."

The secret of real enjoyment of any hobby is to take care of the "tools" you use! Continued good trade and prosperity, Baileys Railway Ltd.!

A Bathroom Model

To those who are handy with woodworking tools and interested to make a present for a friend or for their own bathroom, might I suggest an idea I came across the other day of a model container for bath cubes made in the form of a model wardrobe. The illustration gives you the main essentials—a bottom drawer with no sides, then the front of the cabinet sliding up so that the cubes can be inserted one on top of another. With the front replaced the cabinet is ready for use, you open the drawer, take a cube out and the next one slides down in place.

Model making in the Services. Soldiers making aircraft for special recognition work.

This, made in lime or sycamore and painted in attractive colours, is a neat and useful addition to bathroom equipment, and certainly an inexpensive and rather charming present, free from the restrictions governing the limitation of supplies!

Models in the War Effort

I have often made reference in these pages to the important part models are playing in the war effort. They are used by all the Services, and there are many men (and women too) in uniform engaged in model making as well as some of the best known commercial firms. Here are soldiers making models of 'planes at an anti-aircraft school for officers in the north-east of England. Over 300 N.C.O.s and officers are trained here, and one of the most vital parts of their work is aircraft recognition. The model aircraft being made by these men are used in their instruction, and over 60 different types, both British and enemy, are made and their shadows cast on a screen for identification.

Science Notes

1,300-mile Pipe-line

WHAT is stated to be the world's biggest oil pipe-line, stretching 1,341 miles from Longview, Texas, was opened at Phœnixville, Pennsylvania, recently by Mr. Harold Ickes, Secretary of the Interior. The pipe was laid in 350 days, and has been designed to deliver 12,600,000 gallons a day.

Paper Parachutes

ACCORDING to a report from the United States, parachutes made of paper, and capable of handling loads up to 50lb., now replace those previously made of silk and nylon. These paper parachutes are used for dropping emergency supplies by the Civil Air Patrol.

Coal Dust "Eggs"

AS there is an abundance of anthracite dust in the coalfield at Swansea Valley, a briquetting plant is to be set up there by arrangement with the Ministry of Fuel. It is expected that over 150 tons of coal "eggs," made of the coal dust mixed with pitch, and suitable for domestic use, will be produced next winter.

New Armour-piercing Bomb

ADMIRAL BLANDY, chief of the U.S. Navy Ordnance Department, stated recently that special dive-bombers will have to be used for America's new armour-piercing bomb designed for sinking battleships. It is claimed that the new bomb can pierce the protective decks of a battleship and explode in its interior. Its principal features are a delayed-action fuse, a very thick shell and a heavy nose.

Airport Plan for London

A PLAN for a London airport was announced recently by Mr. F. G. Miles, the aircraft constructor, and managing-director of Phillips and Powis Aircraft, Ltd. The proposed airport, which would incorporate both a land and a marine base, would be large enough to accommodate the largest land-'planes and flying-boats envisaged. Mr. Guy Morgan, the architect, is responsible for the design of the airport, which is sited in a bend of the Thames. The estimated cost would be approximately £20,000,000 after the war.

The plan indicates an egg-shaped flying-boat base fed from the river, and main runways of the land base are 600ft. wide and 2½ miles long. The airport is planned to deal with 8,000,000 passengers a year.

The "Iron Duck"

THROUGH a large Ford factory in Chester, Pennsylvania—one of four in the United States—pass guns, tanks, trucks and other armoured vehicles for Britain and Russia. All the equipment is made rust proof, and among the machines turned out at the factory is the amphibian tractor known as the "Iron Duck," which serves as a troop carrier on land, or in the water.

Stabilising a Tank's Gunfire

A MACHINE which stabilises the gunfire of a tank, no matter how much it pitches and rolls over rough terrain, is the subject of a recent American invention. The U.S. Army Ordnance authorities believe the idea has increased tank shooting accuracy by several hundred per cent. Production of the device is at present on a level with tank output. It is stated that not only do the 75 mm. guns in the M3 medium tanks outrange the Germans' best, but these guns can now be fired when the tank is in motion, thanks to the new stabiliser, which is more than any enemy tank can do.

Cable Telegraphy

A Further Description of the Various Instruments Used for Transmitting and Receiving

By W. T. LOWE and E. PHILLIPS

(*Continued from page 336, July issue*)

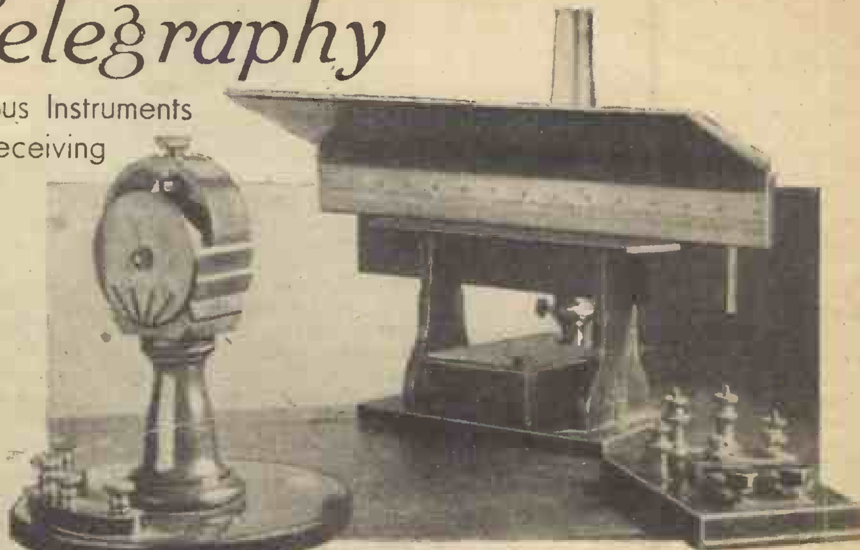


Fig. 9.—A mirror galvanometer.

WHEN wireless telegraphy became firmly established, and a necessary addition to wire telegraphy, attempts were made to adapt printing telegraph systems for use with the new medium.

One of the greatest difficulties in wireless working is caused, as you already know, by atmospherics, which may introduce unwanted extras among the currents being transmitted, and so cause false letters to be printed. In morse telegraphy by wireless such difficulties can be overcome to a certain extent by sending the same message twice, and correcting one reception by the other. If conditions are too bad for this, wireless working would be suspended until conditions improve. In mechanical telegraphy, such as the Baudot, more complex arrangements are necessary. The Hughes could be worked by wireless, but only when conditions are good.

The Baudot Transmitter

THE Baudot, however, was the favourite of the French administration, and efforts were made to adapt it for use between the home country and distant parts of the Empire.

Adaptation was at last successfully made by M. Charles Verdan, a telegraph engineer of Strasburg, Alsace. He evolved an apparatus whereby each letter telegraphed by means of a Baudot keyboard could be retransmitted automatically *twice* from the aerial. The letter was thus actually sent three times, and received three times, but only the third reception would work the actual receiving instrument.

Any atmospherics that intervened after the despatch of the first transmission were automatically wiped out of the second and third transmissions. M. Verdan invented a new and automatic relay for this purpose. Like the Baudot receiver, it was driven by a motor. Each letter was sent from the transmitting key *once only*, but through the Verdan relay each revolution of the brushes over the distributor caused a fresh transmission of this letter for two more transmissions, and a similar reception at the distant station. Two relays are used for each key and receiver. The third transmission passes from the second receiving relay into the Baudot receiver and prints the letter.

Unless atmospherics are very bad, so bad, in fact, as to make wireless reception even of morse impossible for a time, the inventor of this apparatus claims with justice that it will enable messages to be received with a proportion of errors due to atmospherics so small as to be negligible.

This has been proved in peacetime working between the mainland of France and Algiers and also Madagascar, and stations in other parts of Europe. Speed of working is, of course, reduced by two-thirds, as only one letter is actually printed for each revolution of the brushes of the distributor, instead of three letters, as would be the case in wire transmission. But the apparatus can be arranged to transmit three letters per revolution, if wireless conditions are good and repetitions unnecessary. In any case, the advantage of receiving the message ready printed, and correctly printed, even at slow speed, is great enough to justify the use of this clever apparatus.

Hughes and Baudot function well over land lines and short lengths of submarine cable, where the attenuation of the current can be corrected by means of telegraph repeaters.

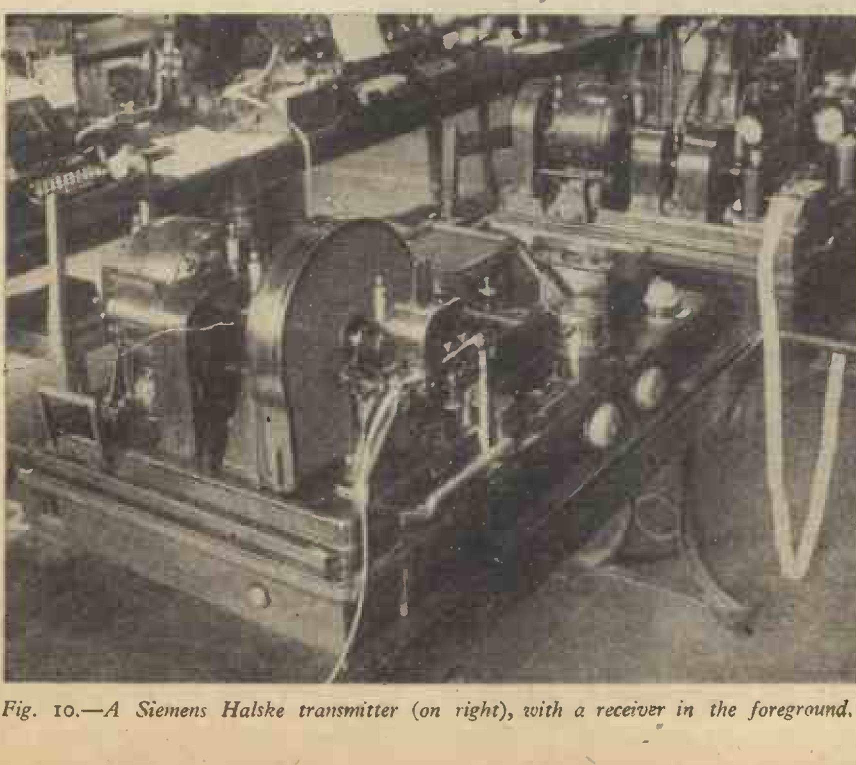


Fig. 10.—A Siemens Halske transmitter (on right), with a receiver in the foreground.

Long-distance Work

THIS, however, is not possible where long submarine cables are used. Over such cables the currents become very weak, and it has been necessary to devise very sensitive apparatus for their reception. Operation of a system used on long-distance cables (the siphon-recorder) was based on morse. Two keys were used, one to transmit dots, the other dashes. Received signals came out on a paper tape, not as long and short marks, but as undulations.

An imaginary line through the centre of the tape divided dots from dashes. The former appeared above the line, and the latter below it. An experienced cable operator could read from the slip at an astounding speed. On the cables which served the Stock Exchange, one of these experts would transmit direct to morse key, with the tape running in front of him, at something like Wheatstone working! At first, cable ships were installed with this apparatus for contacting the shore station through the cable whilst laying or repairing it at sea.

Found to be affected by the ship's vibration, however, the siphon-recorder was eventually superseded by the mirror galvanometer (Fig. 9); a sort of change back, because the mirror was the first instrument used for actually transmitting and receiving cablegrams. Invented by Lord Kelvin, the mirror is fixed by means of a drop of wax upon a tightly stretched silk fibre. It measures only a quarter of an inch in diameter, and rotates from left to right or vice-versa under the slightest impulse. The needle of a sensitive galvanometer is affixed to the back of the mirror. This moves in one direction or the other, according to the polarity of the impulse affecting the galvo. Focused upon the mirror, a ray of light reflects upon a white surface a few feet away. You wouldn't see any movement with the naked eye, but, suspended from its silken fibre weighing no more than the strand of a spider's web, the mirror trembles very gently, the received impulses are greatly magnified, and thereby made readable to the operator. Cable operators read their signals in morse from this apparatus for some years after the first deep sea cables were laid.

The Writing Telegraph

THE instruments already described are hand-operated, so search for an apparatus almost entirely machine operated was inevitable. Invented by two Hungarians in the last decade of the last century, the Pollak-Virag Writing Telegraph appeared to give promising results. Transmission was by paper tape perforated in a special five-unit code. Two lines were required for transmission. At the receiving end two telephones were used. Rods were connected to their diaphragms, which moved when currents were received and caused oscillation of a small concave mirror, supported upon one fixed point and two movable points. One telephone diaphragm moved the mirror about a horizontal axis and the other about a vertical axis, so that, acting together, they caused a reflected spot of light to trace any desired curve. There was a spot-light lamp surrounded by a metal mantle in which a helical slit was cut. The light shone through this slit on to the mirror, and was reflected from the mirror on to a strip of photographic paper, which the apparatus kept moving. After exposure, the paper tape was transferred into developing, fixing and washing baths, and, after drying, was gummed on a telegram form and sent out for delivery. The message was by this means received in a form which closely resembled handwriting of an angular pattern, though it was not, of course, facsimile telegraphy. Operation of the apparatus required a high degree of stability in the lines used, not always possible in those days of overhead lines. Although a speed of 600 words per minute was obtained in experiment it was not adopted for regular use. Results on submarine cables between this country and Europe did not warrant it being adopted. Photographic methods of telegraphy lapsed into disuse until the invention of picture and facsimile telegraph apparatus by Edouard Belin in France, Professor Karolus in conjunction with the firm of Siemens and Halske in Germany, and The Bell Telephone Company in the U.S.A. This was in the 1920's. As the daily papers show, this apparatus in one form or another has come to stay.

Automatic Printing Telegraph

AN automatic high - speed *printing* telegraph (Figs. 10 and 11), however, was introduced in the first decade of this century by Siemens and Halske, the result of researches and experiments conducted over many years. The only manual operation required in this system is the preparation of paper tape for transmission, and gumming of received printed tape on to message forms. There is also, of course, recording of transmitted and received messages (and associated services), which is done by the members of the staff detailed for the purpose. The machine can deal with a speed up to 1,000 letters per minute.

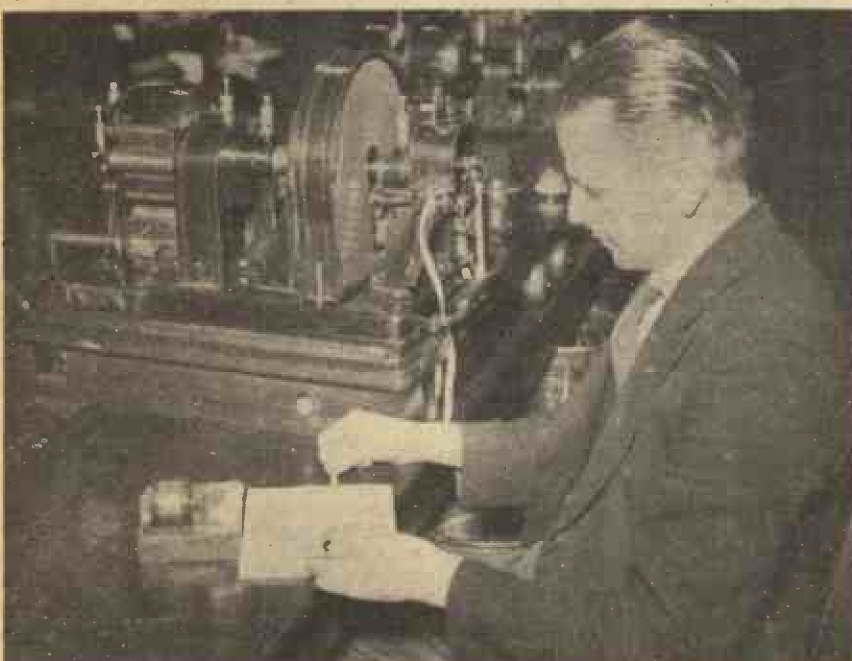


Fig. 11.—Receiving a cablegram on a Siemens receiver.

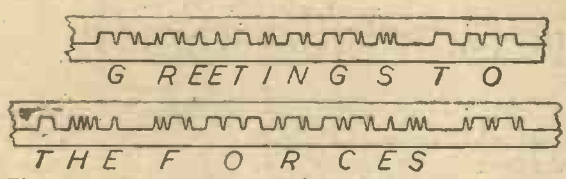


Fig. 13.—A specimen strip as recorded by the undulator.

A special five-unit code (Fig. 12) is used for transmission. Machines for preparing perforated tape for transmission have electrically operated punches worked by a keyboard of the typewriter pattern. The perforations are made in a line across the tape. After preparation the slip is put into the transmitter, which is a self-contained unit. It consists of a distributor of two concentric brass rings. The outer ring is divided into five segments, each of which is connected to one of the transmitter pins. The inner ring is continuous and connected with the line by means of a transmitting relay. A motor causes a brush arm to revolve with copper brushes moving over the faces of the two rings, and so allowing the spacing or marking currents, caused by the perforated tape passing over the transmitting feelers, to pass to the transmitting relay in proper sequence.

The usual necessary arrangements for speed control and synchronisation are embodied.

Apparatus used for reception is more complex. The signals from the transmitting station are received on a polarised line relay. These signals cause the relay tongue to move to the spacing or marking stop. Their function ended, they pass back to the transmitting station. The spacing and marking stops of the relay are connected to a battery whose centrepoint is connected to a brush arm moving over a brass ring which has five segments. As the tongue moves in accordance with the received currents, spacing or marking currents will pass through the brushes via the five segments of the ring into the coils of five relays, one for each segment, setting the tongues of these relays to spacing or marking as required. There are the printing distributor relays. Two banks of five relays each are in use, and it is arranged that while one bank is being set up by the currents at that moment being received, the other bank has already been set up by the preceding currents and is connected at that moment with the distributor which controls the letter-selection and printing mechanism. In effect, one bank of relays prints a letter and returns to normal while the other bank is being prepared to do the same thing at the next moment, and this continues alternately throughout the session.

Letters	Figures, etc.	1	2	3	4	5
A	.		●	●		
B	/		●		●	●
C	'	●	●	●		●
D	&	●				●
E	3	●	●	●		
F	!	●		●	●	
G	"	●	●		●	●
H	;	●	●			●
I	8	●				
J	=		●			●
K	§				●	
L	+	●	●	●	●	
M	?		●			
N	–	●	●			
O	9	●			●	●
P	0		●	●		●
Q	1			●		●
R	4				●	●
S	:			●	●	
T	5					●
U	7		●	●	●	
V	)	●		●	●	●
W	2	●			●	
X	(		●		●	
Y	6	●		●		
Z	,	●		●		●
Letter Space				●	●	●
Figure Space			●	●	●	●
Erasure →		●	●		●	
Unison Signal →				●		
Stop		●	●	●	●	●

Fig. 12.—A five unit code used for transmission.

Joined together in pairs by copper brushes held in a revolving brush arm, the printing distributor consists of six concentric brass rings. On the brush arm axle, the typewheel is also mounted. This is divided into two parts of 28 spaces each. The front part of the rim has the letters of the alphabet and some signs. The back part has figures and other signs. The type wheel is moved forward or backward by the operation of "figure" or "letter" space signal.

The rings of the distributor are arranged as follows. The innermost, No. 1, is continuous. Next, R.2, is divided into two parts of equal length. Rings 1 and 2 are joined together through the brushes. Ring 3 is divided into 4 equal parts. Two of these are opposite each segment of Ring 2. Ring 4 is divided into eight equal parts, each pair of segments opposite one segment of Ring 3. Rings 3 and 4 are joined together through the brushes, Ring 5 divided into 16 parts, each pair of segments opposite one segment of Ring 4. Ring 6, the outermost, is divided into 32 parts, each pair of segments opposite one segment of Ring 5. Rings 5 and 6 are connected together through the brushes. In addition, each ring has another short segment at the end of each series, but only the short segment on Ring 2 is in use. The segments of each ring are connected alternately to the spacing and marking stops of one of the five relays already mentioned, with the exception of Ring 1, which is connected to the power supply. (The terms spacing and marking are used here for conventionality, for in this case their only purpose is to provide, with the relay tongue, a path for the current from one of two segments of each ring at some particular part of that ring.) Now, current from the power supply can pass from Ring 1 through the brushes to Segment 1 or 2 of Ring 2, according to the position of the brushes, thence to the spacing or marking stop as dictated by the current received on Relay 1. The tongues of Relay 1 and Relay 2 are connected together, so the current will continue through the tongue of Relay 1 to tongue of Relay 2, and via the spacing or marking stop (according to current received on Relay 2) to the corresponding segment of Ring 3. The brush being at that moment on that segment, the current flows through the connecting brushes to the corresponding segment of Ring 4. From here through the spacing or marking stop and tongue of Relay 3 to tongue of Relay 4. Thence via the spacing or marking stop to the corresponding segment of Ring 5, and via the brushes to the corresponding segment of Ring 6. From this segment of Ring 6 the current flows via the spacing or marking stop of Relay 5, through the tongue to the coils of the electro-magnet which controls the printing hammer. The other side of these coils is connected with the return path to the current supply.

Operation of printing the letter is performed by discharge of a condenser which is placed in series with the coils of the electro-magnet. This condenser is connected with the short final segment of Ring 2, mentioned above. It is charged at each revolution of the brushes, and when the current path to the printing hammer has been opened by operation of the relays as just described, it discharges through the coils of the electro-magnet attracting the armature. This discharge is momentary and very sharp. Pivoted at its centre, the other end of the armature-printing hammer is under the typewheel, and the paper tape between the two. Consequently, the free end of the printing hammer raises the paper smartly against the typewheel at the moment when the required letter or figure is facing the paper. Duration of pressure is so small that no blurring occurs, although the typewheel is revolving at a rapid rate. The paper is then moved forward one space, and the second bank of relays brought into operation. There is only one position of the relay tongues which will cause any particular letter or figure to be printed. Special signals or settings denote change to letters or figures. When these are received the printing wheel is caused to move forward (for figures), or back to the normal position for letters. Segments 2 and 4 of Ring 6 are joined to a relay for this purpose. Segment 1 of Ring 6 gives a "stop" signal by ringing a bell, and Segment 3 of Ring 6 gives a sign which, when received in sequence, shows that the sender and receiver machines are in synchronism. Segments 5 to 32 correspond to the letters and figures on the typewheel.

This apparatus is very efficient, and can deal with speeds between 200 and 1,000 letters per minute. Counting in the telegraphic way of five letters to the word, this gives a speed of 40 to 200 words per minute. The choice is determined by line conditions.

Staff employed may vary according to the amount of traffic to be prepared for transmission, and to be gummed on message forms, recorded and circulated at the receiver point. One operator, technically skilled, is usually in charge of the two machines, putting the prepared slip in the transmitter, keeping a watchful eye on the receiver, and dealing with faults as they occur.

Proved to be dependable and to fulfil demands made upon it, the Siemens-Halske is, of course, a favourite in Germany, and has been used for communication with countries which had wire communication or submarine cable connection of comparatively short length, Norway, Sweden, and Great Britain. It has also been worked by wireless when conditions were favourable, and experiments have been made to adapt the Baudot-Verdan system, previously described, to it for the work. The apparatus can be worked Duplex, but with the extension of the voice-frequency system for providing several telegraphic channels on one wire, two-way simplex is usual. It is not so personal a system as Morse, Hughes, Baudot or Teleprinter. Queries and replies, etc., have to be made by means of prepared slip. But the high speed of working is an advantage telegraphically, which offsets the difficulty in some degree.

Very sensitive recorder for morse signals, the Undulator is allied to the siphon recorder. The coils are upright, and non-polarised. Two armatures, one playing between each pair of poles, are fixed to an upright rod, and the extension of this has a fine metal tube attached. One end of this tube is curved and rests on the paper tape, which is supported by a curved metal plate. The other end of the tube is attached by rubber tubing to the ink supply held in a metal container supported by a pillar. A special ink is used. The paper tape is kept moving by a motor. When a spacing current is being received, a fine line is traced along the bottom of the tape. But signal currents cause the armatures to move between poles of electromagnets, and the ink siphon moves with them. A wavy line is thus traced on the type (Fig. 13).

Dots and dashes are shown by short or long marks at the upper limit of the siphon's movements.

Making a Saddle-bag

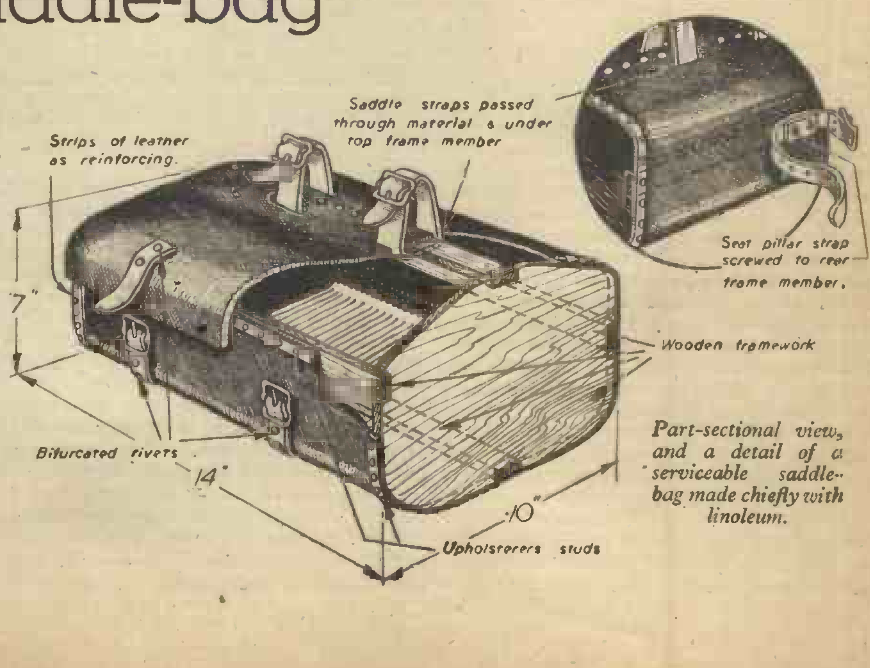
SADDLE-BAGS, at least those of roomy dimensions, are very scarce, and there seems little hope of the position improving.

I decided to construct one on the lines shown in the accompanying sketch.

The frame is of wood, and the covering can be of stout canvas, or if that is in short supply good linoleum can be used. The covering material is fastened to the framework with strips of strap as reinforcing and large-headed upholsterer's studs.

The fastening straps were made up from odd lengths of strap and were fixed to the covering material by means of bifurcated rivets, except in the case of the seat pillar attachment strap, which was screwed through the material on to the rear frame member. The saddle straps, as will be seen, are passed through slats in the material and pass under the top frame member in order that the weight will be taken on the frame and not the material.

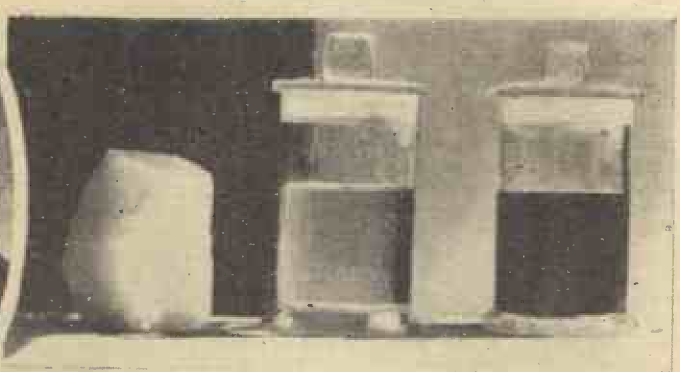
A coat or two of enamel add the finishing touch to a saddle-bag which is not only easy to make but roomy and far from costly.—R.B.



Part-sectional view, and a detail of a serviceable saddle-bag made chiefly with linoleum.

The Story of Chemical Discovery

Facts About Fats



Chemistry's Contribution to a Vital Subject

Above: Michel Eugène Chevreul, the discoverer of the chemical make-up of fats. He was 100 years old when this photograph was taken. Below: Glycerine and stearic acid, the two main components of all hard fats. Top right: The jar on the right contains crude cotton seed oil, the centre jar contains purified cotton seed oil (synthetic olive oil), whilst on the left is a lump of hard fat made by the hydrogenisation of cotton seed oil.

TOGETHER with the sugars and starches, the fats which we eat and digest constitute the main source of our vital energy. Without the regular intake of fat of one description or another our bodies would quickly languish and ultimately cease to function. Fat is, indeed, one of our essential physical life-givers. Without it, we could not exist.

Chemistry during the past and the present centuries has been much concerned with the subject of fats and fatty oils. There is, indeed, a veritable romance to be read into the scientific story of the fats, the discovery of their chemical make-up, their commercial utilisation and the gradual working-out of means of converting one fat into another. So wide and so comprehensive is the scientific record of the natural fats and the fatty oils that it can only be dealt with in a very brief and outline manner in this article. Nevertheless, the fascinating story of the fats, even when briefly summarised, will serve to illustrate the manner and the technique with which scientific chemistry has dealt with some problems of everyday life.

A large number of fats are of animal origin. There are, for example, suet, lard, bone fat, butter fat, goose fat, and horse fat. And there are numerous vegetable fats which are, in most instances, of an oily nature, such as olive oil, cottonseed oil, peanut oil, rape oil, sesame oil, corn oil and so forth. Although a few of the vegetable fats, such as copra and palm-kernel oil, are more or less solid, most of the fats of vegetable origin are oily in character, whilst the majority of the animal fats are solid in nature.

The Centenarian Chemist

The scientific study of the fats began in real earnest with the chemical researches of a French chemist, one Michel Eugène Chevreul, who was born in 1786 and who lived in full possession of his intellectual vigour to the remarkable age of 103 years. Chevreul occupied many chemical positions, industrial and academic, during his long lifetime. In 1816, he established the fact that ordinary soap is a product resulting from the action of an alkali with an acid constituent of a fat, the other fat constituent (glycerine) being liberated during the reaction. In other words, Chevreul showed that when we boil up a quantity of a fat, say, stearin or mutton fat, with a certain quantity of caustic soda (sodium hydroxide) we obtain a soap plus glycerine.

Chevreul demonstrated the fact that animal fats are essentially chemical compounds of glycerine with various substances which afterwards came to be known as "fatty acids." Fats are *glycerides* of these fatty acids, and when a strong alkali takes the place of the glycerine portion of the natural fat, what we know as soap results. Thus:

$$\text{Fat} + \text{Alkali} \rightarrow \text{Soap} + \text{Glycerine}$$

The process of splitting up a fat into glycerine plus fatty acid and of combining the fatty acid with an alkali to form a soap is known as "saponification" (Latin, *sapo*, "soap"). Industrially, it is known as "soap-boiling." It is a process which has been known for centuries, although its precise chemical significance has only been appreciated as a result of the work of Chevreul and other chemists.

Glycerine contains only carbon, hydrogen and oxygen. The various fatty acids with which glycerine is combined in the natural fats are, likewise, merely compounds of these three elements. Hence, fats are intrinsically three-element compounds.

As the nineteenth century wore on, chemists, availing themselves of the new methods of organic chemistry, studied deeply the various fatty acids which were obtainable from natural fats. They divided them into a number of classes, three of which are now presented to the reader for consideration, viz:

$C_{18}H_{32}O_2$	Linoleic acid.
$C_{18}H_{34}O_2$	Oleic acid.
$C_{18}H_{36}O_2$	Stearic acid.

Linoleic acid is the active constituent of linseed oil, oleic acid of olive oil and stearic acid of ordinary beef or mutton fat. When perfectly pure, these acids are quite tasteless. Nature, however, invariably accompanies them and their natural compounds, the fats, with one or more strongly-tasting and, often highly odoriferous substances. Thus fish oil, in its crude state, has a highly unpleasant odour, due, mainly, to the presence of a material known as clupanodonic acid, which is itself a fatty acid, while ordinary fats and vegetable oils are given their characteristic tastes by virtue of the presence of small amounts of other substances.

Hydrogen Content

Glancing for a moment at the chemical formulæ of the three fatty acids listed above, it will be noted that they differ in composition only in respect of their hydrogen content. Linoleic acid contains the least hydrogen of the three; stearic acid the most hydrogen. Linoleic and oleic acids are oily liquids at ordinary temperatures; stearic acid is a solid. Hence we note that one of the results of increasing the hydrogen content of a fatty acid is to raise its melting-point, to change it from a liquid into a solid at ordinary temperatures.

Natural fats which contain a preponderating amount of *olein* (that is, of the natural glycerine-oleic acid compound) are oily in nature, as, for example, olive and peanut oils. Fats which are made up mainly of *stearin* (the natural glycerine-stearic acid compound) are solid at ordinary temperatures. Yet both these classes of fats are utilisable by the human body. Our preferences between hard and soft natural fats are purely matters of natural temperament and training. The Italians include much olive oil in their diets, even to the extent of spreading it on their bread. The more northern and the American nations prefer the hard fats, in the guise of butter and margarine, for such purposes. Nevertheless, both fat classes are equally nutritious.

Fatty acids of the stearic acid family or group are called "saturated" compounds because they contain as much hydrogen as they can hold. The other fatty acids, the oleic and the linoleic groups, are "unsaturated" because it is possible to combine them with hydrogen (or other elements) until "saturation" point is reached.

If we combine linoleic acid with hydrogen we obtain oleic acid. If oleic acid is combined with hydrogen it is changed into the ordinarily solid stearic acid.

Linoleic acid, being a definitely "unsaturated" compound, will absorb oxygen as well as hydrogen. If we expose a film of linoleic acid or of linseed oil to the atmosphere it slowly absorbs oxygen and becomes hard and tough. This absorbing action is much facilitated by incorporating certain metallic substances, known as "driers," into the oil. Linseed oil, therefore, is a "drying oil." On account of this characteristic it is made enormous use of in the paint trade, the linoleum industry and in other manufacturing activities.

Cottonseed, corn, sesame and other oils have this oxygen-absorbing property in a smaller degree. They are called "semi-drying" oils, since, when exposed to the air, they never harden completely, but always present a tacky, viscous surface. Finally, there are the non-drying oils, such as olive oil, peanut and other similar oils, which are based upon oleic acid.

Sebatier and Senderens

We have already noted that by the addition of hydrogen to liquid fatty acids, they can be changed over, stepped up, as it were, into the more valuable solid fatty acids, such as stearic acid. Previous to 1899, this process of conversion was a very difficult operation, but in that year two French chemists, Paul Sebatier and Jean Baptist Senderens, of the University of Toulouse, hit upon the idea of employing an activated nickel powder as a catalyst or reaction-energiser in the hydrogenation of fats and fatty oils. The process of pumping hydrogen under pressure into vats containing liquid fats together with a small proportion of metallic nickel powder proved eminently successful, although not in the country of its origin. It was the Germans who made the most of the newly-discovered Sebatier and Senderens process for the hydrogenisation of fats. Other countries merely followed the German example at a later date.

By means of hydrogenisation, you can convert "unsaturated" drying oils, such as linseed oil, into solid fats of the stearic acid group. By the same process, the stinking fish oils can be changed over into the nowadays highly valuable and commercially utilisable fats of the stearic acid group. In fact, any natural fatty oil, no matter how rank and objectionable its smell, taste and general character, can be changed by the Sebatier and Senderens process into the economically valuable and edible hard, stable fats.

Such processes of fat hydrogenisation are proving one of the mainstays of civilisation, particularly in the present troublous times. Butter is in short supply in all the belligerent countries Synthetic butter, otherwise margarine, a product which has immensely improved since the coming of fat hydrogenisation, has been officially detailed to make up up for the butter deficiency.

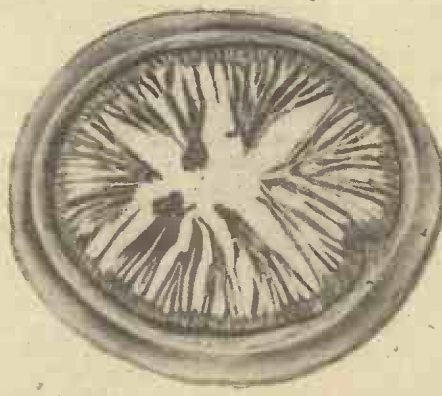
Margarine Manufacture

Now, margarine is intrinsically a wartime product. The French Government, in 1869, offered a prize for a satisfactory butter substitute which would be cheaper in cost than butter and more plentiful in times of military operations. The award was made to M. Mege-Mouries, who found that by carefully chilling purified beef fat, the solid stearin would separate itself from an oily fat, which latter was essentially the same as that contained in milk. This latter was processed-up, and eventually butter-substitute, or "margarin," as it was originally termed, came into being.

Nowadays, of course, margarine manufacture has become a veritable triumph of chemical skill and research, and by the additions of vitamins, together with carefully-controlled flavours and colouring-matters, the high-grade product of our days simulates natural butter with much success. Margarine manufacture, however, could not have been so economically successful if the Sebatier and Senderens fat-hydrogenisation process had not been discovered, for, by means of this process, whale and other fish oils may be hydrogenised and changed over to fats of the odourless stearic group which are at once utilisable for conversion into margarine. Thus a vast source of natural fats and oils has been placed at the disposal of modern civilisation for edible purposes. Even if butter and olive oil were never seen again, the civilisation of the future is not likely to become ill-nourished through want of an adequate fat intake.

During the last war, the Germans, as probably they will be in the present conflict, were in desperate straits in the matter of their fat supplies. Oils of rank origin and dubious character were eagerly sought and hydrogenised-up into fats of the stearic group for human consumption. There is an actual record of the fact that during that war the Gerbmns brought the normally loathsome and well-detested bluebottle fly into their service for the purpose of fat production. This creature in its thousands was induced to lay its eggs on fish offal. Within a day or two an enormous crop of grubs resulted, which, after they had grown to a maximum size, were raked away and put into a press. A pale yellow fatty oil was expressed from them, the yield being 45 grams of oil per kilogram of grubs.

Disgusting as this narration may be, it is necessary to mention it here in order to stress the fact that, carefully hydrogenised, this "bluebottle oil," as we may call it, could be converted into the purest of stearins for margarine making, and that, in this guise, it would be equally as nutritious as any other form of fat—"to one who has no imagination," as one writer quaintly put it!

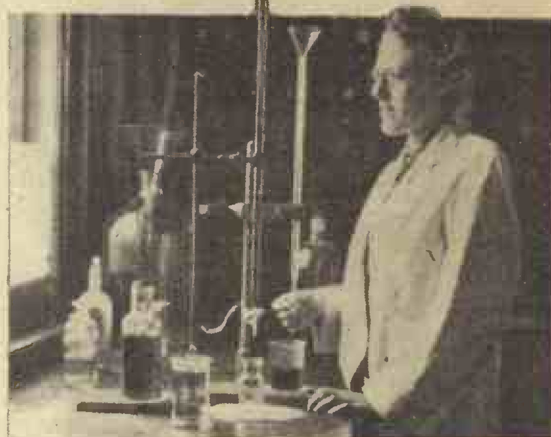


Nature's mechanism for fat absorption. A section of the small intestine of a dog, showing the fibrous lining through which absorption into the blood stream takes place.

All the fats and oils which are found throughout the animal and vegetable kingdoms, although they differ enormously in palatability, have practically the same food value and the same digestibility. All of them are capable of supplying the body with from two to two-and-a-quarter times as much energy as any other food. They are all compounds of carbon, hydrogen and oxygen.

So far as we are at present aware, there exists only one poisonous fat. This is chaulmugra fat, which is obtained from Indian maratti oil. In 1910, the Germans began to make margarine from it. An outbreak of poisoning resulted and the maratti oil was thenceforth blacklisted for all edible purposes.

One or two natural fats, notably castor oil, have a well-defined purgative action, but, with these exceptions, the natural fats and fatty oils, when carefully purified, are, in reasonable quantities, beneficial to us.



Estimating the alkalinity of a soap—a routine test which is made daily in all soap-producing firms.

There is still some disagreement as to the precise manner in which the various fats are taken up and absorbed by our bodies, but it seems definitely to have been established that a stomach juice in our systems contains an enzyme or active chemical substance which is named *steapsin*. This steapsin chemically spilts up tht fats which we eat, converting them into glycerine, and their constituent basic fatty acids. A part of the freed fatty acids is converted into soap through combining with the alkaline medium in the upper intestinal tract, which soap acts as an emulsifying agent for the remainder of the fatty acids. The fatty acids and the glycerine are subsequently absorbed through the intestinal walls. Once in the body, the fatty acids are re-converted into actual fat, which is stored by the body as a reserve food material. If such material is not actually required, the body continues to store it—ultimately to its own detriment, for the unhealthy nature of undue fatness or adiposity is well known. A man who has become emaciated by poor food and semi-starvation has little fat in his tissues, for his ordinary muscular exertions have been more than sufficient to oxidise his scanty fat supply away into carbon dioxide gas and water.

Human fat is yellow and butter-like in appearance. It contains stearic, palmetic and oleic acids, the oleic acid being preponderant.

It has been conjectured that, in the future, meat and dairy products will become scarcer. If this proves to be the case, we shall become increasingly dependent upon fats and oils of vegetable origin, of which there is apparently an unlimited supply.

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.

Electric Arc Soldering

I INTEND making some electric soldering equipment, using a carbon electrode to form a small arc between the carbon and the job, to melt the solder, similar to electric welding.

Could you advise me on the following points: (1) Voltage to use (mains 250 A.C.) (soft solder, silver solder or spelter being used); (2) Kind of transformer to use; (3) If a design for a suitable transformer has been published by you and if it is still obtainable?—C. Spoors (Glasgow)

IT is hardly likely that a successful electric soldering equipment could be constructed on the lines suggested, on account of the fact that the temperature of the electric arc set up would be so high that it would be liable to damage the materials to be soldered. In the soldering process, it is desirable that the materials should be heated more or less gently to the melting point of the solder, whereas the electric arc gives a concentrated heat of high temperature and one which is not readily controlled.

Gas-proof Room

CAN you inform me if compressed gases can still be purchased, although they may not be required for work of national importance?

I intend to construct a partly gas-proof shelter in a dining-room. What amount of oxygen (i.e., cubic feet per hour) should be used in keeping the room in a habitable condition, at normal temperature, should conditions necessitate the use of such a shelter? How can the carbon dioxide be removed by chemical means in order to keep the air pressure at a safe level?

Would you please explain how nitrous oxide, prepared by heating ammonium nitrate, is purified?—K. L. Churley (London).

(1) Compressed gases, such as oxygen, nitrogen, carbon dioxide, ethylene, etc., are still to be obtained from The British Oxygen Co., Ltd., Wembley, or from any of their many branches and supply depots.

(2) You do not give us the dimensions of the shelter which you propose to make. Neither do you let us know the number of persons which it is to contain. These and other details would be required to calculate the necessary oxygen content of the apartment. However, you may make a rough estimate for yourself by taking into consideration the fact that the average adult human being inspires about 500–600 c.c.s of air at each intake of breath, and that the number of respirations is usually 15 to 18 per minute. Air contains, approximately, 20 parts by volume of oxygen. In our opinion, it would be most unwise to take a compressed air or oxygen cylinder into an air-raid shelter, for, in the event of a bomb exploding in the vicinity, the hazard would be increased owing to the possibility of the cylinder itself being shattered by blast or by other cause.

(3) Carbon dioxide can be removed from air by means of strong solutions of caustic potash. Clothes could be saturated with this solution and hung about.

(4) To obtain perfectly pure nitrous oxide (N_2O), as derived from the heating of ammonium nitrate, the gas should be passed through a strong solution of iron (ferrous) sulphate to absorb any traces of nitric oxide gas, and, afterwards, through a solution of caustic soda, to remove any chlorine which may be present in the gas in consequence of the existence of traces of ammonium chloride in the ammonium nitrate used for the preparation of the nitrous oxide. The gas should then be washed by passage through a small quantity of water. Finally, it should be dried by passage over calcium chloride or some similar dehydrating agent. All supplies of nitrous oxide for anæsthetic purposes are very carefully purified in this manner.

Solenoid Construction

I WISH to make a solenoid, ⅜in. diameter by 1in. to 1½in. long, with sufficient striking power to push down a piano key.

Will you kindly furnish me with the following information:

The voltage required. The diameter of wire. The number of turns required. The diameter of core, and the correct way to wind the coil?—D. C. Hall (Chingford).

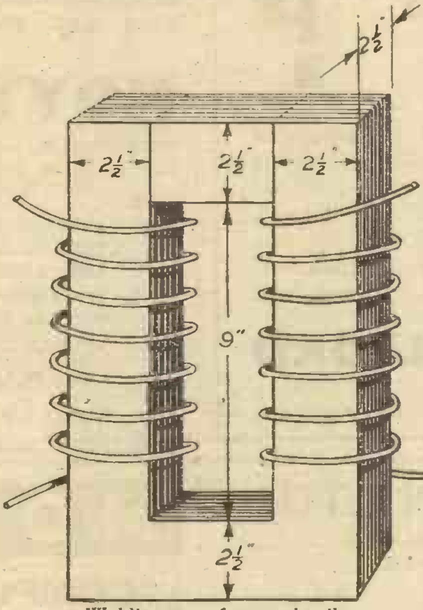
THE force required to depress the key of a well-made piano varies from about 2 ozs. to 3½ ozs. when the key bed is reached. The coil can actually be designed for any particular voltage available, but there are certain factors which should be taken into consideration. In the first place D.C. current will be the best to use as it will enable a simple type of solid iron core to be used, and the coil will be less noisy than an A.C. coil. For safety reasons and to eliminate the necessity of taking up a lot of space with insulation a low voltage is preferable, and 12 volts D.C. could be used.

The small diameter of ⅜in. rather limits the winding space, but you might experiment with a coil of 900 turns of 32 s.w.g. enamelled wire on a former 1½in. long, with a ⅛in. diameter core. All the turns will be wound in the same direction and a variable resistance should be connected in circuit to control the pressure on the key.

Welding Transformer

CAN you please tell me how to wind a transformer for input 230 volts having an output of 50 volts at a high amperage? I want to make an arc welding set with the metal filling rod as one electrode and the other wire earthed on to the job. Have you any book dealing with this subject or any blueprints? Does a piece of wire, a given length, offer the same resistance if in a straight line as it would if wound into a coil?—S. Beardsell (Huddersfield).

A LENGTH of a certain size of copper wire has the same resistance when straight as when it is made into a coil. This does not mean that the same value of current will pass through the wire when connected to a given voltage, if the supply is A.C. as the mutual inductance between the turns when wound into a coil will set up a reactance voltage so that the coil will pass less current on A.C. than it would on the same voltage D.C. The coil will pass less current than the straight wire if the supply is A.C.



Welding transformer details.

Assuming you require an output of about 80 amps. from the transformer, the core might consist of insulated thin iron laminations, built up with overlapping joints to a thickness of 2.5in. as shown.

The primary winding could consist of 192 turns of 11 s.w.g. wire, whilst the secondary winding could consist of 5 coils each containing 42 turns of the same wire as the primary, the 5 coils being connected in parallel. It is important that the 5 coils be adjusted, if necessary by varying the turns slightly, so that an equal voltage is generated in each coil.

If you prefer to buy a welding transformer it is desirable that this should be one which is specially designed for welding, so that you would either have to obtain one from a transformer manufacturer, a maker of welding plant, or a secondhand welding transformer. I do not know of any books which deal specifically with the design of welding transformers.

Stage Dimmer

I DESIRE to construct a 10-stud dimmer for a small stage set-up and I would be obliged if you would advise me whether a series resistance (a) or a potential dividing system (b) would be the most suited and what resistances should be used.

The supply is 230/250 volts A.C. and the current consumption is 4 amps.—G. T. Lewis (Swansea).

A SERIES resistance would probably be the most suitable and the following lengths of nickel-chrome resistance wire could be used between the various studs:

1 to 2	4.9 yds.	20 s.w.g.
2 to 3	5.95 yds.	20 s.w.g.
3 to 4	6.35 yds.	21 s.w.g.
4 to 5	12.4 yds.	21 s.w.g.
5 to 6	9.5 yds.	22 s.w.g.
6 to 7	8.2 yds.	24 s.w.g.
7 to 8	10.6 yds.	25 s.w.g.
8 to 9	10 yds.	29 s.w.g.
9 to 10	14.5 yds.	34 s.w.g.

Making a Camera Obscura

I WISH to build a camera obscura and I shall be pleased if you would inform me what type of lens I should use.

Where can I obtain parts, etc., for building the instrument?—R. J. Browness (Kirn).

TO make a camera obscura to give a sharp and bright picture, it is essential that you use a good lens and a really flat mirror. Both these items are expensive.

The most suitable type of lens is a telescope object glass of about 4 or 5 feet focus, which perhaps you could obtain second-hand through sale and want adverts. of certain periodicals. The mirror should be optically flat, but failing this you might try a piece of good plate glass silvered on the front surface. It is useless to use a good lens unless you have a good mirror.

You could by way of a makeshift try using a spectacle lens. This would be quite cheap but the image would not be very bright. The table on which the image is projected would be better slightly saucer shaped to counteract spherical aberration of the lens.

Lubricant for Turning Iron and Steel

PLEASE state the quantities of soft soap and washing soda which should be used per gallon of water as a lubricant for use when turning iron or steel.—H. Merryweather (Southwell).

THE proportions are 1 lb. carbonate of soda, 1 quart soft soap, 10 gallons of water. Boil together for about ½ hour. An addition of 1 quart of lard oil is an improvement.

Extracting Ethyl Alcohol

CAN you please tell me if it is possible to produce ethyl alcohol from potatoes? Can you also give me instructions on how to produce small quantities in a home laboratory suitable for experiments in organic chemistry?

Also, can an electrical current of high amperage but very low voltage cause injury to a person?—A. Orwell (Manchester).

IT is possible to prepare ethyl alcohol from potatoes. The starch is extracted from the potatoes and this is hydrolysed to sugar, which latter is then fermented by means of yeast to alcohol, the resulting solution of alcohol being finally distilled in order to concentrate and purify it. We cannot give you any more *practical* details, since the unauthorised making of ethyl alcohol, even on the laboratory scale, is a highly illegal act. You can, however, look up more precise details on alcohol production in any practical book on organic chemistry, as, for example, in Perkin and Kipping's "Organic Chemistry," Part 1.

We would remind you of the fact that *iso-propyl alcohol* can be used in many experiments in place of ethyl alcohol. This alcohol is not dutiable and is, therefore, fairly cheap, costing, before the war, about 2s. per lb. It can be obtained from Messrs. A. Boake, Roberts and Co., Ltd., Buckhurst Hill, Essex.

(2) A high amperage current of low voltage can do considerable injury to a human being or an animal. Remember always that it is the amperes of the current which do the killing! The volts (or the electrical pressure) are harmless without the amperes.

THE Cyclist

Editor: F. J. CAMM

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Phone: Temple Bar 4363

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Comments of the Month

The Greatness of Clubs

By F. J. C.

MANY of our famous clubs, with their roots firmly established after 50 years or more of continuous sporting activity, are justifiably proud of their record. We must, however, bear in mind that great men make great clubs; clubs do not make great men. A club may achieve fame because some outstanding rider rides under its colours. Another may become famous because it includes among its membership great legislators, or great fighters for the cause of cyclists. Bidlake, Hillier and others are good examples of great riders, and great protagonists of the cause of cycling.

A club ceases to be great when those great men leave. Great men leave clubs when, in the course of time, a young and over-enthusiastic set of members introduce the discordant note. These young members have a tendency to look upon the older men as having had their day, unmindful of the fact that the club has remained in a healthy position throughout its history because of the services the elders so consistently rendered. It is true to say that no club has made a great man, and when great men leave, the clubs usually decline. We have seen many examples of it in the last 20 years. It seems deplorable that the whole history of cycling politics is punctuated by these discords, splits and lack of agreement.

It has been so for 50 years, and in spite of the new bodies which have been formed, the new rules which have been framed, and the elimination of those faults which have been the cause of the trouble, splits, factions and feuds continue. One well-known club has lost practically all of its older members in this way.

It is said that national bodies are too dictatorial, and that they do not bow to the will of their members. It is also said that whilst claiming to be democratic in their constitution they are not really so, because in some cases a resolution can be passed at an A.G.M. of which no notice need be taken of a committee having over-riding powers and which exercises dictatorial powers without reference to the membership. A national body cannot claim to speak on behalf of its membership unless on important points it takes a referendum of that membership. Because, say, 50 years ago the attitude of cyclists towards rear-lights was to oppose them, that does not mean to say necessarily that a national body must oppose them in perpetuity. New generations spring up every few years, and people's views change. Every so often, therefore, it is necessary for a ruling body to have its views fortified and confirmed by the members themselves.

Massed-start Racing

Now, on the questions of massed-start racing, undoubtedly there are two schools of thought. The national bodies oppose it, and when the matter was put to the test the majority of clubs opposed it. A minority movement with its own governing body was therefore started to control massed-start racing and to promote such events. The two bodies interested in road and track sport respectively have considered it necessary to impose penalties on any who take part in such races, as, of course, they are perfectly entitled to do. These two bodies made their attitude quite clear in a joint announcement published on November 25, 1942, in which they made it clear that any affiliated club which has a member in any way associated with massed-start racing should take action against that member, failure to do so rendering the club liable to suspension. In this we think they were unwise. The underdog will always claim sympathy, especially when, being in a weaker position, he is set upon by someone with more might. The attitude of the national bodies has undoubtedly forced into the ranks of the new body many who would not have considered the matter at all, but for the considerable amount of publicity given to the dispute. Those riders who were suspended were naturally supported by their own clubs and their own friends.

The dispute has affected one of the larger clubs—the Catford, although at the moment of going to press we are happy to be able to report that efforts are being made to effect a compromise, an effort which we hope in our next issue to be able to report has been successful. Now the Catford C.C. resigned from the body controlling road sport, and the resignation was accepted. It is important that we should understand the reasons why such an important club founded in 1886 came to this decision, which carries with it the penalty that none of its members can participate in open-road sport. The decision was taken, not as one might suppose because the governing bodies refused to recognise a new one, but because of the uncompromising attitude towards massed-start racing of one of the bodies—that concerned with governing road sport. They refused to expel from their ranks members who had joined the new body controlling massed-start racing.

Views of Minorities

Now, in this country minorities are entitled to hold their views and to go their ways without threats from a majority, and efforts to suppress a new movement before it has been given a fair chance can, in our view, only result in the new form of racing gaining fresh adherents. We must also admit that at least one of the national bodies went to a considerable amount of trouble to sound the clubs as to their views on massed-start racing, and as we have said earlier, there was a majority vote against it. Rather than widen the breach, we hope that both bodies will get together in a non-controversial spirit and endeavour to find a solution agreeable to both parties. If there is goodwill on both sides this must result. A threatening attitude by either or both parties will merely result in widening the breach and splitting road sport asunder.

Executive Side of National Bodies

National bodies by a dictatorial attitude, lack of diplomacy, and failure to regard themselves as the servants of the various branches of the sport they represent, have been responsible for a sufficient number of breaches in the sport. Some of the officials have assumed proprietorial and dictatorial powers, and there is little wonder, therefore, that in the ranks of the more powerful clubs there are those who think that the time has come when new blood should be introduced into the executive side of our national bodies.

They also feel that a member of the Committee of one national body should not serve on the Committee of another, otherwise views held by one body are automatically imported into another, and thus it is not possible to obtain a representative vote on a particular problem.

"Borrowing a Bicycle"

ALTHOUGH the stealing of cycles has grown to alarming proportion in recent years, and particularly during the war when supplies have been restricted, it was almost impossible to charge a man with stealing it. The charge was "borrowing without the consent of the owner."

In response to a request from the National Committee on Cycling, representing all organised cyclists in this country, Mr. P. Noel Baker, Parliamentary Secretary to the Minister of War Transport, has offered to amend the Road Traffic Act to stop bicycle "borrowing."

At present anyone who takes a bicycle from its owner cannot be convicted of theft if he just says he took it on loan. Mr. Noel Baker has asked the National Committee whether they wish the Act to cover bicycles, as well as motor-cars, and they have replied pressing for the necessary amendment. The Committee has, therefore, performed valuable service to motorists, for car stealing has also been on the increase.

Tramline Risks

THERE are now many miles of disused tram track both in London and other cities. They are a danger to thousands of cyclists and motor-cyclists, but the law does not at the moment compel the road authority to remove the old tramlines and charge the tramways with the cost of doing so.

The National Committee on Cycling are now asking for legislation to compel the road authority to remove disused tramlines or fill them up.

The National Committee on Cycling are also pressing for the removal of all "cat's eye" road studs which lie too close together or project too high above the normal surface. Many accidents to cyclists have been reported from this cause.

PARAGRAMS

The Flower Pot Hotel, Sunbury, and a glimpse of the parish church in the background.

Chisham in Fleet Air Arm

RON CHISHAM, Portsmouth North End C.C.'s discovery of 1938, is now a pilot in the Fleet Air Arm.

"For Devotion to Duty"

ARTIFICER GEORGE BELLFIELD, City C.C. (Wolverhampton), has received the King's appreciation for devotion to duty. He was a survivor of H.M.S. *Somali*, which was torpedoed and sunk after being in tow for three days. Bellfield is now serving on a motor torpedo boat.

Another R.A.F. Club?

TOMMY BRAUND, pre-war track star of Morpeth Road Club, has banded together several R.A.F. colleagues as a club.

Barnesbury C.C. Loss

A. E. CHEETHAM, Barnesbury C.C., who was serving as a gunner with the Merchant Navy, has been killed in action.

Bradford Member Decorated

SERGEANT AIR-GUNNER A. T. WILKINSON, Bradford Road Club, has been awarded the D.F.M. for conspicuous bravery during an R.A.F. attack on Wuppertal.

Manchester Wheelers' Diamond Jubilee

TO commemorate their Diamond Jubilee, Manchester Wheelers presented a silver trophy—"Lowcock-Taylor" cup—for their annual invitation 50-mile event. The initial winner was D. K. Hartley, Dukinfield C.C.

Unique Church Window

THE evacuation from Dunkirk and the Battle of Britain are depicted in a stained glass window at Little Missenden Church, Bucks.

Old Timers Meet

THIRTEEN members of the Fellowship of Old Time Cyclists, all but two of whom cycled, attended an informal annual meet of the Fellowship. All were over 70 years of age. Isn't that just too, too clever of them?

Utility Riders

IT is estimated that at least 1,500 people daily leave their machines at London Underground railway stations. All available accommodation is taken.

Ernie Stapley for R.A.F.

E. E. STAPLEY, Finsbury Park C.C, first hon. secretary of the R.T.T.C., but only for a short period, has joined the R.A.F. His brother Frank is serving in North Africa with the R.A.F.

Club Expelled

SANDON C.C. have been expelled from membership of the North London District of the Road Time Trials Council.

Wilf. Higgins Promoted

FORMER Empire Games Champion, Wilf. Higgins, of Manchester, has been promoted to Sergeant-Major in the Royal Engineers.

Southgate C.C. "Annual"

TEN riders took part in Southgate Cycling Club's 22nd consecutive 24-hour ride. The course—one of 213 miles to Cheltenham and back—proved difficult but all entrants qualified for certificates.

Prisoner of War

BERNARD PEARCE, Portsmouth North End, is now known to be a prisoner in Jap hands.

Peterborough's Loss

T. P. HALES, chairman of Walton C.C. (Peterborough) has died.

Met in India

BOB WATSON, Ferryhill Wheelers, and Jack Heron, Thornaby Wheelers, have met in India. Both are with different units of H.M. Forces.

Bournemouth Arrow News

TWO members of the Bournemouth Arrow C.C. are now known to be prisoners of war. They are Eric Drake and Fred Mason; both are held by the Italians.

Speedwell Member Missing

SERGEANT AIR-GUNNER KEN ADAMS, Speedwell B.C., is reported missing following an operational sortie.

Convoy Caused Diversion

AN important West London road time trial—the Velma C.C. "50," which was won by George Fleming, Ealing Manor, with 2.5.6—was almost marred by the closing of a section of the course by the military. Before the event was over a certain number of the competitors had to be diverted from the official route to another road.

Fred Willett Missing

FRED WILLETT, pre-war star of the Norwood Paragon, a Sergeant Pilot in the R.A.F., has been reported missing following operations over Germany. He had taken part in many raids.

Lost at Sea

WILLIAM MAY, Maidenhead C. and A.C., a 4th officer in the Merchant Navy, lost his life at sea following enemy action.

Killed in Action

WALTON Cycling and Athletic Club mourn the death of their member, Sergeant Eric Davies, R.A.F.

Polytechnic Old-timer

P. W. BROWN, of Derby, one of the outstanding riders of the Polytechnic C.C., who rode in the World's Championships at Antwerp in 1894, has died.

Liverpool's Award

A MEMBER of the Liverpool Century Road Club, O. Butler, has been awarded the Military Medal. He is serving in the Middle East.

Alan Barker's Call-up

WELL known in North Lancashire and Manchester racing circles, Alan Barker, Warrington C.C., has been called for service in the R.A.F.

21 Years After. . . .

TWENTY-ONE years ago Dave Marsh won the world's road championship. It was decided on a Shropshire course. Now his twin sons have joined his old club—the Shaftesbury C.C.

Doug. Hartley in R.A.F.

PROMINENT time-trialist Doug Hartley, Dukinfield C.C., has joined the R.A.F. He has been on deferred service for some months.

Shaftesbury News

THIRTY members of the Shaftesbury C.C. are with the Forces, and one, R. Maggridge, is a prisoner of war in Italy.

News from Norwich

ONE of the first British soldiers to enter Tunisia was J. Nudds, Norwich C.C., holder of several club records. K. Voisey, of the same club, is in the Middle East, and a colleague, D. Sparkes, is in Cairo.

Chairman Resigns

OWING to pressure of work J. Wilton has resigned the chairmanship of the Barnesbury C.C. He had been in office since 1936.

Brian McGrath Safe

FORMER member of the National Cyclists' Union staff, Brian McGrath is now known to be a prisoner of war in Japanese hands. He had been posted missing for over 17 months.

Hampshire Road Club's Record

OVER 100 members of the Hampshire Road Club are serving with H.M. Forces. Two young members—J. Taylor, former club captain, and R. Pope—have lost their lives while on operational sorties. Both were sergeants in the R.A.F.

Barker Joins R.A.F.

ALAN BARKER, the Lancashire time-trialist and member of the Warrington R.C., has reported for service with the R.A.F. as a pilot.

Cumnock Rally Success

ONCE again the Cumnock rally, promoted annually by the West of Scotland Cyclists' Defence Committee, was a great success. Some 6,000 people attended, and the trade donated a total of £45 in prizes for competition.

Team Record Passed

THE R.T.T.C. has passed the 30 miles team record put up by the Clarence Wheelers in the Addiscombe event. The new figures are 3 hrs. 49 mins. 45 secs.

Revival in Fife

THE Fife Cycling Association has been revived, and Robert Maxwell, 11, Thirteenth Street, Cardenden, is the new secretary.

Fast Scots "50"

THE fastest Scottish "50" of the war was clocked by Alex. Hendry, Glasgow Wheelers, in the Glasgow United "open." His time of 2 hrs. 6 mins. 39 secs. is only 1 min. 47 secs. slower than Scots record, put up by Bill Scott before the war.

Most Northerly Dealer

MOST northerly cycle dealer on the mainland of Britain is Magnus Mowatt, of Thurso, Caithness.

Scots Record Broken

RIDING in the Ayrshire and Dumfriesshire C.A. "30," Crawick Wheelers broke the Scots 30 miles team record with a time of 3 hrs. 50 mins. 56 secs. This is 1 min. 6 secs. better than the previous best by Glasgow Wheelers in 1937. The Crawick riders were David Scott, James Scott, and Jack Tudhope.

Prisoner of War

EDDIE ROBERTS, Fountain C.C., who was posted as missing in Malaya, is alive, but a prisoner of war in Japan.

The Bass Rock, North Berwick, Scotland.

Around the Wheelworld

By ICARUS

Re-erection of Sign Posts

FOLLOWING its decision to permit the re-erection of signposts in towns, the Government, in consultation with the military authorities, has agreed to extend this by sanctioning the re-erection of signposts in rural areas. For security reasons, the signposts will not be put up in certain districts, but the decision means that some thousands of signs will be reinstated, with corresponding advantage and convenience to those who still use the roads.

The signposts were removed after the fall of France, and careful plans of their exact location were kept. It seems a pity that the removal of the signposts was not made the occasion to modify the whole of our signpost system and to standardise it, but obviously the Ministry of War Transport is far too busy dealing with war problems to spend time on this matter. Let us hope that when the war is over they will do so. We must be sufficiently grateful that most of them are to be reinstated. Their removal was severely criticised, as it was thought to be an unnecessary measure of home defence. The Germans, it was said, if they invaded this country, would hardly do so unless they had made adequate plans as to route. They certainly would not find their way around by means of signposts. No doubt they possessed a very complete stock of maps, kindly provided by Ribbentrop when he was Ambassador to this country. However, perhaps it is wise to err on the side of caution.

Bath Road Smith's Cup

THE famous cup won outright by C. A. (Bath Road) Smith, in 1891-1892, is now in the custody of the Editor of this journal pending a decision as to a suitable event for which it could be put up. Cycling club officials are invited to send suggestions for suitable competitions. It is a magnificent trophy, almost as large as the famous Cuca Cup, and is of considerable weight. Whatever competition is suggested, it must, of course, have a national appeal.

Dunlop's Experiment

JULY 23rd was the anniversary of the granting of the patent, in 1888, to Dunlop for his invention of the pneumatic tyre. As is well known, he experimented with air tyres to make the riding of his son's tricycle over the stone setts of Dublin more comfortable. A great deal has been written regarding his first test in the yard of his Belfast home with a wooden disc about 16in. in diameter, to which he had fastened his crude first pneumatic tyre. He bowled this down the yard, together with one of the iron-tyred wheels taken from his son's tricycle, and one is not surprised to note that the pneumatic tyre won—but not for reasons concluded by Dunlop. The only fair test would have been to have taken two iron wheels of identically the same weight, one equipped with iron tyres, and the other with pneumatic tyres. Of course, the pneumatic tyre would still have scored, but my point is that precisely the same effect could have been obtained by bowling an iron flywheel down the yard. However, unscientific as was the test, we all know the result, and the pneumatic tyre goes down in history as one of the world's greatest inventions—a great invention being that which benefits everybody irrespective of race. It paved the way for the motor-car and the aeroplane. Dunlop's book, "The History of the Pneumatic Tyre" (I have a treasured copy sent to me by Dunlop, and a further copy presented to me by his daughter, Mrs. Jean McClintock) is a fascinating book which every cyclist should read.

Another fascinating book which deals with the history of the pneumatic tyre is the "Wheels of Fortune," by Sir Arthur Du Cros, published just before the war.

"Can It Be Done?"

APROPOS the paragraph by my colleague Wayfarer, in the July issue, I have received the following letter from H. B. R., of Sale:

"The paragraph under the above heading, by 'Wayfarer,' in the Cycling Supplement to the July issue of PRACTICAL MECHANICS, reminds me of the ever-recurring problems regarding perpetual motion.

"The answer is immediately: Yes, it is done every day by every cyclist, provided, of course, he does not use a brake up hill.

"When a bicycle travels down hill of its own accord, the movement is due to the force of gravity and, provided brakes are not applied, then the maximum speed attained is that due to the force available (due to gravity) overcoming windage and friction. If the machine is left to coast through the hollow of the dip and as far as it will up hill, then the stored energy attained due to velocity has been used up in covering the distance thus travelled.

"Contrariwise, if brakes are applied, then some of the energy available is dissipated in heat, due to friction between the brake shoes and wheel rim or, in the case of hub brakes, the brake lining.

"It must always be remembered that you cannot get more out of a thing than you put in, and the contribution of power on a bicycle is acquired from two sources only, i.e., (1) human effort, and (2) down-hill gradients, or, in other words, gravity."

Road Accidents—June, 1943

DEATHS as a result of road accidents in June were the lowest for any month in the past ten years. The total of 380 is sixteen fewer than in April, which previously had the lowest record of fatal road accidents for many years.

Compared with June of last year, the principal reductions were in the deaths among adult pedestrians and motor-cyclists. The number of adult pedestrians killed fell from 95 to 71, and the number of motor-cyclists killed from 75 to 41.

The reduction in the number of fatal accidents to children, reported last May, was unfortunately not maintained, and the total of 120 children killed is nine more than in June of last year.

This setback is attributed partly to the late Whitsuntide, which would have the effect of reducing the figures for May and of increasing those for June. There is reason to hope, therefore, that the setback may be only temporary, but the importance of training children in kerb drill is again emphasised.

Particularly disturbing is the high proportion of children to other victims. This has increased from one in seven in the first half of 1940 to about one in five in the first half of this year. In June the proportion was nearly one in three.

Injured of all ages numbered 8,865 in June, and of this total 2,258 were seriously hurt.

Road Race Championship

THE National Committee of the British League of Racing Cyclists inform me that they will hold a road race championship on Sunday, September 5th. They have selected twenty-five of the best massed-start riders in the country to take part, and these include internationals and Service riders. The Mayor of Harrogate has promised to start the race and present the awards.

P.O. Gibbney

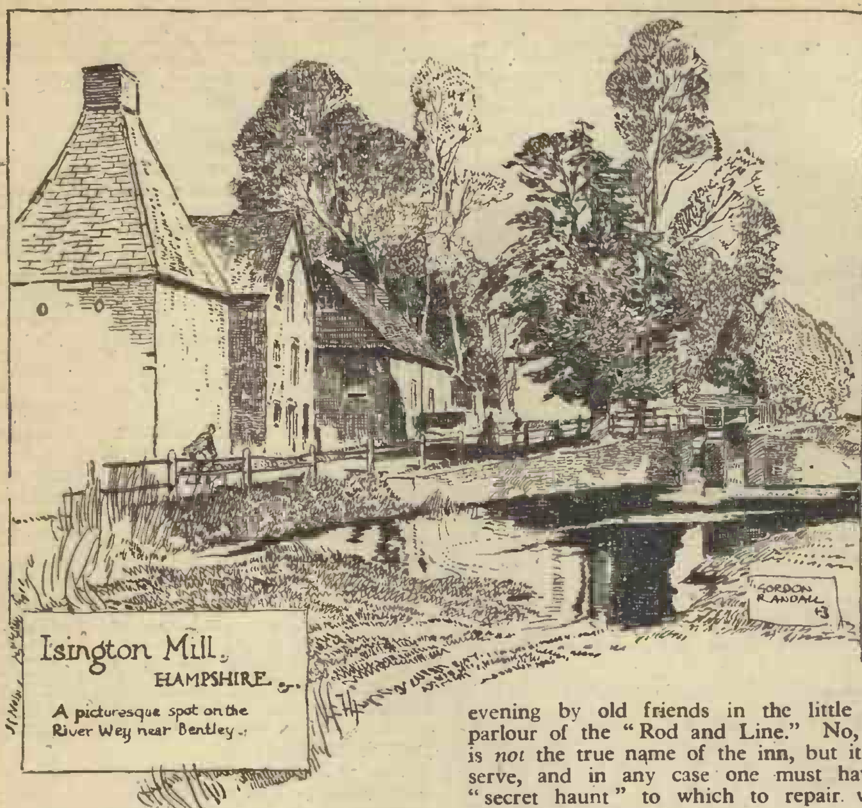
REGARDING our paragraph in the August issue regarding Petty Officer Gibbney, in which we stated that he was missing from operations, readers will be pleased to learn that he escaped injury and is now a prisoner of war in Germany. Let us hope that, together with all other prisoners, he will soon be back in this country.

N.C.U. Membership Well Ahead of Schedule

MEMBERSHIP of the Union for the 1943 year, up to May 31st, is 32,568, showing an increase over the corresponding period of 1942 (wartime record) of 4,127. The big increase in the membership is undoubtedly due to the enthusiasm of clubmen and private members, who are themselves acting as recruiting agents throughout the country, with great success, whilst increased activities and events being run by many of the Union's centres is also having a most beneficial effect.

Cyclorama

By H. W. ELEY



Isington Mill, HAMPSHIRE

A picturesque spot on the River Wey near Bentley.

Raleigh and Rudge-Whitworth

A COMBINATION of two great names in the world of cycles is foreshadowed by the news that the Raleigh Company is acquiring the Rudge-Whitworth cycle business. But I am glad to be informed that the old name of "Rudge" will not disappear, and that bicycles will still be manufactured and sold under that name. "Raleigh" . . . and "Rudge" . . . two famous names, and long may they remain so!

Commander Campbell's Cycle

CLAUD BUTLER is frequently "in the news," and I note that following a meeting of the "Pickwick" Club (of international fame) he has presented a bicycle to Commander Campbell. Why? Well, the answer is simple; it appears that at the Pickwick meeting the gallant Commander confessed that he had never owned, or ridden, a bicycle! A dreadful confession, to be sure, and one that made Claud's heart sink! So . . . the gift of the bike, and it only remains for me to say that I hope fervently that the Commander will use his cycle often and derive health and pleasure from it.

With Rod and Line

I HAVE written previously in these random notes about the delights of angling. And to me it is never more delightful than when I sit by a pool when it is raining gently. I like the feel of the rain on my face, and I always think that when the gentle shower comes, and ripples the surface of the pool, and one can hear the slow drip of the rain from the trees, the fish rise more freely. It is when the rain starts that I look anxiously at my red-topped float, and "sense" that it will soon be pulled under. To-day has been such a day, and I have just returned from a pool I wot of . . . a shady, pretty pool, where lurk some rather nice bream and plenty of perch. Not a big "bag" to-day, though . . . I know not why; just "fisherman's luck"—to be condoned with later in the evening by old friends in the little bar-parlour of the "Rod and Line." No, that is *not* the true name of the inn, but it will serve, and in any case one must have a "secret haunt" to which to repair when solitude is needed. . . .

Present Vogue for Cycling

CHATTING recently with some ardent cyclists, I heard the view expressed that the present vogue for cycling was but a "wartime fad," and that when hostilities are over, and petrol more easily obtained, all the folk who have found a new and wartime joy in the cycle will return to their cars and push their bikes away into some lumber-room . . . presumably to await the *next* war, and be hauled out to do "austerity service" again. Well, I am not so sure! Somehow, once one has tasted the joys of cycling, the pastime lays a firm hold upon one's affections, and is never given up. But we shall see. I think it would be a tremendous pity if the thousands of men and women who have "taken to cycling" because of war restrictions and circumstances gave it up when the war is over. Cycling has brought new health and new delights to many. It has re-created an interest in the great world of Nature, and has shown many thousands of folk how rich is this land of ours in lovable villages, picturesque hamlets and winding, ragged lanes.

Post-war Planning

TALKING of "after the war" (and what a general topic it is!), one can hardly do so without thoughts of reconstruction schemes, planning for the "new world," and the road we should travel if we really want to build a better, finer country. Well, I recently came across a little book entitled *Calling all Parents*. It is by John Kay, and in my view it is the most convincing piece of writing that has appeared dealing with post-war planning. Its great virtue is that the writer gets down to essentials; he obviously mistrusts the spate of plans which the politicians produce week by week. He outlines the vital "*how*" of the problem; and as I read the book I felt that it lived completely up to its sub-title . . . "A Practical Plan for post-war Britain." All whose eyes are turned to the bright horizons of the future which *can* be, should read this little volume. Most bookstalls have it.

An Old Timer

HAD news a few weeks ago of that grand veteran of the cycling movement, A. J. Wilson . . . "Faed" of immortal memory. He is living in the Cotswolds, and while these days he does not often appear either in print or public, he still takes a lively interest in matters connected with cycling, and I believe he still rides a tricycle. Greetings and good luck to one of the great "Old Timers"! "Faed" was in at the beginning, and I do not know how many years ago it is that he was employed by the Dunlop Company. Later he founded the advertising business which for so many years bore his name, and which handled a great volume of motor and allied trade business.

Hay Crops

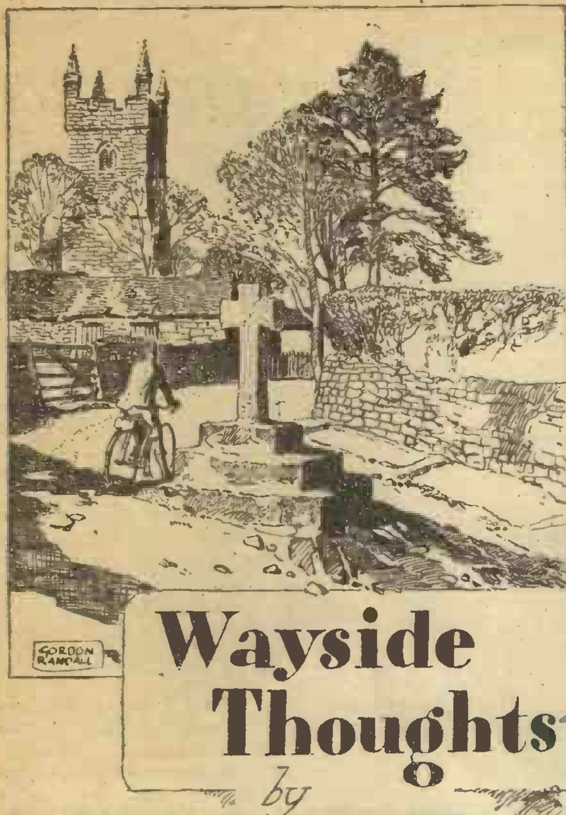
MY farmer friends (and I have many, I am happy to say) tell me—with a certain amount of reserve—that the hay crops have been good. I am glad. One never expects an English farmer to wax enthusiastic about his crops, or his stock, but I believe that in most districts the hay has been good and plentiful. Farming is to-day so vital to all of us that I find townsmen taking quite a keen interest in these matters agricultural . . . and how good it is that it should be so! We erred greatly in ignoring agriculture and regarding it as something less important than industry. Why, it is our biggest industry! And never again must we allow it to be neglected as the Cinderella of our national structure.

Pageant of Flowers

JULY!—and Queen Summer is at the zenith of her reign. The tall hollyhocks now stand like gorgeous sentinels along the border of the garden on which I can look as I write, and the reds, crimsons and salmon-pinks of their big blooms are wonderful against the dark blue of the delphiniums, while the rustic arches set at intervals along the paths are smothered with roses . . . American Pillar, Dorothy Perkins, and some whose name I do not know. What a brave July show they all make! And the vegetable "patch" which I reach through the little white gate is good, too . . . despite all the talk of new and mysterious pests, my vegetables make a fine showing, and I feel proud and satisfied as I walk among the rows of beans and peas, and muse upon the wondrous dinners I could have . . . if only the joint from the butcher's matched the bounty of the vegetables! But I do not grumble. I try to take comfort from the fact that all the best doctors now say that we ate far too much meat in the "good old days." Maybe we did . . . but I shall be glad when the days come when a goodly sirloin of beef or a sizable shoulder of lamb again graces my table!

A "Bit of England"

THE rain has ceased, and outside the air is fresh and keen. A time for cycling, and not typing! So, out with my bike, and I think I will ride out through the lanes, and after many a detour come to Nether Hatton, where there is a grey old church, some sixteenth-century cottages . . . and an inn. It is called "The Bull and Ring," and it possesses a pleasant low-ceilinged parlour, a cheery landlord, and some casks of good ale. In other words, I seek a "bit of England."



Wayside Thoughts

by F. J. URRY

Sheepstor, Dartmoor village.

After the War

BEHIND the scenes the cycle trade is, I think, beginning to realise its great potentiality for much more than an ordinary revival after the ending of the war. No one with any interest in the making, selling or riding of the wartime bicycle is satisfied with that product, and that in itself is a good sign, for it must be admitted the machine of to-day is very far from being representative of what a bicycle can and should be, even in its cheapest form of production. I was invited recently to attend a meeting of dealers and was encouraged to tell them my thoughts on the presentation of the bicycle and its accessories to the public, and how to persuade buyers to see their purchases are the best they can afford, that the machine fits them, is geared rightly for the purpose for which they require it, and, above all, to put over the cycling story as a game to be played for the greater enjoyment of life, by its owner. That is where the industry has failed; it has not taken sufficient pains to sell cycling as well as the implement of cycling, and that lack of intimate interest has resulted in so many riders remaining ignorant of the game of cycling even while fully acknowledging its convenient form of travel. There will be, I am convinced, little wrong with the post-war bicycle as far as specification and layouts are concerned, and providing a closer and more personal attention is given to fitting the machine to the individual, and not the other way round, then I can visualise the great army of riders expanding to astronomical numbers. For, speaking personally, it is not possible for me to think ordinarily active people can fail to find enjoyment, adventure and health under their own motive power, roaming the glorious roads and lanes of Britain. I have been doing it for 54 years, and each succeeding decade seems to be better than the last: a quiet delight beyond the telling.

We Need Teaching

OCCASIONALLY some readers ask me what I mean when I say a bicycle should fit the rider like a glove fits the hand. It is quite simple. You must be comfortable, whether you want to potter or race, and that means an easy posture, right reach, saddle ease, suitable gearing and as little bicycle as is compatible with these necessities. It is impossible to lay down a general specification to suit everyone, for personal equation applies in cycling as it does in every other game, and the breakdown from the "full roadster" tradition of bolt upright position to the ease of more comfortable travel attained by a writing posture must be undertaken by degrees, for you cannot dismiss a long-standing prejudice by simply telling people it is wrong. Prove it by example. You who know, lend your machine to the doubter for half a day, and in nine cases out of ten that individual will be a doubter no longer. I have seen this occur time and time again, with the result that the rider of a bicycle has become a cyclist in the full and joyous meaning of that term. Here is an extract from a letter recently received from a Scottish reader, and it is typical of many: "When I bought my new cycle some time ago I did so in sheer ignorance; there was a bike, it had a three-speed gear, so I walked out with it. I have persevered with it, but now find—on comparison with other machines—it is far too heavy, and the gearing is far, far too high. I do not want to make the same error again when I buy another machine after the war, so would you please send me your ideal specification. I know now there is nothing takes the joy out of cycling more than pushing an enormously heavy cycle around." That last sentence is true, and is or should be the death-knoll of that handicap to easy riding—the full roadster, the sit-up-and-beg model, still too beloved of maker, dealer and novice.

These Short Breaks

I WAS among the Montgomeryshire hills on a recent week-end of mixed weather, joining a party of lads who had asked me to roam with them for a few hours, and had promised to show me a bit of new country. Actually they did not do that, but they gave me a very happy welcome and took me to numerous places where the food restrictions did not appear to have penetrated. Apropos of my previous paragraph, we had in our company a jolly man of 47 summers who had but recently taken to long-distance week-end riding, and seemed to be finding it more enjoyable than the success promised to him. He was a motorist in 1939, then a walker of the fells, and coming in touch with this group of boys during one of his tramping trips was persuaded to try cycling. Wisely he listened to advice on buying and riding, and took some pains to get fit enough to sit on a saddle for an hour or more without stiffness, to use a change-speed gear with discretion, and to know when to dismount and walk; all simple but important items when a week-end itinerary includes many hill crossings and some mountain tracks. He was a joyful comrade, with a keen sense of humour often directed against himself, particularly on saddle choice and the steady decline in his gear ratios: for as is the way of club life, this advice on good riding was handed out in the form of leg-pulling. When we were well up on the moors a wind and rain storm came sweeping over the mountains at a spot where the only shelter was the macs we carried, and I wondered how our novice would take the rather fierce conditions. He was the liveliest of a lively party, and when a kindly hill farmer's wife regaled us with tea, bread and real butter and home-made cheese, and the stormy sky showed signs of evening repentance, it was he who trotted us up the valley of the young and mountainy Severn to our resting place among circumambient hills, radiant in the sunset glow.

So Much Depends on Ease

EARLY the following afternoon my companion and I parted from these boys, who have their homes close to the shipbuilding areas of Lancashire and Cheshire, and came home on the wings of a bountiful wind, in sunshine as delightful as June can present, and over roads remarkable for the absence of traffic, roads I have known for years, but which seem to take new characteristics from their loneliness. Under the cone of Corndon Hill, and the running ridges of Long Mountain, the way skipped down the vale to Shrewsbury and it was only when we were within a few miles of that centre we met any kind of traffic, and then but a small number of ambling riders, most of whom needed the lessons of position and pedalling. "If a thing is worth doing, it is worth doing well," an injunction with which most of us agree, but cycling seems to be the exception. I should be less than a worthy representative of the pastime did I not use my utmost endeavours through the channels of persuasion to get this unfortunate state of things altered, and by so doing make cycling what it deserves to be, the greatest individual game in Britain. Actually it is that now, I suppose, but so many of us are playing it so badly, and sometimes painfully, that such do not call it a game at all, but hard work. And so it must be to some of the numerous folk we saw on that Sunday evening, riding too highly perched with hands above their waistline, middle-footing the pedals, and turning gears so obviously beyond comfort that their bodies swayed as they leaned against the wind or toiled up a slope. Some of the cycling I see to-day is sheer cruelty to the riders, but unfortunately there is no law against the self-infliction of pain. We may improve the style one day, but it will need all the efforts of which the technical press, the cyclist and the trade are capable; yet I will not despair, for verily I believe there are better times, better bicycles and better riders to come.

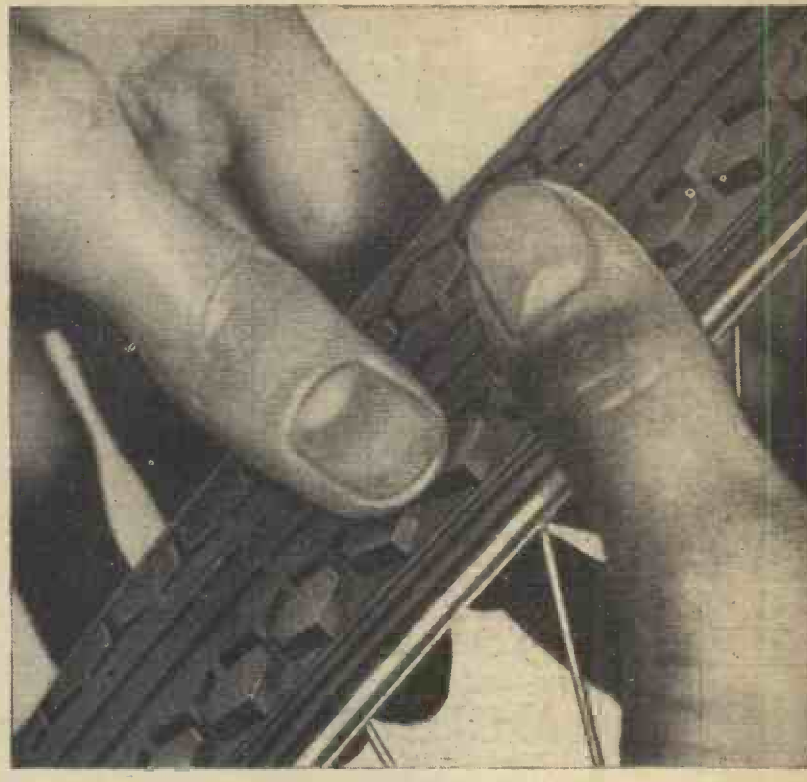
Freedom of the Road

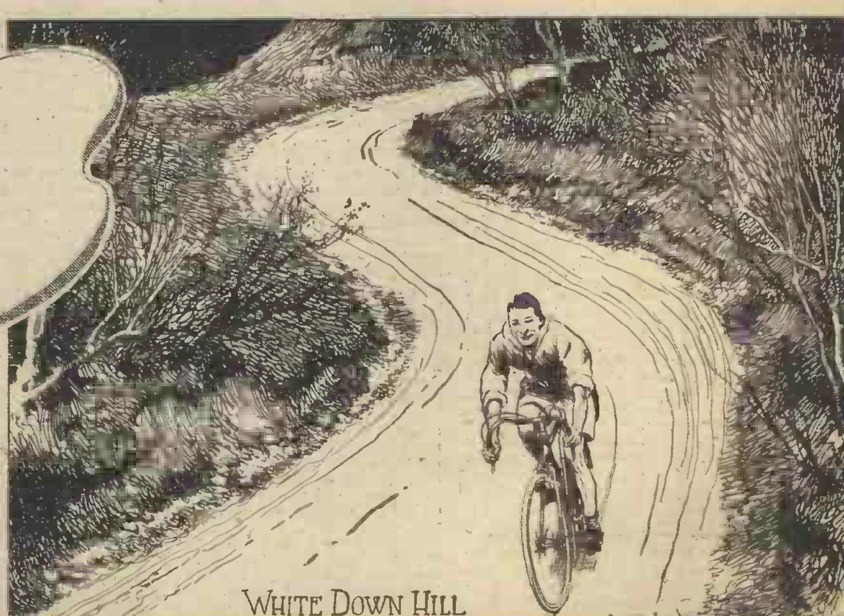
I AM glad to know the industry is taking a genuine interest in the affairs of the road as they affect the cyclist. Time and again I have stressed the fact that the prime asset of the sport and pastime, and it naturally follows of the trade also, is invested in the free use of the King's Highway as the general public have known it since the disappearance of the toll gate. Many people, far too many, I am afraid, treat this question very cursorily and are too ready to assume what is, will continue to be, without intervention from them. But there are other interests at work and very powerful ones, and they will seek—indeed, are seeking—to institute certain controls, excusing the loss of freedom to the community on the grounds of attaining greater safety in travel. That way, of course, lies a process of restriction of the use of some of our public highways which we, as cyclists, can only look upon as intolerable. There are other and better ways of achieving a greater degree of safety on the road, but the great commercial interests in the transport world do not want to even contemplate them; they desire other people to suffer restrictions and prohibitions, and the pedestrian and the cyclist are fair game in their eyes. It is pretty certain that if the pastime and the trade act together in this matter, draw up a memorandum for submission to the M. of W.T., the very weight of votes behind such a screed will preserve our present status on the road. But if we lack this proper sense of co-operation in the defence of our rights, or fail to use the power we possess in our voting strength, we shall be risking a serious defeat through the principle of division and attack which so nearly gained the world for Hitler. Anyhow, the present position seems to be that the trade is interested, and I know the pastime is; so it is only a question of the co-ordination of forces based on sound principles.

The Way to Work and Home

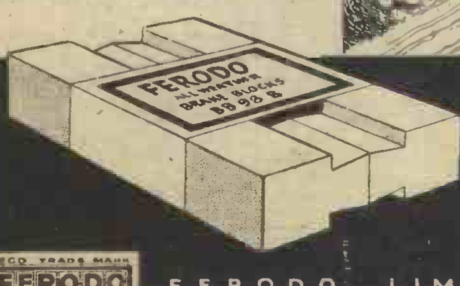
SOME of my corresponding friends seem to think I am just a cyclist with lots of leisure time to enjoy the road, and no particular business or domestic problems to solve. How wrong they are would quickly be proven if they could spend a working day with me. As a utility cyclist I ride over 3,000 miles a year, and that adjective utility covers many unusual things in these days. For instance, I have just brought two cooking pots to the works for repair, and my journey home to-day will be a delivery of dog-meat for the hound at home and some odd pieces of wood and wire for the repair of the chicken-run. Most days of the week I act as general carrier to my family and friends, and the good turns I am able to do are usually repaid, for in these times it is a question of helping each other and so easing the strain for many people. There have been occasions when my loaded machine has weighed over 50lbs., and at such times I have smiled to think at the advice so frequently given to other people to ride as light as possible. Yet it is remarkable what a good-tempered piece of machinery the bicycle is, and how wonderfully adaptable; and although my week-end bags are mainly things of rags and tatters, and my rear-mudguards are patched with lengths of celluloid cut from old guards, I can still carry on.

The Strath Fillan, near Crianlarich Scotland.





WHITE DOWN HILL



My Point of View

BY "WAYFARER"

The Steppers-off

AN early impression of one who has come back to cycling after some years of motoring relates to the number of people who step off the side-walk without the slightest regard for their future. If these thoughtless idiots were the sole victims of the trouble which so frequently results, it would not matter very much. Unfortunately, however, the cyclist who unwittingly hits them usually gets the worst of the encounter. The moral is that cyclists should "mind their step," presuming that every pedestrian who is meandering along the side-walk is liable, without preliminary investigation, to seek an early arrival in the next world—or, at any rate, in the local hospital—either for himself or for an inoffensive cyclist. It remains remarkable (if not incomprehensible) that, after all these years of motoring, the man-in-the-street still thinks he is alone on an uninhabited island!

Purpose-rides

I HAVE always been an exponent of the plan of carrying out rides with an object, or purpose-rides. Even in connection with such a paltry matter as posting a letter I would ignore all the red boxes in the immediate neighbourhood and cycle on and on until I found a box I really liked. Then I would turn for home with the satisfying recollection that the mere posting of a letter had entailed a total ride of from 20 to 25 miles. When I was a member of the C.T.C. Council I liked to attend the meetings by cycling thither, and not always by the direct route. These were useful purpose-rides—though, to be sure, a journey undertaken for its own sake, with the idea of obtaining exercise and fresh air and a nice tea along the road is not to be sneezed at.

In the years immediately preceding the war a cheque was in the habit of reaching me on Wednesday mornings. Thus Wednesday became a day on which I had important business to transact, for the cheque was to be paid into my bank account, and I trundled my way into the country until I found a bank I liked, and there I would dispose of the slip of paper, always trying not to patronise any branch more than once. Ultimately, the credit side of my pass-book took on the appearance of a young gazetteer. I am all for these purpose-rides—and it may be aded that, early in June, I cycled from Birmingham to Aberystwyth, via Skegness, in order to attend a meeting! I need not have gone quite so far round!

Metamorphosis

WHAT a change has taken place in the appearance of things outside licensed premises along country roads, especially at week-ends! In pre-war days, every inch of space was occupied by motor-cars, whose owners (with their friends) were inside drinking beer and other pleasant liquids (including, possibly, lemonade). Nowadays, bicycles abound, sometimes stacked against the walls of the pub; sometimes reposing in proper stands which the inn-keeper, with commendable enterprise, has provided. Well, this much can be said: under the new dispensation the bicycle-owners have done something to create the thirst they are so busily assuaging—whether present-day beer is worth drinking is another matter, with which we have no concern here—and that, when the time comes for them to return home they will not be such a danger to other road-users as they might have been if driving cars.

The Mental Effect

AFTER doing three miles of a 17-mile journey which it was my intention to develop into nearly twice that distance, in order to obtain my Sunday lunch at a cottage in the Forest of Arden, I suddenly remembered that my usual "iron ration" had been forgotten. This consists of a small piece of cheese or chocolate, which is consumed if emptiness asserts itself, being kept "for a rainy day" if not needed. I decided that it was not worth while going back home to pick up the missing fragment of sustenance, but the mental effect of that forgetfulness endured—and increased. I could think of nothing else. I tried to divert my mind to other matters, but time and again it came back to the question of that missing "iron ration." Futile to tell myself that I could easily do 30 miles or so between meals without food! Vain to remember that on recent tours I had carried a small slab of chocolate the whole way and brought it home again unbroached! The mental effect of that absent food made me feel hungry—ravenous—so that, by the time half my morning's ride was done I had to adjourn to a farm I wot of and buy a tuppenny cake. Consuming that as I rode onwards, I was quickly restored to normal health. Moral: Always carry an "iron ration"—if only because of the mental effect.

The Bicycle's Magic

I ATE my midday meal on that Sunday in company with four or five young friends—all, like myself, skilled users of knives and forks!—whom I met by chance, and whose presence round the table was most acceptable. (Two of them are more enthusiastic about touring in Ireland than even I am, and that's saying something!) In the course of conversation I happened to mention that, on the previous day, I had had tea with Mr. and Mrs. Blank and their little daughter Jeanie, met casually, all on tandem, along the road. "What!" said one of my companions "Are they still pushing that big girl? It's surely time she had a bike of her own, or that she took her mother's place on the tandem, and then her mother could buy a bike and learn how to ride."

My ejaculation of surprise brought forth the unexpected news that Mrs. Blank can't ride a bicycle, although she cycles thousands of miles every year and devotes all her holidays to cycle-touring! I never suspected her of being a non-balancer of bicycles. Of course, she is not the only wife and mother who is keenly interested in practical and actual cycling without being able to balance a bicycle on her own account—not by a long chalk is that the case!—and this is the reason why, at the moment, I speak of the bicycle's magic. For it *is* magic that the benefits of cycling are available not only for the millions of people who have learnt how to control the fickle two-wheeler, but for the hundreds of people who, for one reason or another, have never mastered the art of leading, unassisted, an upright life along the road. There really seems to be no limit to the gifts which the magical bicycle can bestow.

Villains in Those Days

A MIDLANDS newspaper recently dug out of its columns of 50 years ago a letter from an anonymous correspondent who complained of the vile behaviour of a party of cyclists, "some dozen of whom carried Japanese parasols of bright colour," sight of which caused his horse to shy. "It is conduct of this sort that brings cyclists into contempt." That's just too bad, isn't it? The anonymous one, claiming to be a cyclist and to be connected with the cycle trade, felt that he must "protest most strongly against such carryings on," adding that "surely clubs might enjoy their runs without the objectionable accompaniment of parasols." Evidently there were villains amongst cyclists in those days—just as there were frivolous complainants amongst the general public! Nothing changes!

Notes of a Highwayman

By LEONARD ELLIS

The Gateway to North Wales

SHREWSBURY is a town that never fails to attract and to please. Not only is it the focal point of most of the roads leading from London and the south to one of the most popular touring grounds of the British Isles, but in itself it is well worthy of much more than a cursory glance. It would not be too much to say that because of its position it must of necessity attract traffic, but because of what lies beyond, it is too often spurned and used merely as a stepping-stone. To those who have in the past passed by Shrewsbury, and to those who to-day by reason of the modified road system by-pass the town, I urge a little more restraint when next in the neighbourhood. I know that comparisons are odious, but I cannot refrain from suggesting that Shrewsbury ranks with Chester and York as one of the most beautiful old places in the country. It is true that it does not possess Chester's complete ring of old walls, and there is no equivalent of York Minster, but there are some very fine old churches, and there are old gates.

Beauty By-passed

TO the traveller in a hurry Shrewsbury will not now be seen at all, as a new by-pass road skirts the town and rejoins the Holyhead road at a point where the Welshpool road branches to the left. In the old days before the by-pass the passage through Salop was at once a joy and a nightmare. Almost the first thing we saw on approaching from the east was Lord Hill's column, suggesting a rural Trafalgar Square. This is said to be the tallest Doric pillar in the world, 132ft. high. It stands on the very edge of the town and is a landmark for many miles around. Then follow a mile or two of flat and pleasant residential road until the old Abbey Church is seen on the right. This is a beautiful old building in mellow red sandstone, partly Norman, and is well worth an exploration. On the opposite side of the road, in the corner of a coal-yard, will be found the "Abbot's Pulpit," the old stone pulpit of the refectory, a sculptured gem of the 14th century. We now enter the town. The shops close in, the roads get narrower, and very soon we are threading our way across the English Bridge over the River Severn. Be it noted that this is the second time we have crossed the Severn. The first time was at Atcham, three miles back, and we shall cross it twice again on our way to Wales. Once over the English Bridge the main road stands on its hind legs to ascend Wyle Cop, one of the steepest pitches in this historic highway.

The Glory of Shrewsbury

ON our left will be seen the Old Lion Tap, and a black oak window shows the room where the Earl Richmond stayed on his way to defeat Richard III at Bosworth Field. At the top of this rise the main street is appallingly narrow and traffic congestion was once acute, but the cyclist will be well advised to seek the beauties of the side streets. Black and white houses are here by the score, many of them like Ireland's Mansion and Owen's Mansion being world famous. To continue to North Wales there are two right-angled turns in less than 50 yards and then the road flattens out to cross the Welsh Bridge. After this a long climb up Frankwell takes us clear of the town. But we are not dashing through—we have turned into the side streets in a very profitable inspection for a few hours. We can see more of the "magpie" houses, including a very fine specimen called the Council House Gateway. In a chamber above the gateway were held the Council meetings of the Marches of Wales. When we really must push on we have a choice of eight good roads out of Shrewsbury, and each one will take us to the beauty we seek.

The Council House Gateway, Shrewsbury.

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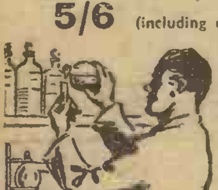

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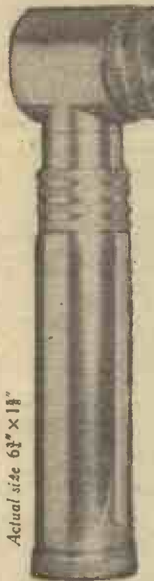

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