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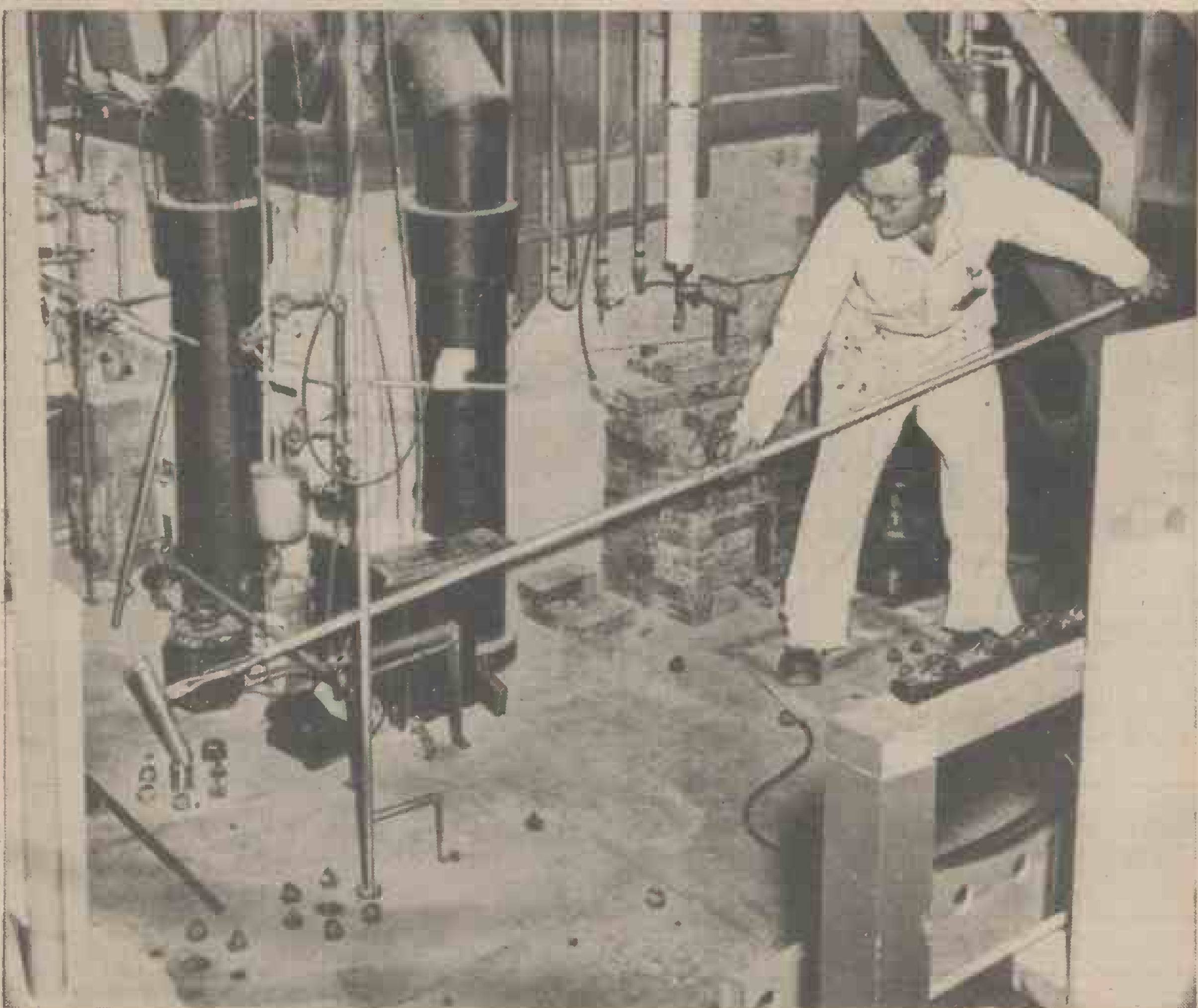
NEWNES

PRACTICAL MECHANICS

9d.

EDITOR: F. J. CAMM

AUGUST 1946



INSIDE AN ATOMIC BOMB FACTORY (See page 383)

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Inland - - - 10s. 6d. per annum.
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Canada - - - 10s per annum.
Editorial and Advertisement Office : "Practical Mechanics," George Newnes, Ltd.
Tower House, Southampton Street, Strand, W.C.2
'Phone : Temple Bar 4363
Telegrams : Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XIII AUGUST, 1946 No. 155

FAIR COMMENT——BY THE EDITOR

Compensation of Patentees

INVENTORS whose inventions have been used by the State during the war will be interested in the announcement made by the Prime Minister that a Royal Commission has been set up to determine what awards should be paid to inventors in respect of the use of their inventions, designs, drawings or processes by Government Departments and Allied Governments during the war.

The following persons have been appointed members of the Commission: Lord Justice Cohen (chairman); K. R. Swan, K.C. (deputy chairman); G. M. Bennett, Sc.D.; Lt.-Col. Sir John Greenly; Lt.-Col. Sir George Lee; Sir James Rae, J.P.; Sir William Stanier, F.R.S.; R. G. Lloyd, M.A., B.Sc. (secretary).

This Commission follows the general lines of that set up in 1919 and will normally sit in public. The Commission's terms of reference may be summed up briefly as follows:

A dispute under Section 29 (Right of Crown to use patented inventions), sub-section 2 of the Patents and Designs Acts, 1907 to 1946, shall be referred to the Commission instead of to the Court if the owner of the patent or of the registered design and the Government department concerned agree to submit to the Committee's decision. The Commissioners may then decide and settle such dispute with authority to investigate and determine questions of infringement and validity as far as necessary.

In cases where terms of user, etc. (including assignment to a Government department under Section 30 of the Act) have been agreed or are in the course of agreement between the owner of a patent and a Government department, the Commissioners may advise the Treasury as to giving or withholding approval and may assist in settling any terms on which no full agreement was achieved yet.

In cases of use by, or with approval of, a Government department or an Allied Government where the inventor or owner has no statutory right to payment or compensation, the Commissioners may, on request of the Treasury, advise on any special remuneration (if any) that is proper under the circumstances.

In cases where, under the Agreement between H.M. Government and the U.S. Government concerning the Interchange of Patents Rights and Information of March 27th, 1946, a licence was granted to the U.S. Government, the Commissioners may, on request of the Treasury, determine the amount of compensation (if any) to be payable to the licenser in view of the utility, the extent of use and all other relevant circumstances.

Certificates of Craftsmanship

THE Government-sponsored Building Apprenticeship and Training Council (B.A.T.C.), which was established three years ago under the chairmanship of Sir Malcolm Trustram Eve, set up a scheme for the registration of the building trade apprentices serving apprenticeships under conditions which meet the minimum standards of the Council. These minimum standards stipulate that there shall be a written standard of apprenticeship which shall provide: that the apprentice shall be taught his whole craft; that the apprenticeship shall be subject to the oversight of a Joint Apprenticeship Committee of the Industry; and that the apprentice shall be released by his employer on one day a week or its equivalent for regular and compulsory attendance during normal working hours at an appropriate technical course.

The National Joint Councils for the Building Industry in England and Wales and in Scotland (covering the traditional crafts) responded to the lead of the Building Apprenticeship Training Council, and established national apprenticeship schemes complying with these standards. Large numbers of approved apprentices have already been registered.

The scheme provides that a certificate will be given to successful apprentices once the Joint Committee has declared that the apprenticeship has been completed satisfactorily. The first three of these "Certificates of Completion of Approved Apprenticeship" are now to be granted to:

L. S. Coventry, 5, Sefton Street, Litherland, Liverpool; R. Jones, 82, Victoria Road, New Brighton, Cheshire; K. J. Brown, 27, Kimberley Crescent, Fishponds, Bristol.

They are to be congratulated on their success and on becoming the first of the many craftsmen who in the future will have the certified proof that they entered the industry and were trained for their craft in accordance with the new conditions established by the Industry and the Building Apprenticeship and Training Council.

The registration scheme will greatly benefit the industry by encouraging sound apprenticeship and thereby raising the standard of craftsmanship in the building industry. From now on it is expected that there will be a steady stream of well-trained apprentices passing on into the ranks of craftsmen.

International Technical Congress, Paris, 1946

AN International Technical Congress is to be held in Paris from September 16th to 21st, 1946. The object of this Congress is to emphasise the important part which must be played by engineers and other technicians in the period of post-war reconstruction, and to stress the necessity for technicians from the different nations to collaborate. Papers for discussion are being contributed from many European countries and the United States of America and include several from Great Britain.

The subjects cover a wide range and the method of presentation takes the form of reports on recent progress and developments in such fields as plastics, construction, aeronautics, power plants and town-planning, as well as more abstract matters such as the position of the technician in the political structure.

The organising secretary for Great Britain is Mr. Robert Lowe, 82, Victoria Street, London, S.W.1.

The Snobbery of Craftsmanship

"THE snobbery of craftsmanship is greater to-day than several decades ago. Wrong though it is, the moulder is regarded as somebody lower in the social scale than the artisan who, when he stops work, can leave reasonably clean and tidy. Hence, when a choice of occupation is available, the young men of the future will avoid the foundry unless foundries are made cleaner, more attractive, and with higher pay—unless the snobbery is changed."

These words were spoken by Sir Claude D. Gibb in the course of his Edward Williams lecture before the British Institute of Foundrymen. It is true that there is snobbery amongst craftsmen. The toolmaker thinks he is superior to the turner, the turner to the fitter, the fitter to the foundryman; and all of them consider that they are superior to, say, tailors, printers, carpenters, painters or builders. If everyone is to avoid the trades which soil the hands, there will be an extreme shortage of labour in certain industries! A certain amount of dirt is unavoidable; it would be impossible, for example, to make the overhaul of motor-cars or the repairing of tyres clean industries. Is it not encouraging snobbery to adopt the suggestions made by Sir Claude D. Gibb? The old adage says that a cat in gloves catches no mice, and the best positions will only be held by those who can truly claim to be all-round men; and deservedly so.

Mechanical and Hydraulic Analogies

Their Use as Aids in Electrical Technology.

MECHANICAL and hydraulic analogies for the explanation of difficult phenomena occurring in electrical technology are becoming increasingly popular. That analogous description is a great stimulant to thought is an opinion held by a large percentage of engineers. Everyone has at some time or another found a new way of viewing a difficulty by a colleague's ready description using analogous systems to clarify the reasoning.

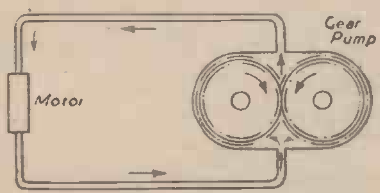


Fig. 1.—*The hydraulic system.*

Electrical technology deals with an intangible energy medium and here then the analogy can be especially useful when the comparisons are drawn from more materialistic mediums.

Electricity is defined by the leading dictionaries as—"The manifestation of a form of energy believed to be due to the separation or movement of certain constituent parts of an atom known as electrons." An electron possesses a mass when at rest of 9.042×10^{-28} gms, and R. Stranger tells us that their diameter is $\frac{3}{2 \times 10^{13}}$ in. The migration of these incredibly small particles is consequently invisible to the observer and, as our definition explains, it is the manifestation of the energy of these particles which we witness in the multifarious apparatus around us.

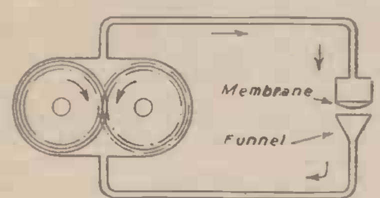


Fig. 3.—*A hydraulic analogy.*

Electricity: Rate of Flow

Electricity employed as a form of energy is closely related to fluid pressure. Pressure, rate of flow, and resistance to flow, are terms used by the hydraulic engineer; while the corresponding terms of the electrician are, electromotive force, current flow, and electrical resistance. The hydraulic engineer measures his quantities in pounds/sq. in. (pressure), gallons/min. (flow) and resistance to flow in back pressure or pressure drop at a selected flow rate. The electrical engineer deals with electromotive force in terms of voltage, a flow rate of so many amperes, and electrical resistance to flow in ohms.

It is easily shown that just as Ohm's Law applies in the electrical circuit with

$$\text{Amperes} = \frac{\text{Electromotive Force}}{\text{Electrical Resistance}}$$

So can we write

$$\text{Flow Rate} \propto \frac{\text{Pressure Head}}{\text{Resistance to Flow}}$$

A similar analogous system is found to exist when the "conductors" of the energy mediums are considered. Common sense tells us that with fluids in pipes

$$\text{Resistance to flow} \propto \frac{\text{Length of conductor}}{\text{Cross sectional area of conductor's bore}}$$

$$\text{i.e.,} \quad R \propto \frac{l}{a}$$

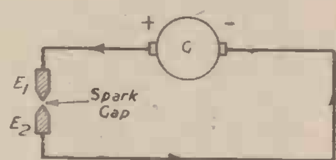


Fig. 2.—*A generator and spark gap.*

If a value "k" be employed to take care of the surface finish inside the bore of the "conductor" we can write:

$$R \propto \frac{k_1 l}{a}$$

Electrical conductors follow the same type of law—

$$\text{Resistance} \propto \frac{\text{Length of conductor}}{\text{Cross sectional area of conductor}}$$

$$\text{i.e.,} \quad R \propto \frac{l}{a}$$

If we introduce a value ρ called specific resistance (measured in microhms/cm. cube) of the conducting medium we can write

$$R = \frac{\rho l}{a} \text{ and the analogy is complete.}$$

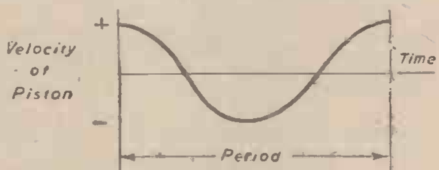


Fig. 8.—*Velocity of the piston over a given time.*

Uni-directional Current Flow

Direct current electrical engineering is concerned only with uni-directional current flow, and this system of energy transmission can be likened to the hydraulic system drawn in Fig. 1. One very great difference between hydraulic machinery and electrical machinery which must be kept very clearly in mind is this: most hydraulic apparatus is constant flow variable pressure, while electrical apparatus is constant pressure (voltage) variable flow. Variation of hydraulic loading does not alter the output from the pump; it is pressure in the line that is the variable factor. Variation of electrical loading causes the current flow to change; the electrical pressure (voltage) remains constant. Here, then, our analogy breaks down and reminds us that an analogy is rarely ever accurate at every comparative point we elect to study.

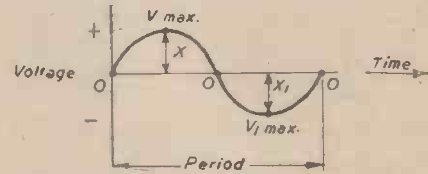


Fig. 4.—*A sine wave.*

While we are considering a simple circuit of uni-directional current flow it is possible to give a simple analogy for the electrical spark gap used in so many practical devices.

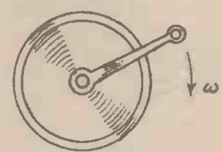


Fig. 6.—*A flywheel and crank.*

Consider a generator G (Fig. 2) connected to electrodes E_1 and E_2, the intervening space between E_1 and E_2 consisting of air. (In many cases it is low-pressure gas.) Then if the voltage generated is increased from zero to a high order we will reach a point where the voltage, or electrical pressure, is sufficiently high to break down the resistance of the air gap between E_1 and E_2, giving us a current flow in the circuit and a visible spark across E_1 and E_2.

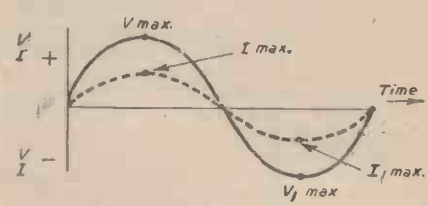
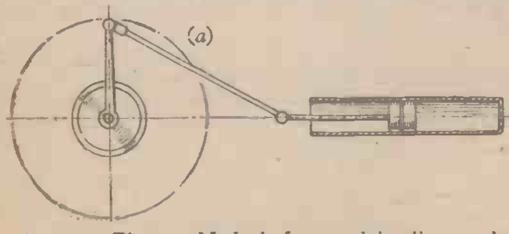


Fig. 5.—*An instance where the current wave is of lower amplitude than the voltage wave.*

The hydraulic analogy is surely that shown in Fig. 3, where a gear pump is supplying liquid to a pipe blanked off by an elastic membrane of non-porous nature. Pressure will be built up in the pipe line until a sufficiently high pressure capable of bursting the



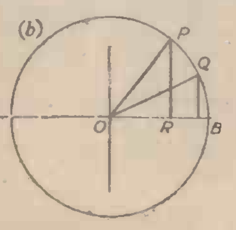


Fig. 9 (*Right*).—*The suction stroke.*

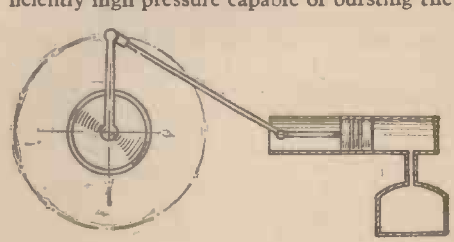


Fig. 7.—*Method of ascertaining linear velocity of the piston.*

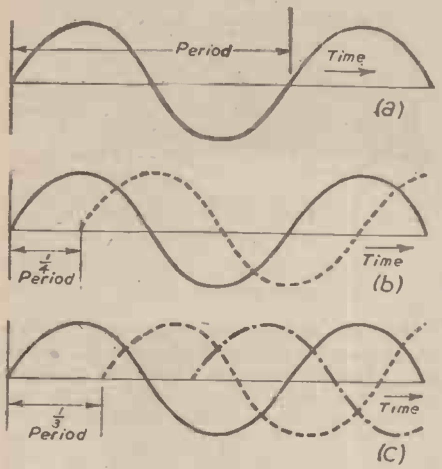


Fig. 10.—Showing single-phase, two-phase, and three-phase A.C. systems.

membrane is reached, and a flow of liquid will be obtained. The initial jet of fluid corresponds to the spark in the electrical circuit.

Alternating Current

Alternating current presents more complicated problems for explanation, and many find it almost an impossibility to grasp quantities varying in very short time intervals. Alternating current transmission of energy is concerned with a continuously varying pressure and current flow. Consider a simple A.C. generator; it generates a voltage which rises from zero to a maximum and falls from a maximum to zero in one direction and then repeats this growth and decay of voltage in the reverse direction. We draw what we term an A.C. wave to represent this growth and decay; it looks similar to that in Fig. 4.

This growth and decay in two directions takes a certain finite time, and the time for one complete cycle is called the period. In actual practice it is often only a small portion of a second.

The number of cycles in one second is termed the frequency. Thus on 50 cycle mains we find that Fig. 4 is produced 50 times a second and the period would be 1/50 of a second.

The other point to keep in mind is the amplitude of the wave, and this is a measure of the actual pressure in the case of our voltage wave. The distance x or x_1 being a representation of this value.

If this voltage wave be impressed on a pure resistance circuit a variable current will flow, and this current will keep in step with the impressed voltage. The current wave, naturally, will not necessarily be of the same amplitude as the voltage wave, this depending on the electrical resistance opposing the current flow. Fig. 5 explains this in diagrammatic form.

The analogous system is partly mechanical and partly hydraulic.

Imagine a reciprocating engine—we simply show the flywheel and crank—Fig. 6. If the flywheel is rotating at a constant velocity ω, the crank also will have a constant velocity ω.

But if we consider this crank connected to a connecting rod and piston, Fig. 7a, and examine the linear velocity of the piston, we find a very different story.

The piston moves with simple harmonic motion and the distance x of R from the centre of crank O traced out by P, Fig. 7b, can be shown to be $x = a \cos(\omega t + \beta)$ where

a = amplitude of movement.
β = epoch or angular distance moved through by point Q.
ω = angular velocity of P.
t = time.

The first and second differentials of x with respect to t give velocity and acceleration of R.

If we plot the 1st differential referred to, then we get a wave which gives us the continually varying velocity of the piston over a given time (Fig. 8). The amplitude will vary with engine conditions and the period will be the time for one complete revolution of the crank.

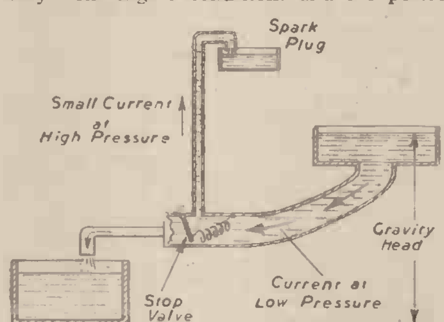


Fig. 14.—A hydraulic analogy which shows the principle of the high tension magneto.

If the piston is made to do work in a cylinder and a liquid inserted, it can be seen that the liquid which is at one moment pumped from the cylinder can be sucked back into the cylinder on the next portion of the stroke; the suction stroke (Fig. 9). The flow will then be a flow in two directions.

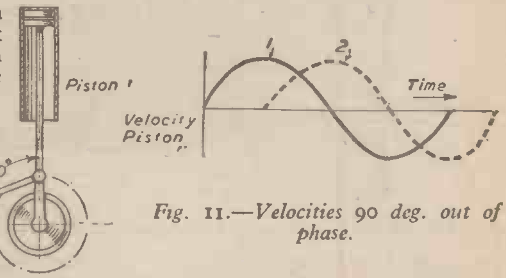
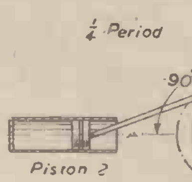



Fig. 11.—Velocities 90 deg. out of phase.

Polyphase Working

A mechanical hydraulic circuit of the type just discussed is an analogous system for our A.C. electrical circuit. Now this type of circuit is termed single phase. But we can utilise the ground work already laid to explain the mysteries of polyphase working.

By a polyphase system of alternating electric currents is meant a system consisting of several alternating currents having the same frequency, i.e., same number of waves per second—but differing in phase—i.e., so related to one another that they do not reach their maximum or zero values simultaneously but consecutively. Although any number of alternating currents of the same frequency might be combined so as to form a polyphase system, yet in practice the number of phases rarely exceeds three.

Fig. 10a shows a single-phase alternating current system.

Fig. 10b shows a two-phase alternating current system.

Fig. 10c shows a three-phase alternating current system.

If we so dispose our cylinders and pistons in our mechanical hydraulic circuit about the same crank we can produce an analogous system for two-phase and three-phase working.

Consider diagrams Fig. 11 and Fig. 12.

It will be easily seen that the velocities of the pistons will vary with time and will be out of phase one with another. In Fig. 11 the velocities are 90 deg. out of phase 1/4 period $\frac{(360^\circ)}{4}$ apart; two-phase working.

In Fig. 12 the velocities are 120 deg. out of phase $\frac{1}{3}$ period, $\frac{(360^\circ)}{3}$ apart; three-phase working.

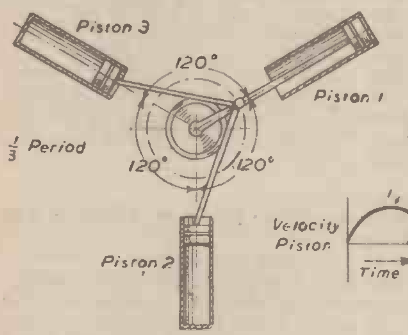
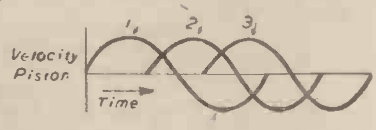



Fig. 12.—Velocities 120 deg. out of phase.

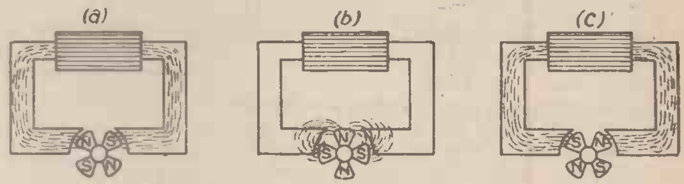


Fig. 13.—In high tension magnetos the rapid reversal of flux produces a high voltage in the secondary winding.

High Tension Magnetos

The magneto used for ignition on internal combustion engines generates a rapidly

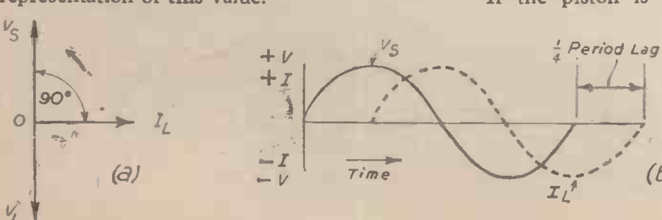


Fig. 15.—Vector diagram of a pure inductance circuit.

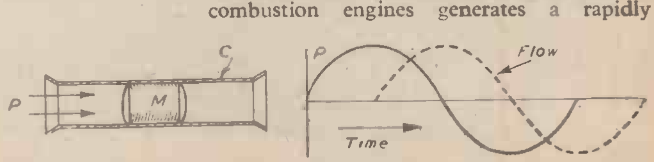


Fig. 16.—A pneumatic analogy of Lenz's Law.

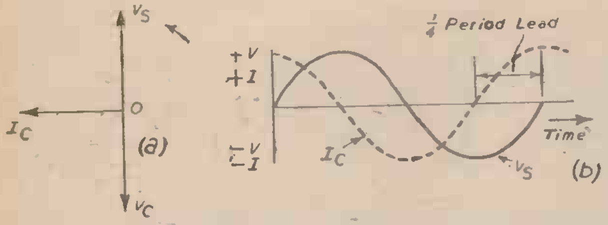


Fig. 17.—Vector diagram of a condenser in an electrical circuit.

changing alternating e.m.f. and this is accomplished on the polar inductor type by revolving a number of polar inductors between the laminated poles of the armature core. The rapid reversals of flux produce a high voltage in the secondary winding, and diagrams of this type of magneto appear in Fig. 13a, b, c.

An hydraulic analogy for this type of high tension magneto has been put forward by R. C. Clinker, wherein the well-known water ram is used to represent in principle the rapid rise of voltage in the magneto. The kinetic energy of a large flow of water at a very low pressure is utilised to pump water to a great height, where a portion of this energy reappears as a small flow at a very high pressure. This transformation is effected by suddenly arresting the flow of water at low pressure by a spring-controlled valve which oscillates rapidly. Each time the valve closes, the kinetic energy in the slowly moving body of water manifests itself as a pressure which forces a small quantity of water up the delivery pipe to a great height (Fig. 14). This small flow at a high pressure corresponds exactly to the small current at enormous voltage which passes through the secondary winding at each spark discharge.

Current Lag and Lead

Much difficulty is occasioned in a study of electrical technology by the respective lag and lead of current over voltage in inductive and capacitive circuits. In a circuit possessing pure inductance the vector diagram Fig. 15a, b, shows in very academic fashion the state of affairs that exist inside the circuit.

V_S = mains voltage.
V_L = inductance terminal voltage.
I_L = inductance current.

The inductance terminal voltage is equal and opposite to the mains voltage, and the inductance current lags behind the mains voltage by 90 deg. Electrical inductance is an inertia effect, a tendency to resist change, as expressed by Lenz's Law.

An analogous system is found in pneumatics. Consider an inertia member M, Fig. 16, capable of movement in a pipe conductor C, friction being negligible. If a pneumatic pressure P be applied to the pipe, the member will be accelerated in a direction corresponding to the direction of the fluid flow. The fluid flow is then retarded by inertia of the mass M. If the fluid flow be reduced the inertia of M will tend to maintain the flow and thus resist its decay. This is an exact analogy of Lenz's law of the inductive circuit which in electrical terms is stated as "the direction of the currents induced in a circuit as a result of a change in the interlinkages between the circuit and a magnetic field is such as to oppose the change which produces it, or is suicidal in effect."

Electrical Condensers

Stranger phenomena still occur in the electrical condenser. The vector diagram is as shown in Fig. 17a, when the circuit is one of pure capacitance.

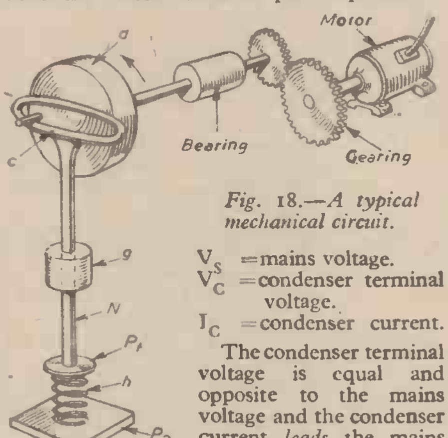


Fig. 18.—A typical mechanical circuit.

V_S = mains voltage.
V_C = condenser terminal voltage.
I_C = condenser current.

The condenser terminal voltage is equal and opposite to the mains voltage and the condenser current *leads* the mains voltage by 90 deg.

Let us examine a mechanical circuit as shown in Fig. 18. The plates p_1, p_2, and helical spring h are analogous to an electrical condenser and are connected to a mechanical supply of alternating force represented by the disc d, and cross head c, imparting simple

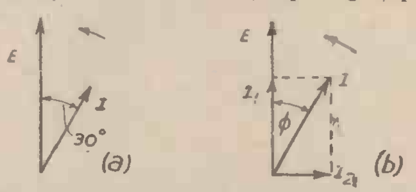


Fig. 20.—Vector showing current lag on voltage in an inductance capacitance circuit.

harmonic motion to the plunger N working in the guide g. Let the model be so constructed that when the cross head is in mid position the spring h is in a neutral state, the mechanical condenser is not charged. Place the mechanism in this state and rotate the disc d a quarter revolution in the direction shown. The spring becomes fully compressed and the mechanical condenser is charged. Continue the rotation another quarter revolution and the condenser is discharged, another quarter revolution and the condenser is fully charged in the opposite sense, the spring being fully extended. Complete the whole revolution and the condenser is now discharged and one complete cycle has been performed.

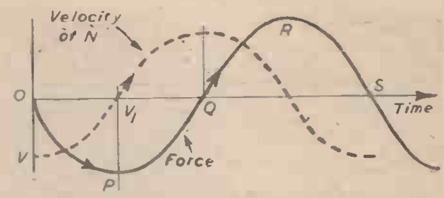


Fig. 19.—Velocity leading in time the force that produced it.

In the electrical circuit a wave is plotted with voltage and current against time (Fig. 17b.).

Now let us plot the velocity of plunger N and the force between N and spring h against time. We will commence when the crankpin is halfway between top dead centre and bottom dead centre, the downward velocity of the plunger at a maximum, and the spring in the neutral position exerting no force (point O and V, Fig. 19). We continue our rotation and the velocity of N gradually falls to zero and the force between N and h becomes greater as the spring is compressed (trace OP and VV_1, Fig. 19).

The graph Fig. 19 shows the velocity of N and the force between N and h plotted against time.

When the plunger reaches bottom dead centre the spring is pressed with a continually decreasing force, hence the trace PQ (Fig. 19). At Q the spring is in the neutral position and the velocity of N is a maximum. As the movement continues the spring expands and the trace is represented by QRS.

Examining Fig. 19, we see to our surprise that the velocity leads in time the force that produced it, just as the current leads the voltage which produced it in the electrical condenser.

Power Factor

The final analogy I want to discuss is that of Power Factor.

In A.C. working Power Factor is of vital importance to consumer and supplier alike.

Fundamentally, power is supplied in volts and amps, the direct multiplication of these terms in a D.C. circuit giving the actual wattage. In A.C. circuits things are not so elementary. Power is expressed as (E.I. cos ϕ)

where E = volts.
I = amps.
cos ϕ = power factor.
where ϕ = angle of lead or a lag of I over E.

Imagine a circuit containing inductance, capacitance and resistance so that the current lags on the voltage by an angle of 30 deg. Fig. 20a.

Then we can by the simple use of rectangular components split the current

(*Continued on page 383.*)

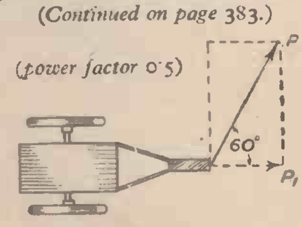


Fig. 25

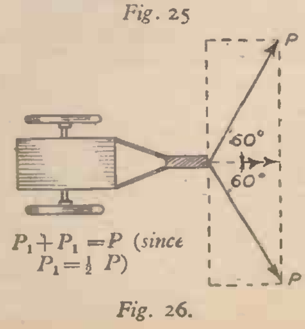


Fig. 26.

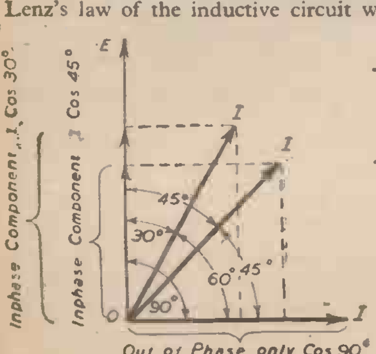
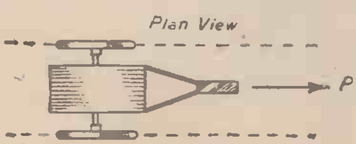


Fig. 22.—Vector for three values of power factor.



Figs. 23 to 26.—The horse and wagon analogy.

Fig. 23

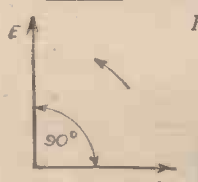


Fig. 21.—A bad power factor.

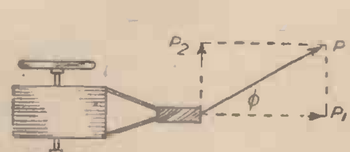


Fig. 24

SPRAY PAINTING

3—Large Capacity Double-acting Air Compressor

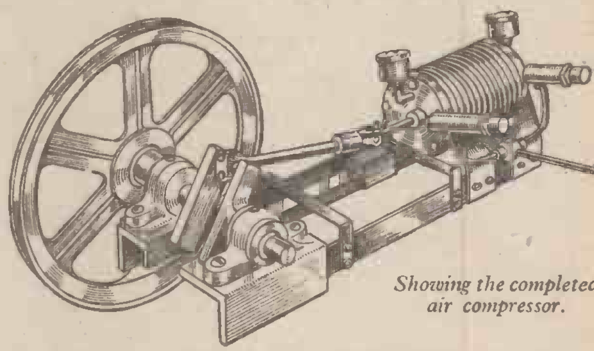
(*Continued from page 356, July issue.*)

OPERATING at a relatively low speed, this air compressor has a capacity of almost three times that of the average small spray-gun compressor. The piston is double-acting, so that compressed air is delivered at the end of each stroke. Slow speed greatly reduces wear of the moving parts, there is practically no vibration, and the delivered air is cool. Oil pumping is eliminated as the piston has graphite packing instead of rings, possible because of the low speed, and thus a crankcase is dispensed with entirely.

You can make this compressor from standard stock-size sheet, rod and tubing, except for the cast bearings and elbows. All the parts must be fitted accurately to eliminate pounding. The cylinder, Fig. 1, is turned to 3in. in diameter, from a length of mild steel rod. Face the ends and saw off a ½in. disc to use as a cylinder head. With the remainder cut to length, chuck it in a lathe, between a four-jaw chuck and tail centre, and cut the fins. Start these with a V-point tool, working in as deeply as possible, then true up the edges with a chisel-point tool. Repeat this procedure until the required depth has been reached. Boring the cylinder is a long and tricky job. Mount it between the reversed jaws of a chuck and start by drilling a hole large enough to accommodate the smallest boring bar, which is used until the bore will accommodate a larger one. After completing the last cut to within .01in. of the finished bore, the bored surface will appear quite smooth. Now use a surfacing tool, taking "microscopic" cuts by running the carriage back and forth without advancing the feed. Finally hone the surface with a well-oiled stone. The work should rotate about 500 r.p.m., and the stone is moved back and forth with one finger until the bore is mirror bright.

The piston, Figs. 1 and 2, must fit practically air-tight, even without packing. Silver-solder the bronze and brass discs to the piston rod before turning them to size, and finally remove only .001in. of metal per cut, stopping when the piston shows signs of sliding into the bore. Then wrap the piston in cotton and put it where it will not be damaged.

Now go to work on the cylinder head. Face the inside while the disc is held in the four-jaw chuck, and cut the retaining shoulder for the gasket, Fig. 2. Bore for a running fit on the piston rod, then face the outside of the head and bore the stuffing box. Turn the cover or gland from brass. With the cover in place, drill and tap for four mounting screws, installing each screw before the hole for the next is drilled. The same procedure is followed for the eight cylinder-head screws. Drill one hole into both head and cylinder, tap the latter and counterbore the head for body clearance. Screw down this one and then drill the hole exactly opposite. Two taps are required: a tapered one to start the thread and a bottoming one to carry the thread down to sufficient depth. A gasket of rubberised asbestos is cut to size and the holes pierced by laying it and the head on a block of wood and drilling down through the head.



Showing the completed air compressor.

When the head is screwed down the piston should centre itself without binding. Wrap ¼in. graphite-asbestos rope packing, used for low-speed pumps, into the piston groove, so that the packing bulges out, but keep working it into the groove until the piston enters the cylinder. The packing is woven, so do not cut off stray bulges, but work them in. A couple of drops of oil put in the intake valves each hour of operation will replace any grease lost from the piston packing.

An intake and exhaust valve are fitted at each end of the cylinder. The intake valve, Fig. 3, has a thin, flat piece of steel, such as a piece of feeler gauge, fitted over a hole in the cover. On the suction stroke it bends away from the hole and air enters, but on the pressure stroke it is forced against the hole and air in the cylinder can escape only through the exhaust valve. To prevent dust or paint from being sucked into the cylinder, a filter cap may be slipped over

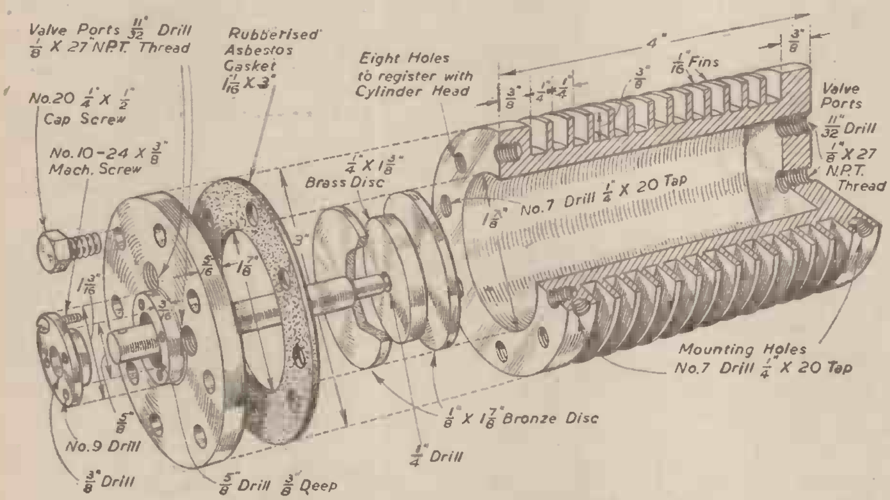
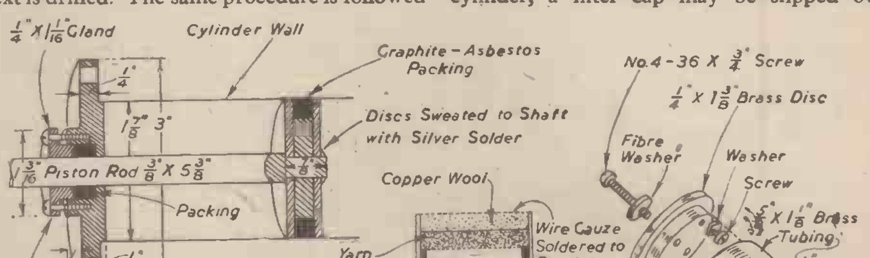


Fig. 1.—Cylinder and piston assembly.



Figs. 2 and 3.—Component parts of the cylinder and piston.

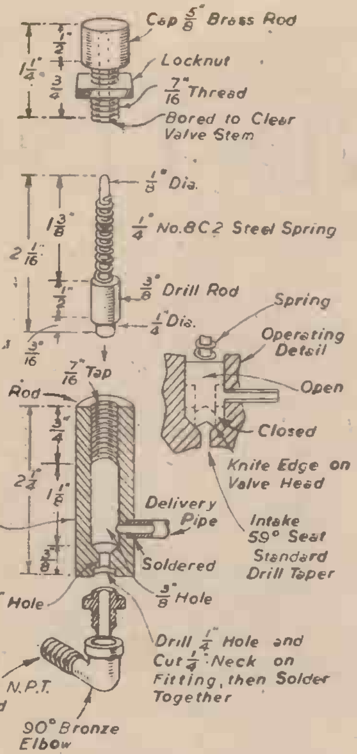


Fig. 4.—The exhaust or delivery valve.

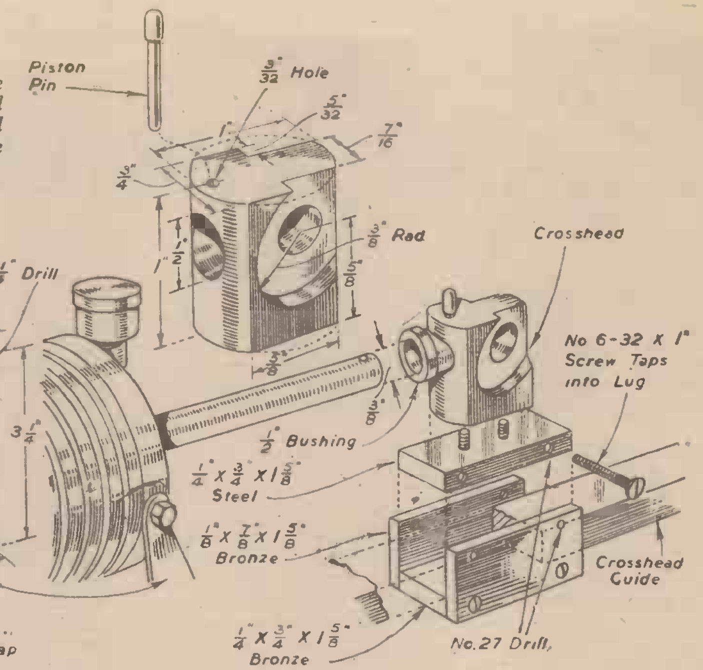


Fig. 6.—The piston rod supported and steadied by the crosshead.

each valve. When the filter pads become clogged with foreign matter replace them.

The exhaust or delivery valve shown in Fig. 4 is more complex, for it works under pressure and at a rather high temperature. The strength and adjustment of the valve-stem spring determines the pressure of the delivered air. On low pressure, the delivery of air is almost a steady stream, but on high pressure it comes in spurts with a lull between each. An expansion tank or long hose does much to equalise these spurts of high-pressure air. Regardless of speed, the pressure stays close to where the valve is set; more speed simply means more air but not higher pressure. Both valves are connected to a single delivery pipe, as shown in Fig. 5.

The piston rod is supported and steadied by the crosshead. (See Fig. 6.) When installing the brass bushing, drive it in first, then bore out to a tight running fit. A pin holds the piston rod in the bushing and crosshead. As the latter is subjected to extreme stress, accuracy in construction is important. The sliding sleeve on the crosshead guide is also detailed in Fig. 6. Fig. 7 shows the guide and how it is attached between brass crosspieces, which later are soldered to

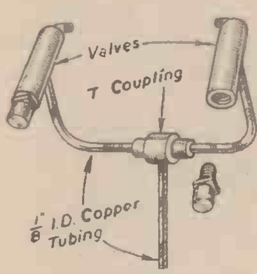
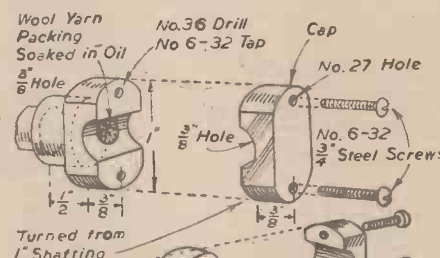


Fig. 5 (left).—Both valves are connected to the single delivery pipe as shown.



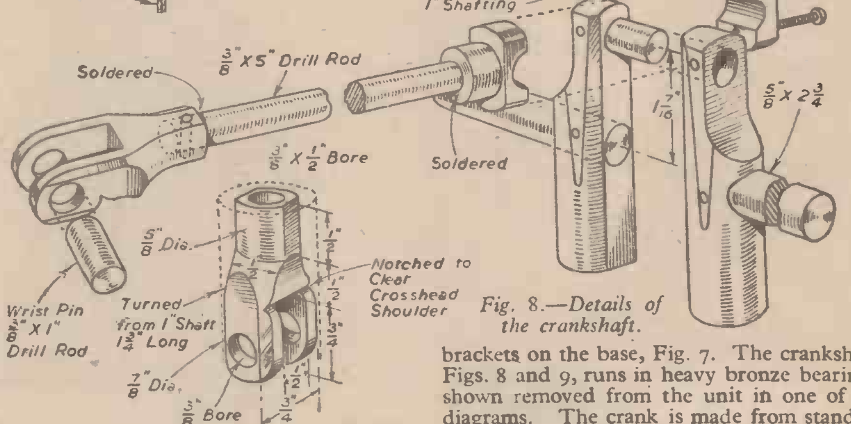


Fig. 8.—Details of the crankshaft.

brackets on the base, Fig. 7. The crankshaft, Figs. 8 and 9, runs in heavy bronze bearings, shown removed from the unit in one of the diagrams. The crank is made from standard steel shafting. The heavy butt ends are counterweights. Drive them on to the shaft, drill and pin them in place, driving each pin in firmly. Then sweat-solder the parts together, using zinc-alloy solder and stainless-steel flux, by laying the assembly on an asbestos pad over a gas plate. Bring up the temperature to the point where the flux boils, then apply solder. When cool wash well in warm water.

The connecting rod between the crosshead and crankshaft is also shown in Fig. 8. It consists of three parts soldered together. Leave the soldering of one end until the entire compressor is assembled and centred. The crank bearing is lubricated by a pad of wool yarn in a cavity in the bearing. See upper detail of Fig. 8. Take up the screws until there is no slack in the cap, but stop before binding starts. The bearing on cross-

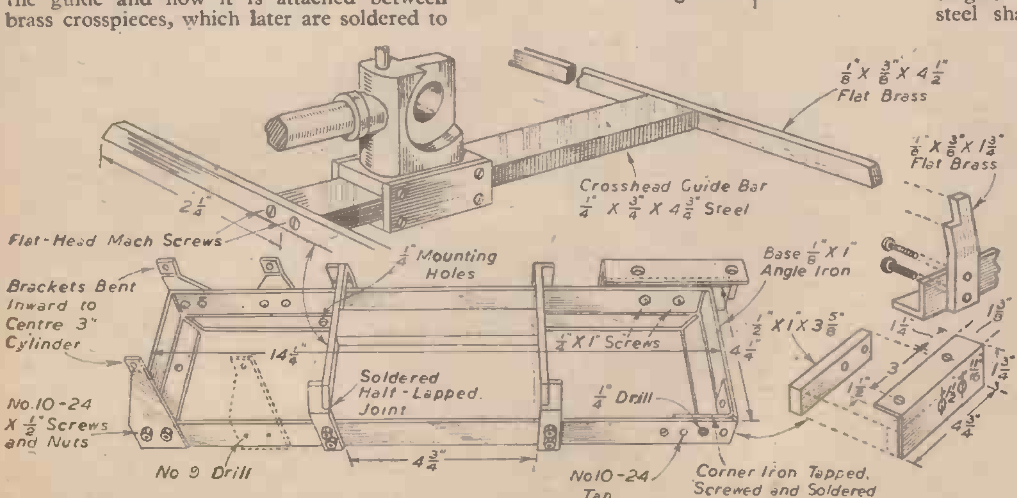


Fig. 7.—The guide-bar and details of built-up base.

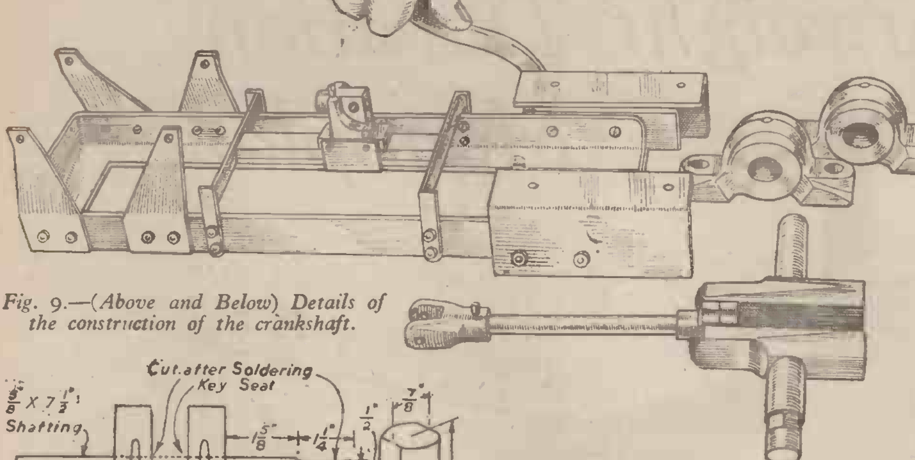
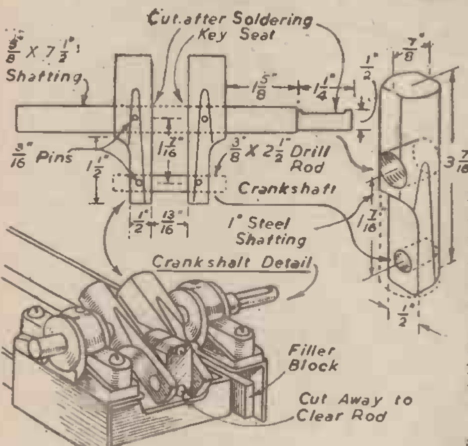


Fig. 9.—(Above and Below) Details of the construction of the crankshaft.



head, detailed in Fig. 8, requires considerable hand filing after lathe work is finished. The base, Fig. 7, is a length of angle iron, notched and bent to shape, with the end secured by a corner iron. Tap holes in the frame, screw the iron in position, solder, then file the screw shanks off flush. Three mounting holes are drilled to hold the base on a wood sub-base. The crankshaft bearing supports are pieces of angle iron spaced from the base, as shown in the extreme right-hand detail of Fig. 7. The centre of the crank must be in line with the end of the piston. As misalignment of only .01in. will cause the shaft to bind, be prepared to shim up one or the other of the bearings. The cylinder is held by four brackets bolted to the base and to the cylinder. See Figs. 6 and 7. The crank is centred so that there is a slight air gap at each end of the piston stroke. Then the guide rod is slipped in place, and, after letting it centre itself between the two supports on the base, brass crosspieces are soldered to the supports, using zinc-alloy solder and stainless-steel flux. Stick graphite is the best lubricant for the guide, crosshead and crank, with a few drops of machine oil added from time to time. The table, Fig. 10, gives information on the volume of air delivered at three speeds. Fig. 11 shows an air filter with a pressure gauge and safety valve attached. Gauge and valve are standard items, the tank can be made of brass or galvanised iron.

[By courtesy of POPULAR MECHANICS PRESS, *Chicago.]*

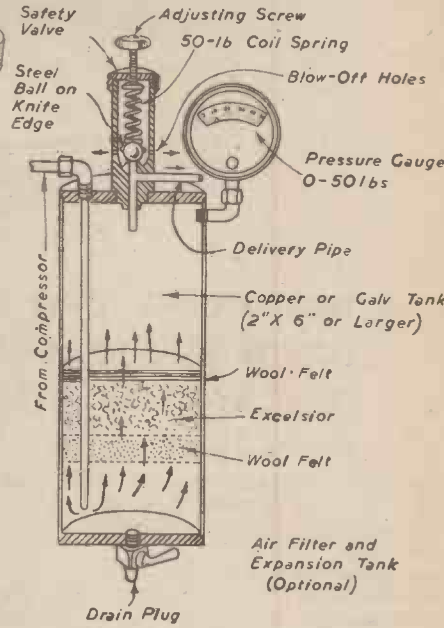


Fig. 11.—Air filter with a pressure gauge and safety valve attached.

	SPEED AND COMPRESSOR DELIVERY TABLE			
Comp. Pulley	Motor Speed	Motor Pulley	Comp. Speed	Air Delivered
		1 in.	172 r.p.m.	2.74 cu. ft. per m.
10 in.	1,725 r.p.m.	2 in.	295 r.p.m.	4.62 cu. ft. per m.
		3 in.	458 r.p.m.	6.58 cu. ft. per m.

For higher speed the size of valve ports must be increased. Maximum delivery not to exceed 8 cu. ft. per minute and pressure not greater than 50lb.

Fig. 10.—Table showing volume of air delivered at three speeds.

Mechanical and Hydraulic Analogies

(Continued from page 380)

vector into an in-phase component I, and an out-of-phase component I_2 (Fig. 20b). Then the power is $E.I_1$, where I_1=in-phase component, and we can easily see that I_1 is I cos ϕ. Thus Power=E.I. cos ϕ, as previously stated.

If a consumer is running his apparatus at such a bad power factor that I is 90 deg. lag, then we see (Fig. 21) that he has no in-phase component of I and hence no power, even though his apparatus and conductors are fully loaded, and he is paying for volts and amps which give him negligible results. Fig. 22 shows this vectorially for three values of power factor: Zero power factor—cos 90°=0; 0.866 power factor—cos 30°=.866; 0.7 power factor—cos 45°=.7.

Animal Drawn Wagon Analogy

The same state of affairs is found in mechanical and hydraulic systems. A very similar case occurs when we examine an animal drawn wagon.

For maximum power to be applied to the wagon, the animal must pull along a line of action parallel to the track of the road wheels (Fig. 23).

If the animal pulls with the same force p in a direction at an angle ϕ to the track of the road wheels, then the *real* power applied to the wagon is the component p_1 (the in-phase component). The other component of p, p_2, is not doing any useful work in pulling the wagon and can be called the workless component. Mathematically, the power p_1=p cos ϕ where cos ϕ is the power factor.

Bad Power Factor

It can be seen quite readily that if the animal pulls in a direction at 60 deg. to the track line (Fig. 25), the actual pull on the wagon is one half of the pull exerted by the animal, because p_1=p cos 60°. Thus p_1= ½ p (since cos 60°=0.5). To obtain the original pull p on the cart if the animal persists in pulling at this angle of 60 deg., we should need another animal (Fig. 26).

An even better analogy is that of a pulsating water supply delivering 50 spurts of water per second (this is similar to 50 cycle electric mains). Imagine moving a cup under the tap just as the spurts ceased and moving it away just as the spurts commence. The cup will never fill with water. This is working at zero power factor. Obviously, to get the cup filled in the fastest time synchronism between movement of cup and pulsations of the water supply must be achieved (unity power factor).

Should the cup be moving at ".5 power factor," then we should need two pulsating supplies to give us the quantity of water we could obtain by synchronism, a most uneconomical state of affairs. It is for this reason that installation engineers correct the power factor to as near unity as economically suitable for any specific case, and thus effect a great saving on the cost of running the plant.

Our Front Cover

THE illustration on the front cover this month is one of the first pictures of the inside of an atomic bomb factory to be published. It was taken in the Clinton Laboratories of the Oak Ridge, Tennessee, plant, which is operated for the U.S. Army by the Monsanto Chemical Company.

Radio-active substances produced at the factory are now to be distributed to hospitals and laboratories of science for use in the treatment of disease, and in experiments which may throw new light on the processes of life. The illustration shows the start of an operation on the plant. Scientist Paul Schallert, using long-handled tongs, is introducing active material through the roof of a concrete-walled cubicle. It drops inside to chemical processing units which can be operated safely from outside the cubicle.

A Lightweight Duration Monoplane

This illustration shows the fine lines of the lightweight duration model. A full-size layout blueprint is obtainable from these offices.

THIS MODEL CAN BE CONVERTED INTO A SEA-PLANE BY FITTING FLOATS

THIS machine complies with the S.M.A.E. fuselage formula $\frac{\text{(overall length of model}^2\text{)}}{100}$ and can be flown in any lightweight or open duration competition. Carefully draw the plans full size.

Fuselage

The fuselage is 29in. long, and is built entirely of ⅛in. × ⅛in. balsa. Build one side on the drawing, on a flat board, by pinning the top and bottom longerons in position, and then cementing the upright members in place.

The sharp bend in the top longeron at the rear of the fuselage should be made in the steam jet of a kettle. Cement the diagonals between uprights Nos. 2 and 3, and 4 and 6, and fit a piece of hard 1/16in. sheet balsa between uprights Nos. 1 and 2.

Two pieces of hard 1/16in. sheet balsa, with the grain of the top piece at right angles to that of the bottom piece, are fitted between uprights Nos. 10 and 11, and a ⅛in. diameter hole is pierced through them to take the bamboo peg for holding the rear of the rubber motor. Build a second side in exactly the same manner, making sure that both sides are identical.

The cross-member can then be fitted top and bottom. Make sure that the fuselage is true.

The nose, between the cross members Nos. 1 and 2, is strengthened with 1/16in. hard sheet balsa. A paper tube, with about ⅛in. diameter hole, is cemented at the tail and the wire tail-skid is fitted. Make sure there are no rough edges on the fuselage which may harm the rubber motor.

The two 18 s.w.g. brass tubes for the undercarriage are then fitted, and small pieces of 1/16in. sheet balsa are fitted as shown on the drawing. Cover with tissue, dope, and apply two coats of banana oil.

Undercarriage and Wings

The undercarriage legs are of streamlined bamboo with 18 s.w.g. fittings bound and cemented to them. The wheels are of two laminations of 1/16in. hard balsa, streamlined and bushed with 18 s.w.g. tubing. The cross piece is of 20 s.w.g., bent to give the required width of track.

The span of the wings is 40in., with a constant 5in. chord, giving an area of 194 sq. in. The section used is R.A.F./32. The leading edge is ⅛in. × ⅛in. sq. balsa set diamond fashion; the mainspar is ⅛in. × ⅜in. balsa; and the trailing edge is ⅛in. × ⅜in. balsa, shaped to the aerofoil section.

Cut the ribs from 1/32in. sheet balsa (except where 1/16in. is shown on the drawing) and space them 1.6in. apart. Build the wing in two parts, and add the centre section afterwards. Reinforce the mainspar with thin plywood on each side, giving the wing 3½in. dihedral and 1½in. sweepback.

Add the tops, which are bent from 1/16in. × 1/16in. birch, the corner gussets at A and B, and the four birch pegs for the rubber bands used for wing fixing. Note that the tip rib on each wing is of streamlined section. Cover with tissue, dope, and apply two coats of banana oil.

A piece of ⅛in. sq. balsa is cemented about 1in. from the leading edge to give the required incidence.

Tailplane

The tailplane has a span of 16in. and tapers from 4in. to 3in., giving an area of 53 sq. in.

The ribs are cut from 1/32in. sheet balsa and spaced 2in. apart. The leading edge is ⅛in. × ⅛in. balsa, the mainspar is ⅛in. × 16in. and the tailing edge is ⅛in. × 1/16in. shaped to the aerofoil section.

Bend two tips from 1/16in. × 1/16in. birch, and two small 22 s.w.g. hooks for the rubber bands. Cement these in position and cover with tissue, dope, and when dry apply one coat of banana oil.

The Rudder

The rubber is 7in. high, ¾in. wide at the tip, and 5in. at the base. Shape the base to fit on the tailplane. The base is of ⅛in. sheet balsa, and to this cement the leading edge ⅛in. × ⅛in. balsa, and the front spar ⅛in. × ⅛in. balsa, and a bamboo dowel, about 1½in. long × ⅛in. diameter, which fits into the paper tube at the rear of the fuselage. The ribs, which are streamlined in section and cut from 1/32in. sheet balsa, are then cemented in position.

Add the rear spar, ⅛in. × 3/32in. balsa, and the trailing edge ⅛in. × 1/16in. balsa. Bend the tip from 1/16in. × 1/16in. birch, and two small hooks for the rubber bands from 22 s.w.g. and cement these in position. Cover with tissue dope, and apply one coat of banana oil.

The Propeller

Lay out the block as shown in the drawing and test for balance. Carve the propeller carefully and make sure that it is perfectly balanced. Cover with tissue, apply one coat of thick banana oil, and test for balance again. Cement an 18 s.w.g. bush in position.

The noseblock is made from a block of balsa about 1in. × 1¼in. × ¾in.; bush with an 18 s.w.g. bush. Fit a lightweight ball-race between the propeller and nose-block. The freewheel is self explanatory. The wing is fixed by a rubber band passing around the fuselage from peg to peg, at the leading and trailing edges.

The tailplane is held in a similar manner, by a band passing round the fuselage from hook to hook.

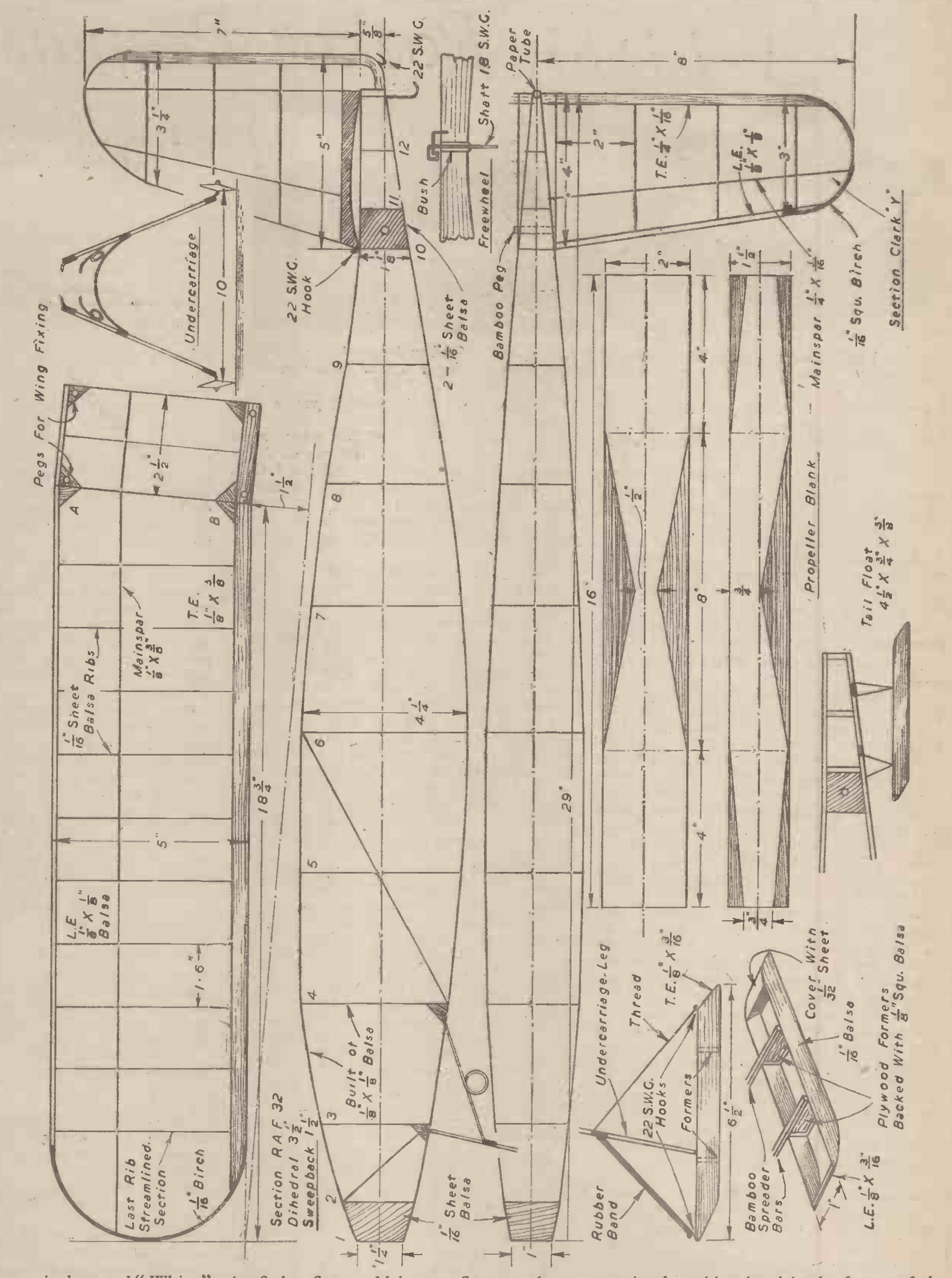
The rudder is held in position by fitting the bamboo dowel into the paper tube at the rear of the fuselage; and a rubber band round the fuselage fitted to the front hook holds the front firm. A rubber band is then passed from the rear hook around the tail-skid.

Adjustments to trim are made by moving the wing slightly, and the rudder is also movable.

The model flies best climbing in wide circles against the torque and is very stable. It has been flown without damage in a wind which crashed or grounded nearly all the other machines. The best power for the machine is 1½oz. of 3/16in. flat rubber, made

SCALE DIAGRAMS OF THE LIGHTWEIGHT DURATION MONOPLANE

THESE MUST BE PLOTTED FULL SIZE; OR YOU CAN PURCHASE A BLUEPRINT FOR 2s.



into 12 strands, about 44in. long and "White" rubber rope tensioned. The weight of the machine with rubber, complete, is 5¼ozs.

Weight of Wings	..	1¼oz.
Fuselage ..	..	1 oz.
Tail Unit Comp.	..	⅜oz.
Rubber	..	1⅜oz.
Undercarriage ..	..	⅜oz.
Prop. with noseblock	..	¾oz.
		5¼ozs.

Lightweight Seaplane

This 'plane can also be used as a seaplane by fitting floats. Make two floats as shown in the drawing, cover with tissue, and apply a coat of banana oil.

Each float is built on a plywood former, backed with ⅛in. sq. balsa. The rear former is built in the same manner, and the bamboo spreader bars are bound and cemented to these formers. The sides are of 1/16in. sheet balsa and the top and bottom are of 1/32in. sheet.

The brass tube (18 s.w.g.) is bound and cemented in position, and two small 22 s.w.g. hooks are bound and cemented to the front and rear spar (⅛in. × 3/16in. balsa) to take the rubber band in the front and the thread at the rear. Make sure that this rubber band is tight and that there is no "give" when the 'plane is taking off. The rear float is made in the same manner, but is fixed firmly to the fuselage as shown.

The Ju. 8-263. This was a Messerschmitt project turned over to Junkers for development and manufacture: prototypes only were produced, the surrender bringing a halt to further work.

Rocket Propulsion

Rocket-powered Interceptors: Early Walter Bi-fuel Engines

By K. W. GATLAND

(*Continued from page 347, July issue.*)

THE autumn of 1944 saw another type of interceptor in action with the Luftwaffe, rocket powered and possessing phenomenal climbing ability. This was the Messerschmitt 163B, a tailless fighter which, including the time involved in take-off, took less than four minutes to reach a height of 40,000 feet.

Its outstanding performance under climb, however, was badly offset by a poor endurance. The period of flight under power at full throttle was little more than four minutes, and although it was possible to extend the actual flight duration by alternate bursts of power and gliding, the machine could not stay in the air for much longer than half an hour.

The fact that the Me.163B had a rate of climb seven or eight times greater than the best Allied fighters was no guarantee of its success. Its limited endurance did not permit sufficient time to make an effective interception, and certainly, once having flashed past the level of the bomber formations, there was little chance of challenging the target again. The aim, nevertheless, was to shoot up the formations during the almost vertical climb and, if fuel permitted, to circle above the bombers and attempt a second interception during a dive.

The tailless aeroplane pioneer, Dr. Alexander Lippish, is credited with the design of the Me.163, of which there were four versions: (a) trainer, 163A; (b) fighter—operational, 163B/O; (c) fighter—operational improved, 163B/1; and (d) fighter—development, 163C.

The machines of the 163 series were the first step in fighter design toward the ideal all-wing layout, and apart from the fact that each sub-type employed a slightly different power unit, the addition of a separate "cruising" motor and a pressure cabin in the 163C were the only principal differences. There were, however, slight variations in length and span.

The Messerschmitt 163B

It was the 163B versions that Allied pilots encountered over Germany, for the "C" sub-type did not proceed much farther than the prototype stage.

The fuselage was short and stubby, and the wings, which were set midway along its length, swept back at 23 degrees to compensate for the absence of a tail-plane. A single vertical fin with normal rudder control was fitted on the centre-line at the rear.

Of all-metal construction, the fuselage housed the rocket engine in the tail-end. The cockpit was placed about a third from the nose and was faired by a large "Plexiglas" moulded hood. At the rear of the pilot was the main oxidiser tank (containing hydrogen peroxide) which with two small self-sealing tanks in the cockpit gave a total capacity of 270 gallons.

The basic structure of the wing, main and auxiliary spars, was of wood. The covering was entirely dural and fixed slats, 7.17 feet in length, extended along the leading edge. Two split flaps of 7.73 sq. ft. area, with a minimum downward angle of 45 degrees, brought the landing speed down to 100 m.p.h.

The fuel, a hydrate-methanol solution totalling 130 gallons, was carried in two wing tanks.

The armament comprised two Mk. 108 30 mm. cannon mounted in the wing roots which each fired 60 rounds, and the pilot was protected by 15 mm. armour plate at front and rear, the nose of the machine consisting of a detachable cone of armour.

A heavy metal skid was fitted for landing and this retracted into a fairing beneath the fuselage. There was also a small retractable tail-wheel which interconnected with the rudder for taxying the 'plane in conjunction with wheels fitted to the skid. These main wheels were also used in take-off, being jettisoned once the machine was airborne.

The electrical services were supplied by a 2,000 watt "windmill" generator fitted in the centre of the armoured nose.

The instruments, which were carried on normal type "dashboard" panels, covered a fairly wide range and included an altitude-compensated air-speed indicator, rate of turn indicator, and all normal navigational equipment. The power unit registered on a composite accelerometer/thrust indicator, and there were other instruments which recorded the fuel feed pressures and tank capacities. An indication of low level in the tanks was given by red warning lights, and a fire warning device was also fitted.

Controls

The thrust of the HWK 109/509A1 engine of the Me.163B/O was controlled by a throttle fitted on the port side of the cockpit. There were five settings, "Off," "Idling," and three stages of power ranging from 220lb. thrust in the lowest gate to 3,520lb. at the maximum setting.

The necessity of providing a composite aileron/elevator control in the wings made the design of the flying control system somewhat unorthodox. In full lateral movement, the control column operated the composite aerofoils (these are known as "elevons") as ailerons. A true longitudinal movement functioned them as elevators, while diagonal motion of the column brought about the operation of only one elevon effecting roll and pitch.

Performance

The machine flew at a maximum speed of 515 m.p.h. at sea-level, while at heights greater than 13,000ft. this figure was increased to 558 m.p.h. Although there was apparently no great difficulty in its control, the pilot had nevertheless to keep a careful watch on his air-speed indicator, as any too violent acceleration around the 550 m.p.h. mark was likely to initiate a sudden downward pitch.

A run of a little more than 700 yards was required in take-off to gain 65ft., and the 'plane climbed away at approximately 450 m.p.h., reaching a height of 20,000ft. within 3.04 minutes. The maximum ceiling was reached at 40,000ft. after 3.98 minutes, further altitude being impossible because the cockpit was not pressurised.

The leading dimensions of the "B" sub-types were as follows: length, 18.7ft.; span, 30.5ft., and the overall height, 8.2ft. The gross wing area was 211 sq. ft.; the wing loading at take-off, 42.9 lb./sq. ft., and at landing, 21.9lb./sq. ft.

The Messerschmitt 163C

The 163C version embodied a cruising motor in addition to its main rocket engine, and this, the HWK 509 A2, was found to be much improvement on the single HWK 509 A1 and HWK 509 B units of the earlier sub-types. It developed a maximum thrust of 3,970lb., plus 660lb. from the auxiliary unit. The endurance under full throttle was raised to 12 minutes, the operational ceiling to 52,500ft., and the time entailed in reaching 40,000ft. was an improvement of 96 seconds on the climb of the 163B/O. Its maximum flying speed was approximately 600 m.p.h.

The machine carried 5,570lb. of propellant, and the addition of the cruising motor and pressure cabin put the all-up weight at 11,300lb.

In an effort to further improve the range and endurance, the fighter versions were, on occasions, towed up to interception height behind orthodox fighters. This was not the usual practice, however, as the prime utility of the 'plane was in its ability to climb from the ground and reach combat height almost within sight of the oncoming formations. It was essentially a fighter for the defence of specific targets and normally could not be expected to patrol.

ROCKET ENGINE	PROPELLANT	PERFORMANCE thrust—min. to max.	APPLICATION
R11/203	"T" and "Z" stoff	220lb. to 1,650lb.	Me. 163A
HWK 109/509 A1 ..	"T" and "C" stoff	220lb. to 3,520lb.	Me. 163B/O
HWK 109/509 A2 ..	"T" and "C" stoff	220lb. to 3,970lb., plus 660lb. (cruise)	Me. 163C
HWK 109/509 C ..	"T" and "C" stoff	220lb. to 4,400lb., plus 880lb. (cruise)	Ju. 8-263

Table I. Power units of the Messerschmitt 163 series.

The Trainer Version

The training of pilots was made in a lower-powered version of the fighter, the 163A.

A development of the HWK 109/500 Walter assisted take-off motor (PRACTICAL MECHANICS, March, 1946, p. 209), the R11/203, was fitted in the trainer, and propulsion was by the reaction of H_2O_2 and calcium permanganate. The maximum fuel capacity was approximately 3,300lb., which gave the machine an endurance under power of a little more than three minutes, and a 20,000ft. ceiling. The thrust was controlled through a normal type throttle box, from 220 to 1,650lb.

The Ju. 8-263

A little higher in the scale of development was the Ju.248, a single-seat rocket fighter similar in conception to the Me.163C. The machine was, in fact, a development of the 163 series, but had been handed over to Junkers for production to allow Messerschmitt to go ahead with no fewer than eight other project aircraft, chief amongst which was a new version of the Me.262 fitted with a Walter rocket unit in the tail.

The 248 was later reclassified 8-263 to obtain consistency with the original series. Several improvements considered desirable from the standpoints of production and operation were incorporated, and although the machine bore a strong resemblance to its forebears, it had been cleaned up aerodynamically by the provision of an entirely redesigned fuselage.

The incorporation of a retractable undercarriage eliminated the bulky landing skid and tail-wheel fairing which made the 163's appear clumsy, and this resulted in a well-faired fuselage, the contour of which was smooth and unbroken save for the "bubble" hood placed near the nose. Of semi-monocoque construction, the fuselage fitted a pressure cabin and housed most of the propellant. There were three tanks for the peroxide oxidiser which totalled 352 gallons, while the fuel tanks, containing 185 gallons, were divided, one in the fuselage and four in the wings. In order to ensure a minimum change in the position of the c.g., it was necessary for the tanks to be emptied in a particular order.

Production was facilitated greatly by the use of 163B wings, suitably modified to take the increased fuel load, while the fin and rudder were also standard assemblies of the 163 series. The switchover to the 8-263 would, therefore, have involved no great loss in output.

Apart from the engine these were the principal differences. The HWK 109/509C, developing a maximum thrust of 4,400lb. plus 880lb. from the cruising unit, gave the machine a maximum speed of 620 m.p.h. in level flight. It climbed at the rate of 13,800ft. per minute at sea level, reaching its ceiling at about 50,000ft.

The machine had an all-up weight of 11,340lb., which was reduced to 4,640lb. by the consumption of the propellant. Its overall length was 26ft., and the wing span 31.2ft., an increase over that of the 163B caused by the greater width of the fuselage.

A close-up of the retracted landing-skid and jettisonable take-off chassis of the Messerschmitt 163B.

The wing loading was 59.4lb./sq.ft. at take-off, which naturally reduced with the combustion of the propellant. At the time of landing with tanks empty, the figure was 24.2lb./sq.ft.

The engines which propelled these aircraft hold much promise for development in conjunction with athodyd units of the type described in the previous article, and by far the most important were those of the HWK 109/509 series (see Table 1).

The Walter Bi-fuel Propellants

Commenced in pre-war days as a private venture, the HWK 109/509 engines were developed by Dr. Walter, of Kiel, being the first fully controllable rocket power units ever to be employed in flight.

It will be recalled that in every case of experiment with liquid fuels before the advent of the Walter units, the oxidiser had always been liquidised oxygen. In service aircraft, however, the use of liquid oxygen would present several difficulties, for although when burned in conjunction with a suitable hydrocarbon it is capable of releasing tremendous energies, the low temperature at which it liquefies (−182.9 deg. C.) means that extreme care must be taken in its storage, transport and handling.

When contained at normal temperature in anything other than a "Thermos" or Dewar storage bottle, it is rapidly reconverted into gas, and unless the tank is pressurised and relief valves are incorporated, there is every possibility of the mounting pressure causing a violent explosion.

These difficulties are not easy to overcome at the best of times, and when a fighter aircraft is considered, which has to be fuelled some time before it actually takes off, the problems become almost insuperable.

Another important factor concerns the materials used in the construction of the tank and feed system, which must be carefully selected as many metals change their physical characteristics at such low temperatures. There are many accounts on record telling of experiments which have been completely ruined by the disruption of the containing tanks and feed lines by this highly volatile liquid.

It was for these main reasons that the Germans strove to produce an entirely new oxidising agent—one that could be handled without overmuch caution by Luftwaffe ground personnel. The V-2 rocket was, of course, a fundamentally different matter, because fuelling and launching took place within a specified time and the weapon was operated by specially trained crews. The use of liquid oxygen, even then, was nothing like 100 per cent. reliable, and several of the missiles exploded as the result of a too vigorous expansion of the oxidiser.

Hydrogen Peroxide

The investigation of various propellant forms involved the German chemists in research for several years, and four oxidisers—gaseous oxygen, nitrous oxide, nitric acid, and hydrogen peroxide, were eventually put forward as the most suitable for rocket-powered interceptors and guided missiles. A further elimination after extensive tests established hydrogen peroxide as the oxidiser for the Me.163, Ju.8-263, Bachem Ba.349, etc., and it was also employed as an auxiliary fuel for the turbine-pump feed in the V-2, as well as in the rocket fighters.

The substance had not been previously considered by rocket experimenters because it had hitherto not been available in sufficient concentration. Its production at 80 per cent. purity was certainly a great achievement and brought full justification to Walter's theories. Actually, the Germans had succeeded in the purification of the liquid to over 90 per cent. strength, but in this state it was found to be dangerously unstable. The compromise, therefore, was *concentration* with a reasonable safety factor; yet, despite this, Me.163's often blew up.

The fuel component in the case of the HWK 109/509 engines was a solution of 57 per cent. hydrazine hydrate, 30 per cent. methanol and 13 per cent. water.

When brought together in the combustion chamber, the two liquids undergo a violent and spontaneous combustion; there is no

CODE	COMPOSITION	APPLICATION	
		In Conjunction with:	For:
A-stoff ..	Liquid oxygen	Ethyl alcohol	
Benstoff ..	Ethyl alcohol	A-stoff	A-4 long-range rocket
C-stoff ..	57 per cent. methanol, 30 per cent. hydrazine hydrate, and 13 per cent. water	T-stoff	Me.163 fighter series—main propellant
T-stoff ..	80 per cent. hydrogen peroxide	C-stoff	
Z-stoff ..	Saturate aqueous solution of calcium (or sodium) permanganate	T-stoff	Walter A.T.O. units; A-4—as turbine generator for fuel pumps; Hs. 293, and Me.163A
Salbei ..	98 per cent.—100 per cent. nitric acid	Tonka, Visol, Petrol J-2, Diesel oil, etc or C-stoff	Wasserfall, B.M.W. rocket engines, etc.
Tonka 505b	57 per cent. oxide-m-xylidine	Salbei	B.M.W. engines
Tonka 505c	43 per cent. triethylamine	Salbei	B.M.W. engines
Visol ..	Butyl ether (with 15 per cent. aniline)	Salbei	Wasserfall, Enzian, etc.
J-2	Coal oil	Salbei, etc.	Various jet and rocket engines
—	Gaseous oxygen	Methanol	Alternative propellant for Hs.293, etc.

Table 2.—Details of some of the main propellants used to power German rocket fighters and missiles.

ignition in the normal sense, the propulsive gases resulting from purely chemical reaction. All rocket engines which operate on this principle are termed "cold" units to distinguish them from the earlier "fuel-burning" types.

A list of the principal fuels and oxidisers used in fighters and missiles is given in Table 2, and it will be seen that the peroxide oxidiser was known by the code, "T-stoff," and the fuel solution, "C-stoff."

First Experimental Walter Engines

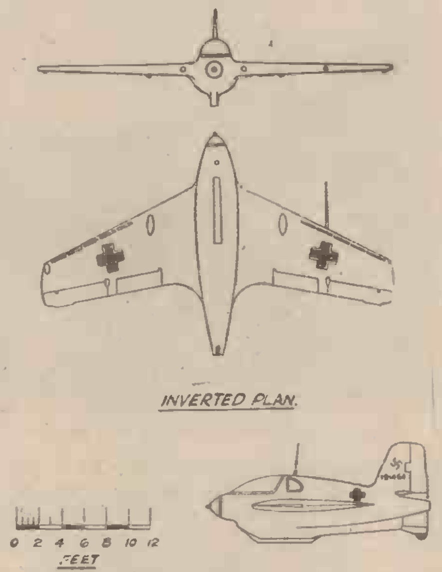
The Reichsluftfahrt-Ministerium assigned the designation 109 to all important jet and rocket engines, the second figure indicating the type and specific model. Thus, numbers in the second group between 001 and 499 inclusive applied to jet motors, whilst those from 500 to 999 were allotted to rocket units.

The first experimental engine of the 163 series was built in June, 1941—an air-cooled variable-thrust unit embodying a H_2O_2 turbo-pump feed system. Its fuel developed a maximum thrust of 1,650lb. for a specific consumption of 36lb./lb. thrust/hr.

This was the forerunner of the HWK 109/509.A1 employed in the Messerschmitt 163 B/O, which went into production with very little alteration to the original design. There were, of course, several lesser offshoots of this development which evolved in the shape of propulsion units for aerial missiles, auxiliary power units for gliders and assisted take-off motors. It will be recalled that the initial use of a bi-fuel unit of the "cold" type was in the Henschel 293 anti-shipping "glide-bomb," first operated during the summer of 1942.

Two main problems confronted Dr. Walter when he first set out to productionise his engines.

The first concerned the building of a combustion chamber capable of withstanding temperatures up to 2,000 deg. Centigrade, and in this, the designer was tackling a



The Messerschmitt Me. 163 B.

problem which had hitherto been only partly solved by earlier researchers. It is true that Sänger, and the Americans, Carver, Truax and Wyld, had developed some promising liquid fuel motors in which, by various refinements, the possibility of burn-out had been very much reduced, but they were, nevertheless, hardly comparable with the large-scale engines that Walter had in mind. In any event, the motors produced by the American Rocket Society could not stand up to repeated firings, and few were capable of withstanding combustion at full thrust for more than 30 seconds. It was, in fact, often the case that motors were so damaged after one firing that they had to be entirely rebuilt before it was possible to test them again.

It was obvious that for a service aircraft, which perhaps may be called upon to fly off to intercept several times during a single day, a motor would be required to operate for quite lengthy periods without need for extensive servicing or replacement. The development of rocket fighters would certainly not have been considered had it not been possible to produce a power unit able to be operated at full thrust for 30 minutes without deterioration.

It was fortunate for Walter that the development of the V-2 long-range rocket (otherwise known as the A-4), under von Braun, had involved similar research. A great deal of data on combustion systems had been amassed since the commencement of the "A" series in 1933, and this must have been of immense value to the designers of the Me. 163. It is, in fact, not unreasonable to assume, from the similarity of the power unit of the A-4 and the HWK 109/509, that the two engines were basically a parallel development.

The A-4 had, too, involved a great deal of research with feed systems, and it would seem that this was largely the solution to Walter's other principal headache, borne out by the fact that the H_2O_2 turbine driven pumps in the HWK engines were of an almost identical pattern to those employed in the long-range rocket.

(*To be continued.*)

Electro-mechanical Differential Analyser

A 100-ton Calculating Machine

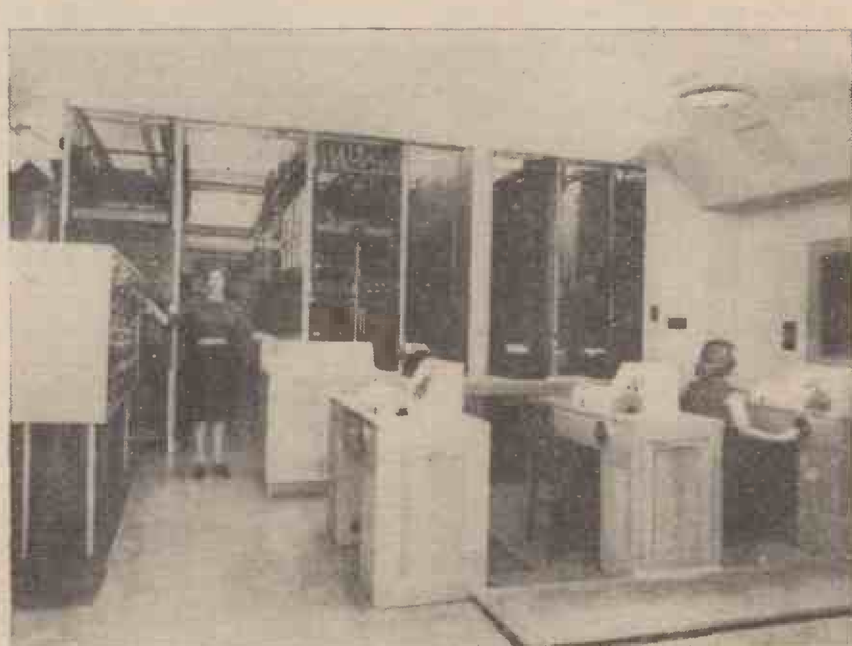
THE illustration on this page shows an electro-mechanical differential analyser, a 100-ton calculating machine installed at the Massachusetts Institute of Technology in America. It was designed for the solution of scientific and industrial engineering problems and worked for three years on important war projects which included computation of range tables for the guns of the U.S. Navy.

Peacetime Problems

Its wartime service now over, the machine has now turned to its original objective, the solution of peacetime problems in a field of usefulness which includes every branch of science and engineering. The panels in the background contain approximately 2,000 electronic valves, several thousand relays, about 150 motors, and nearly 200 miles of wire. In front of the panels are automatic electric typewriters which record numerically the solution of complex differential equations, while in the foreground graphic solutions are drawn in the form of curves on revolving cylinders.

Transmitting Devices

At the left are transmitting devices through which mathematical data is introduced to the machine on perforated paper tapes. The analyser not only relieves human brains of the time consuming drudgery of difficult calculation and analysis, but solves mathematical problems which are economically beyond the reach of ordinary methods of solution.



This machine is capable of solving mathematical problems which are economically beyond the reach of ordinary methods of solution. Invaluable during wartime this machine is now used for solving intricate peacetime problems.

The Calculating Machine

Its History and Basic Principle

By F. W. COUSINS

(*Continued from page 344, July issue*)

It is generally admitted that Newton's Principia is one of the greatest works that has shaped the course of modern science. The debt of Newton to Napier was a very real one, though indirect. Newton relied upon Kepler's calculations to form the Principia, and those calculations could not have been completed in Kepler's lifetime, but for the aid and rapidity of logarithmic quantities.

Napier's Invention

Napier's Mirifici Logarithmorum Canonis Descripto was published in 1614 and contained 57 pages of explanation and 90 pages of tables.

Napier's own account of his invention reads:

" Seeing there is nothing that is so troublesome to mathematical practice, nor that doth more molest and hinder calculators than the multiplications, divisions, square and cubical extractions of great numbers, which besides the tedious expense of time are for the most part subject to many slippery errors, I began therefore to consider in my mind by what certain and ready art I may remove those hinderances. And having thought on many things to this purpose I found at length some excellent rules—Which secret invention being so much the better as it shall be the more common, I thought good heretofore to set forth in Latin for the public use of mathematicians."

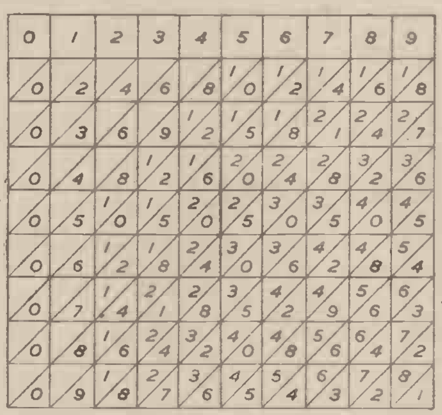


Fig. 8 (*Left*).—*Complete mosaic of Napier's rods.*

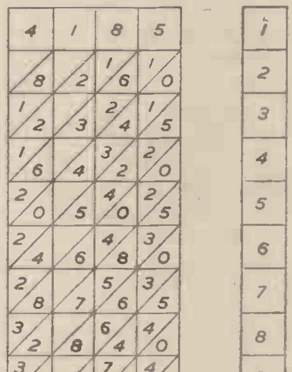


Fig. 9.—*Set up for multiplication of 4,185 by another number.*

Napier made no use of a base, indices were quite unknown in his day and his treatment was based on the comparison of the velocities of two moving points.

It seems probable that Napier who was primarily concerned with trigonometric quantities developed his idea from the sine of two angles.

Sin (A+B)=sin A cos B+sin B cos A. (1)

Sin (A−B)=sin A cos B−sin B cos A. (2)

adding (1) and (2) we have—

$\sin(A+B)+\sin(A-B)=2\sin A\cos B.$

Thus

$$\sin A\cos B=\frac{\sin(A+B)+\sin(A-B)}{2}$$

or

$\sin A\cos B=\frac{1}{2}\sin(A+B)+\frac{1}{2}\sin(A-B).$ (3)

This equation can be used to multiply two numbers.

Thus to multiply

0.1908×0.9925

we find from standard tables that—

$\sin 11^\circ=0.1908$

$\cos 7^\circ=0.9925.$

From equation (3) we can unite—

$\sin 11^\circ\cos 7^\circ=\frac{1}{2}(\sin 18^\circ+\sin 4^\circ).$

The tables record that—

$\sin 18^\circ=0.3090$

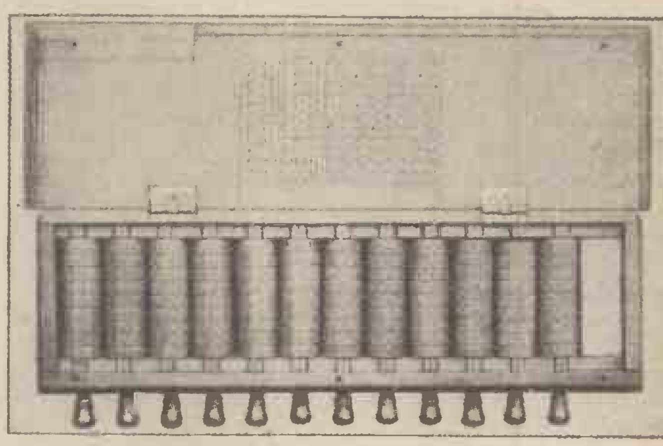
$\sin 4^\circ=0.0698.$

$\sin 18^\circ+\sin 4^\circ=0.3788.$

$\frac{1}{2}(\sin 18^\circ+\sin 4^\circ)=0.1894.$

Thus—

$(0.1908\times 0.9925)=0.1894.$



Napier's Rods—cylindrical form.

Napier's genius was greatly appreciated by Kepler, Tycho Brahé, Edward Wright and Henry Briggs. Wright translated the Latin edition into the English language in the same year as initial publication (1614) and Briggs, Geometry Reader at Gresham College, visited Napier at Merchiston. Briggs improved the system to substantially that in use to-day, and published his Tables des Logarithmes pour les d'un à 10,000 in 1626. (These were 10 figure tables, log. 31, for example, appearing as 1.4913616938).

Numbering Rods

The numbering rods were described in Napier's Rabdologia and this had a great vogue, being used extensively after his death. The Rabdologia was translated into Dutch and Italian while the Latin edition was republished. In London, 1667, William Leybourn published his " Art of Numbring by Speaking Rods: Vulgarly termed Nepeir's Bones."

The Napier Bones in common use were made of brass, silver, ebony or ivory and were exactly a square parallelepipedon, length, 3in., breadth, 3/10in.

Ten rods or " bones " made a set and regarding the indexing of a four sided rod Leybourn gives the following table:

If	1	stands	8	stands
	2	alone	7	on
	3	at the	6	the
	4	top	5	other
	5	of any	4	side
	6	side of	3	of
	7	any	2	the
	8	of the	1	same
	9	rods	0	rod.
		then		

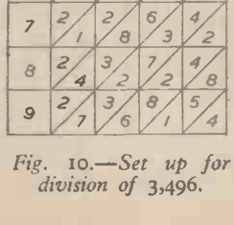


Fig. 10.—*Set up for division of 3,496.*

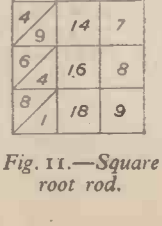


Fig. 11.—*Square root rod.*

A complete mosaic of the 10 rods is shown in Fig. 8 and their use in multiplication is easily seen from Fig. 9.

Multiply 4185×752

Place the rods for 4185 as shown. Then—

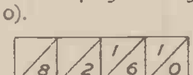
4185× 2= 8370

4185× 50= 209250

4185×700=2929500

Total = 3147120

The numbers in the mosaic are read from right to left, adding the numbers along the diagonal. Thus 4185×2=8370 (i.e., 8, 2+1, 6+1, 0).



Division is carried out in a very similar fashion and a mosaic consisting of the rods set out for the division of 1709544 by 3496 is given in Fig. 10

0/0	1	1	1
0/0	8	4	2
0/2	7	9	3
0/6	4	16	4
1/2	5	25	5
2/1	6	36	6
3/4	3	49	7
5/1	2	64	8
7/2	9	81	9

Fig. 12. — *Cube root rod.*

6	0/1	2	1
1/2	0/4	4	2
1/8	0/9	6	3
2/4	1/6	8	4
3/0	2/5	10	5
3/6	3/6	12	6
4/2	4/9	14	7
4/8	6/4	16	8
5/4	8/1	18	9

Fig. 13.—*Set up for square root calculations.*

If now the horizontal columns in Fig. 10 are added we obtain a column " K," thus :—

3496
6992
10488
13984
17480
20976
24472
27968
31464

Now considering the sum 3496)1709544(look in column K for the first portion of the dividend, i.e., 17095. The nearest figure in column K is 13984, subtract this number from 17095 and place 4 in the quotient, so,

3496)1709544(4
13984
———
3111

Proceed as previously to obtain final result 489.

3496)1709544(489
13984 —nearest figure to 17095 in column K.
———
31114
27968 —nearest figure to 31114 in column K.
———
31464
31464 —nearest figure to 31464 in column K.
———

In the extraction of square roots and cube roots, the number is paired off, or split into groups of three according to the calculation desired.

Two special broad rods are employed to aid these calculations. Fig. 11 shows the square root rod, and Fig. 12 shows the cube root rod.

Extraction of Square Root

$\sqrt{119025}$

Pair number off as in ordinary long hand method,

11/90/25.00

Take set of rods and square root rod. The square root rod shows that the greatest square number in 11 is 9. Subtract 9 from 11, and place 3 in the quotient as it is shown level with 9 in the right hand column of the square root rod.

)11/90/25(3
9
—
2 90

Now double the quotient and obtain 6. This is automatically shown on the square root rod's middle column. Select from a set of rods, one index 6, and rest it beside the square root rod as shown in Fig. 13.

Continuing the problem we see that 4 is the next portion of the root since 256 is the nearest approximation to 290.

6	8	0/1	2	1
1/2	1/6	0/4	4	2
1/8	2/4	0/9	6	3
2/4	3/2	1/6	8	4
3/0	4/0	2/5	10	5
3/6	4/8	3/6	12	6
4/2	5/6	4/9	14	7
4/8	6/4	6/4	16	8
5/4	7/2	8/1	18	9

Fig. 14.—*Another stage in the extraction of square root quantities.*

)11/90/25(34†
9
—
290
256*
———
3425.

Double the quotient 34 to obtain 68 and insert an 8 index rod as shown in Fig. 14. Now look for the nearest No. to 3425, i.e., 3425 as shown with 5 as the final figure of the quotient.

)11/90/25(345‡
9
—
290
256
———
3425
3425‡
. . . .
———

Cube roots are extracted in analogous fashion.

The slide rule was the natural outcome of the logarithmic tabular values, and as explained in the historical survey it had its beginning with the transposition of values from Gunter Lines.

The modern slide rule is a familiar object, few students or engineers fail to possess one. It is, however, a distinct type of calculating device in that it offers only an approximation to a solution and is suited only to that realm of science in which an approximation will suffice.

Log Log Scale

A notable advance was made in 1815 by the introduction

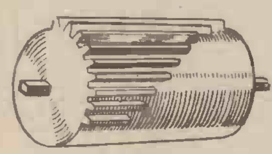


Fig. 15.—*The Leibnitz wheel.*

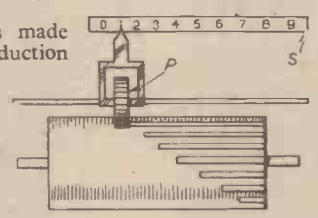


Fig. 16.—*The Leibnitz wheel and pointer.*

of the log log scale. This was due to Dr. P. M. Roget and greatly aided involution and evolution of numbers. The new method of graduation made it easy to obtain the values of an expression of the form y^n by the same mechanical action as evaluating y^n. Since $\log (y^n) = n \log y$, then $\log (\log y^n) = \log n + \log (\log y)$.

The Blaise Pascal machine was of the type that formed simple additions to obtain multiplication. It contained figure wheels carrying the numbers from 0 to 9, the wheels being mounted vertically on parallel shafts.

Wheels mounted in a horizontal plane and fully exposed appeared at the front of the machine. These could be manually operated to advance in steps of 1/10th of a revolution. This motion was transmitted by pin wheel gearing to the figure wheels and the figures could then be viewed through apertures in the main casing.

Movement of any figure wheel from 9 to zero caused a carrying device to advance the next figure wheel, to the left, 1/10th of a revolution. This novel transfer of the tens consisted of a one step rachet operated by a pin in the gearing of the lower numeral wheel which forced a lever attached to the rachet in a direction to cause the higher numeral wheel to move forward a sufficient distance to add one to the higher numeral wheel.

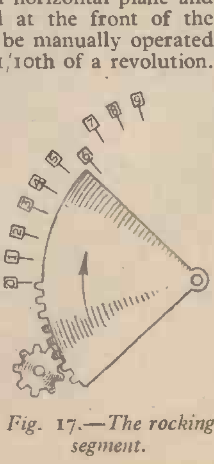


Fig. 17.—*The rocking segment.*

Multiplication took a long time, e.g., to multiply 1234 by 567, one had to register 1234 seven times beginning with the digit dial on the right, six times on the ten's dial and five times on the hundred's dial. This made 72 operations in all.

Sample machines were sent to Queen Christina of Sweden and other influential people, but they were regarded as machines of an unreliable character and never enjoyed any real success.

Digit-Adding Components

The important advancements from the simple machine of Pascal can most easily be followed by a survey of the fundamental digit adding components.

(a) The Leibnitz wheel is actually a stepped reckoner. The teeth do not cover the entire length of the wheel as clearly shown in Figs. 15 and 16. When the pinion P is in the position shown only one tooth on the large wheel contacts with pinion P. If pinion P is moved to the five position, five teeth on the large wheel will contact with it. Thus one revolution of the Leibnitz wheel will record one or five on the counter dial according to the lateral displacement of P along the linear scale S.

This type of mechanism was used by Charles Xavier Thomas to produce his machine in 1820. The smooth running British Arithmometer, and the Glushütter " Archimedes " also adopt this principle in their design. A portion of the internal mechanism of the Glushütter Archimedes is shown in Fig. 19, while Fig. 20 shows the external facia layout. Referring to Fig. 19 the mechanism shown is arranged to lie along the central axis in Fig. 20 and the mechanism is duplicated 10 times. The pinion P is arranged to slide and be manually set to any desired digit. This places P in correct relationship with the Leibnitz wheel L. When the handle H is rotated the bevel gearing B_1 and B_2 record the quotient on the dial wheel D. If the arm N is moved, the dial wheel D can be made to contact with bevel wheel B_3, and the numbers will move in a descending series to give subtraction and division.

Rocking Segment

(b) The Rocking Segment (Fig. 17) is used to good effect in the Comptometer, a picture of which is reproduced on the opposite page. In this type of machine the calculation is achieved by the simple depression of keys which makes it very rapid in operation. A bank of keys operate a series of segmental levers which in turn actuate the numeral wheels of the register.

The carrying of tens is accomplished by the power generated during the manual depression of the keys and this is stored in a mechanical spring only to be released when necessary.

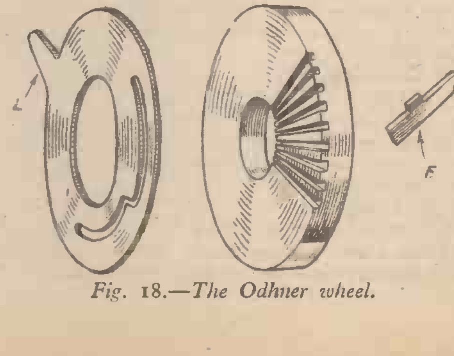


Fig. 18.—*The Odhner wheel.*

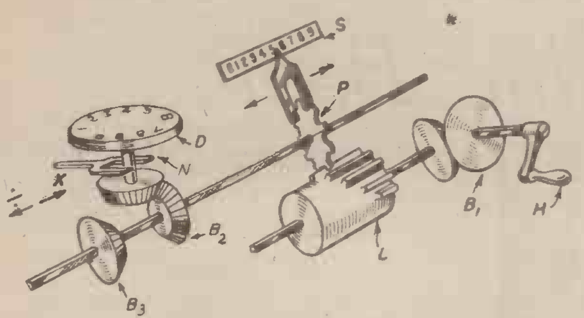


Fig. 19.—Mechanism of Glashütter Archimedes machine.

Many clever features are incorporated on the latest machines to prevent accidental movement of any key, and a locking device which operates if a key is not given its maximum movement.

(c) No finer example of the use of the improved Odhner wheel can be seen than that of the popular compact Brunsviga calculating machine. The accompanying photographs show the general appearance and the mechanism with the cover removed.

The machine performs repeated addition as in the Archimedes already described, but the Leibnitz wheels are replaced by the neat disc-like wheel of W. T. Odhner.

Nine Odhner wheels are shown in the photograph and these fit close together on an axle at the rear of the machine. Each Odhner wheel has a lever L, Fig. 18, arranged for setting against the graduations on the cover of the machine. If the lever is set against any figure of its cover slot that number of teeth are made to protrude from the wheel. When the operating handle is turned the protruding teeth engage small wheels of the product register, which in turn gear with the number wheels in front.

If three teeth are made to protrude by setting the lever L, Fig. 18, and the crank turned once, the product register moves three places. By turning the crank four times the sum 3+3+3+3 or (3×4) is carried out and the number wheels register 12. This necessitates the carrying of a ten and is accomplished by a pin on the number wheel which displaces

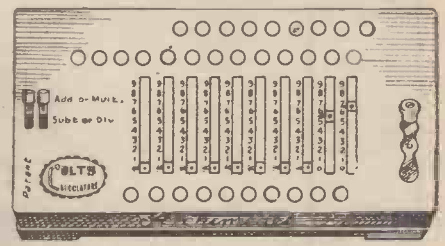
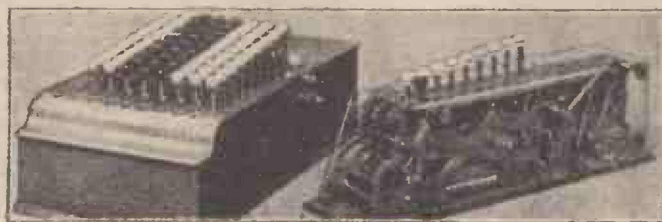


Fig. 20.—Facia panel of Archimedes machine.

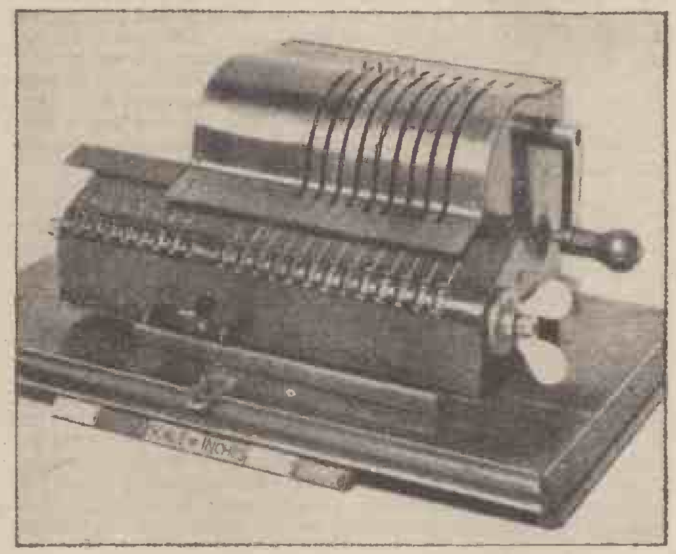
a hammer lever in such a way that the next number wheel is moved one place.

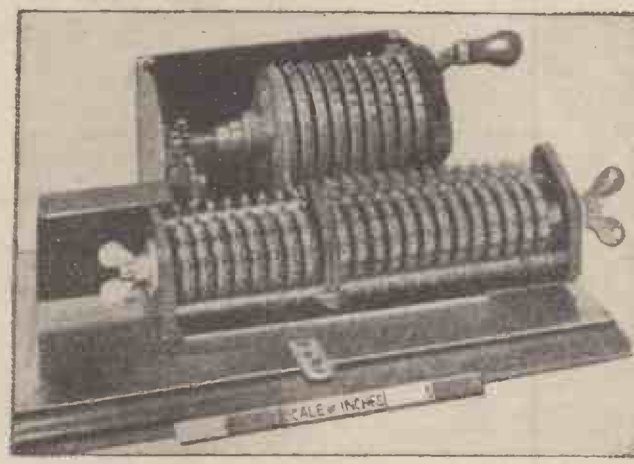
The calculating principle of the Brunsviga differs from most other machines in that it follows in natural manner the calculation of + and – calculations without change of gear. The crank being rotated clockwise for multiplication and addition; counter clockwise for division and subtraction.

(To be continued)



The Comptometer — showing the bank of keys and operating mechanism.





Two views of the Brunsviga calculating machine. (Left) Exterior. (Right) Interior with cover removed.

If We Could Save—By Prof. A. M. LOW

IN these days of utility, economy, and other nasty things the idea is often put forward that trains waste countless sums of money by putting brakes on the wheels. The brake turns the inertia of several hundred tons of metal travelling at 90 m.p.h. into heat, while sparks fly as the metal from brake shoes, rails and wheels is cast to the four winds.

One might mention, in passing, that when a certain electric underground railway was being silenced by the interesting plan of preventing the reflected noise wave from striking the direct wave near the passenger's ear, it was necessary to line certain parts of the tunnels. The dust of metal from the brakes was so fine that it settled in the noise-absorbing substances round the tunnel and became positively explosive. Finely divided metal will burn in air like gunpowder.

In the hope of saving some of this loss all kinds of ideas have been tested. At one time stations were built at the top of a slight rise in the rails so that the trains would be stopped going uphill and helped to start when going down. Like many another case of compromise the civil engineering troubles outweighed any advantages. Another inventor tried to use the braking energy to make electricity and thus to "re-charge" the system. This is a partial success and is, of course, well known.

In electric motor-cars the trouble is one of storage for no one has yet produced the light and perfect accumulator. One day an inductive transmission or condenser capacity storage may solve the problem, but until then it actually does not pay to bother about recovering these serious losses. The waste of heat for which we have all paid on any big railway during one year may run into millions of dollars.

There are other ways in which waste inertia can be used and whenever I approach a flight of steps I keep full steam ahead and put one leg on the bottom step without much bend at the knee. The weight of my body carries me forward and I have at least saved one horrid rise of seven inches.

I always dislike people who indulge in fantastic statistics so I will not add that all the energy saved in this way would be enough to carry me to the top of Mont Blanc.

Making a Swim Boat

Constructional Details of a Novel Pleasure Craft for Young People

By "HOBBYIST"

A swim boat in use.

LAST summer, while cycling through White Abbey, a small town bordering the shores of Belfast Lough, N. Ireland, the writer paused beside a low sea wall to watch a number of young boys sporting themselves in queer, home-made boats which, although rather small—about 4ft. long — and crudely constructed, were extremely buoyant on the calm water. The antics of the youngsters were most amusing, and they were obviously swimmers.

Here, indeed, was a new seaside sport for young people. The boys, aged eight to 10 years, wore swim suits, or just pants, as in the sketch. In each boat was an empty tin for baling-out purposes, and in view of the brisk paddling, splashing and the inevitable "accidental" collisions, the baling tins were greatly needed, for if too much water is shipped the boats slowly sink.

However, that did not worry the "shipwrecked" boys unduly. They played mostly on shallow parts of the sea. One youngster, knowing he was going to sink, just sat still, waiting for the water to engulf his craft and leave him stranded in the water. As the depth of the water was only about 2ft., he had nothing to worry about. He simply stood up, raised his sunken craft, emptied out the water, and got into it again.

How the Craft is Made

The swim boats, which is an apt name for them, are very easily made. It is merely a matter of bending and attaching a piece of iron sheeting around a wooden bow post and a stern piece of semi-circular shape.

The sheeting, from which the boys' boats were made, was old, corrugated stuff, hammered out flat. The reader should consequently be able to adopt the same measures.

The reader will doubtless prefer to follow these instructions on making the craft, for he can then be assured of building a strong, unleaky craft which, if desired, can be joined stern to stern with a similar craft to make a complete two-seater 8ft. canoe of unusual design and construction. The boats are light and easily carried under one arm.

The Sheeting Required

First of all try to obtain a piece of old, or new, corrugated iron (galvanised) sheeting of standard size, this being 4ft. long by 2ft. wide. If old and thin with rust, it will still be serviceable and, in fact, more easy to straighten out. A new piece is preferable, of course, since it will not have nail holes.

The sheeting is best hammered out on a hard, flat surface, using a heavy coal hammer or engineer's hammer. Take the bend out of one curl in the sheeting at a time. Give a series of sharp blows along the length of one curl until flattened out, then begin on the next curl, and so on until the whole sheet has been made as flat as possible, by which time it will be several inches greater in width (approximately 2ft. 8in.).

Constructors who do not wish to go to all this trouble have the alternative of visiting the workshop of a local sheet-metal worker and asking if he can sell a suitable piece of sheet zinc, preferably an old, thin piece, easily bent.

Stiffening Folds

Now, assuming the sheeting has been flattened out to size, as shown at Fig. 1, the next step is putting a 2in. wide fold along the side edges (see dotted lines). These folds serve a double purpose. They help to stiffen the hull (sides) of the boat and provide a smooth edge, so that the boy's arms are not scraped or cut, particularly when using the paddles.

To make the folds, scribe the width with a pencil or a blunt instrument, then put a flat block of scrap wood beneath the sheeting and, with a hammer and cold chisel, make a series of indentations along the guide line, always keeping the supporting wood beneath. This puts a "kink" in the metal and enables it to be bent over and hammered flat. Avoid cutting the metal with the chisel, of course; a blunted cold chisel is the safest implement to use.

Bow and Stern Pieces

The bow and stern pieces detailed at Fig. 2 are cut from ⅞in. thick wood, a bow-saw (or keyhole saw) being used in cutting the stern piece to shape. When cut out, find the centre of the iron sheeting at one end. Mark the post thickness and bend the metal at these lines with pliers.

Place the post in position, as in Fig. 3, and bend the iron sheeting against it and keep it there by means of a couple of 2in. fretwork cramps. To secure the post permanently it is necessary to drill a number of screw holes, following which ¾in. by six roundhead brass screws, based with suitable metal washers, are driven into the post (see sectional detail in Fig. 3).

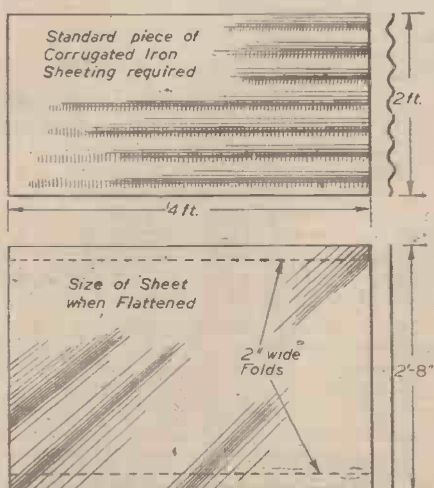


Fig. 1.—Sizes of the corrugated iron sheeting used for the hull.

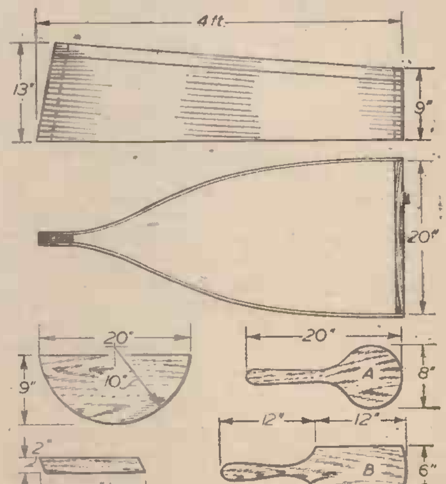


Fig. 2.—Side view and plan of boat, with details of bow post, rear end, and paddles.

Having thus secured one side of the sheeting to the post, do the same with the other side. When both sides have been secured, remove the screws from one side again, open out the iron sheeting slightly, smear the post with a layer of thick paint, then re-screw the parts together again. Repeat this with the opposite side. This procedure makes the joints waterproof.

The sheeting is bent around the stern piece temporarily to see whether the stern piece is the correct size. Make any necessary alterations in the stern piece, then screw it to the sheeting and have the joint waterproof the same as the bow post joints. In view of the extra tension at the stern end, use 1¼in. by six roundhead brass screws.

Finishing the Work

Having secured the sheeting to the fore and aft parts, the work is given a coat of red lead, or you may use ordinary oil paint. A single application, at the outside and inside, will suffice. The wooden parts may need a second application to help to preserve them from dampness.

A large iron screw-eye should be screwed into the stern of the craft for an "anchorage." line. The latter must be fairly long, about 10ft. or 12ft. It is tied to a convenient post, or rock, near the shore, and prevents the craft from drifting too far out to sea. Moreover, if the craft should capsize, the line enables one to swim ashore and haul in the sunken boat, or, alternatively, wait until the tide recedes and then retrieve it.

Paddles

Small paddles are needed, a pair being cut out as shown at A or B, Fig. 2, from ⅞in. thick deal, the edges and handles being spokeshaved smoothly. These paddles may be cut from ½in. wood and the edges merely rounded. There is no need to paint them, unless you wish to do so.

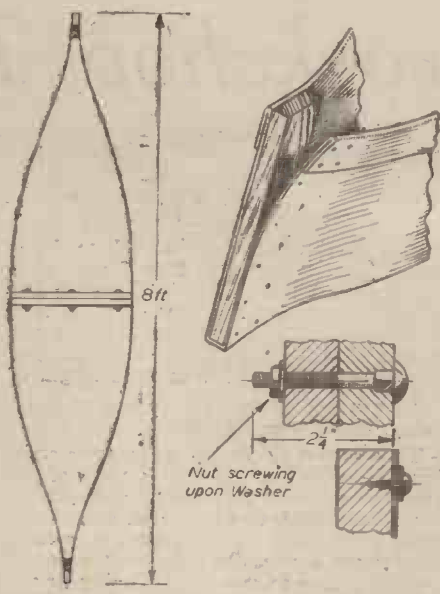


Fig. 3.—Plan of two boats joined together to make a canoe, with screwing and bolting sections.

If a two-seater canoe is wanted, it is only necessary to bolt two identical swim boats together, stern to stern, as depicted in the plan view at Fig. 3. In this case corresponding holes are bored in the sterns for 2¼in. by ¼in. roundhead carriage bolts. Having inserted the bolts (you require three, one near the bottom and two near the top, at the sides) in one stern, the other stern is pushed over them and washers and nuts fixed on, as in the sectional view.

Using the Swim Boats

The swim boats, because of the rounded bottoms and shallow draft, are topsy-turvy affairs, which adds to the fun. A boy or girl soon learns how to keep the boat balanced properly.

He, or she, should sit upon the bottom, with the knees bent up, or with the legs stretched forwards. Another way is to kneel in the boat, the weight of the body being supported on the heels.

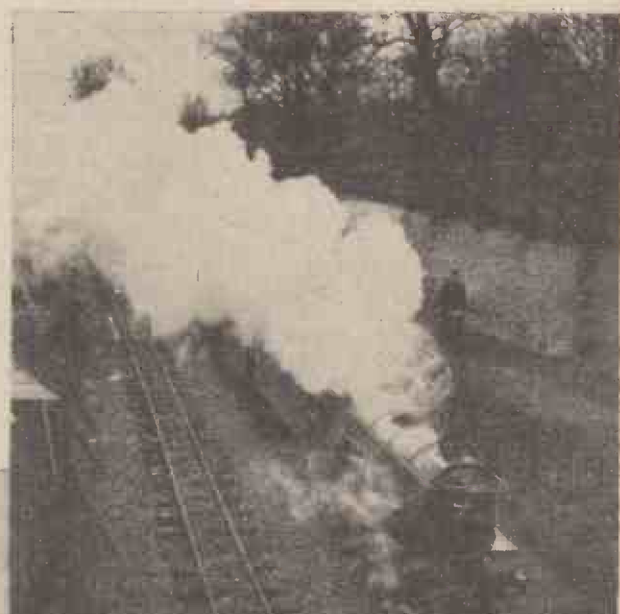
When two swim boats are bolted together to make a canoe, the users should sit back to back. A baling tin should be provided in each boat, this being connected to the stern end, or bow post, by a cord or length of picture chain.

The swim boats are of a size suitable only for youngsters eight to 10 years old. Larger types could be built for larger and older children. The swim boats can be used by children who cannot swim, provided the boats are anchored near the shore so that the water is never more than 2ft. deep. If there is no convenient post or rock to which the line can be attached, a large wooden stake could be driven into the sands, well away from incoming waves or ripples. Swim boats are not, of course, intended only for seaside use; they can also be used on lakes and inland waterways.

Re-opening of the World's Smallest Railway

THE world's smallest railway re-opened recently when the Mayors of Romney and Hythe (Kent) and other civic guests boarded a midget express for Hythe. During the war the Romney, Hythe and Dymchurch midget railway performed a giant's task. Along its Lilliputian tracks only 15in. wide travelled freight weighing up to 100 tons at a time. Its most distinguished passenger was "Pluto," the "pipe-line-under-the-ocean" that spanned the Channel, taking vital supplies of petrol direct to the invasion troops. So important was this cargo that an armoured train, with a miniature ack-ack gun, patrolled the line to prevent interruption. Now the saloon coaches are back. There are nine steam locomotives weighing, with tenders, about 8 tons each. The trains they haul may weigh as much as 100 tons. Because the line is the only means of transport for people who live in the lonely Romney marshes the Government de-requisitioned the railway, and soon, it is hoped, the whole line—which is 13 miles long—will be running normally again.

(Right) The midget express speeding through the countryside on its first run after the re-opening of the railway.



(Below) Just like the real thing. A close-up view of the midget engine and train travelling at speed.

A Home-workshop Telephone

Constructional Details of a Useful Two-way Communication Instrument

By "HOBBYIST"

THERE are many occasions when a means of communication between different rooms in the house, or between a workshop or garage in the garden and a room in the house, would be invaluable. Apart from the saving of time, which a handy and reliable house-telephone would give, the construction of such a device will provide a few hours of interesting occupation and will not call for anything elaborate in the way of either tools or workshop equipment. All the necessary parts are easily obtained, and indeed in many homes the majority of the items will be found already to hand. The apparatus now described is the simplest which can be used for the purpose.

Simple and Inexpensive

It is an inexpensive, two-way communication arrangement, using a couple of head-

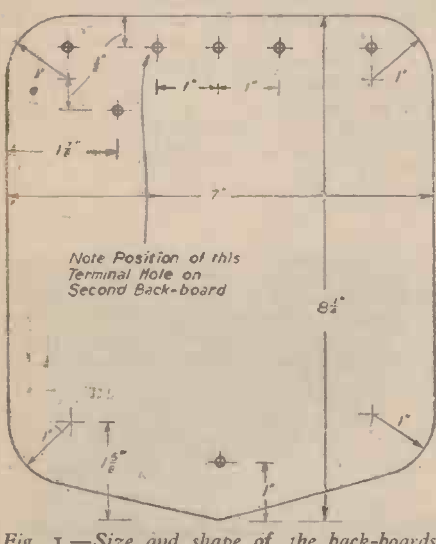


Fig. 1.—Size and shape of the back-boards.

phone units, one at each end of the line, with an electric door-bell (serving as a "call" bell) in the home workshop or attic, and the battery and bell-push in a convenient part of the house, perhaps the kitchen, scullery, hall, parlour, etc. The battery is an ordinary 4½-volt flat flashlamp type which, with occasional use, will last for many months before becoming exhausted. Owing to a simple holder arrangement, batteries can be easily fitted and removed when necessary.

The battery is only used to operate the door-bell. It is in no way connected with the transmitter-receiver units. The latter, due to the electro-magnetic influences set up in the coils when the diaphragms vibrate in sympathy with the direct sound waves, i.e., the sounds produced by the voice, provide their own tiny current, and thus differ entirely from ordinary transmitter units which are built like carbon-granule microphones and which require a small direct current (as provided by a flashlamp battery or wet cell) before they will operate.

The 'phone unit, moreover, apart from transmitting sounds, also serves to receive sounds. Hence the reason for only a single 'phone unit at each end of the telephone lines. On account of the battery and bell-ringing mechanism there are three lines. Actually, there should be four lines, a twin line for the 'phone units and a twin line for the battery and bell. However, as seen in the circuit, it is possible to make use of one of the 'phone unit lines, thereby cutting out the need for an extra length of bell wire.

Faint, But Clear Results

Tests carried out by the writer were satisfactory—indeed, surprising—in view of the primitive nature of the telephone. Reception is not very loud, of course, but quite clear, more particularly if the receiver is pressed close to one ear and the other ear "palmed" with the hand to reduce interfering noises, such as, for instance, the low hum of an electric motor, conversation of friends, passing tram, etc., etc., as the case might be.

One speaks quite normally into the 'phone unit, but it must be understood that the greater the length of the 'phone wires, the greater the resistance to the tiny variations of current. Therefore, try to keep the lines as short as possible. If the home workshop is only a short distance away from the house, or if situated in an attic, the telephone should give every satisfaction.

The Back-board

The first thing to make is the back-board. The dimensions and shape of this is shown at Fig. 1. Cut out two identical back-boards from ½in. or ⅜in. deal, such as shelving material.

The various holes are all drilled with a ⅛in. drill. Note the position of one of the terminal holes on one of the back-boards (see Figs. 4 and 5). If the terminals are arranged on both back-boards as shown at Fig. 1, one of the terminals will be in the way of the battery, so this terminal is kept beneath the other two terminals, as shown. The grain of the wood, by the way, should run the *length* of the back-boards. If ⅜in. or ½in. plywood is available, use it.

The Transmitter-cum-Receiver

When carrying out his experiments, the writer made use of second-hand headphones,

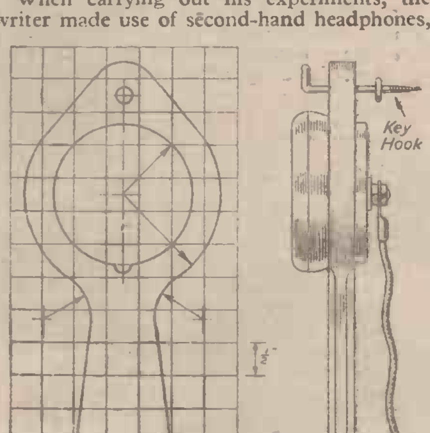


Fig. 2.—Outline of 'phone holder plotted in ½in. squares, with side view, showing 'phone fitted in its aperture.

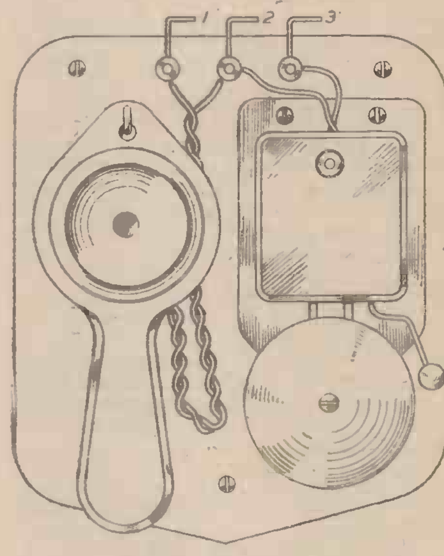


Fig. 4.—Fitment to be installed in workshop, wired to house.

the units ("Brandes" B.B.C. superior matched-tone type) having terminals on the back of the casing for the leads. However, almost any make of 'phone unit will serve. The leads, on all-bakelite cased units, usually project through a hole at one side of the casing. A notch is provided in the wooden holders (see outline at Fig. 2), which allows for the projection of the lead wires.

The holder (two are needed, of course) is cut from ⅜in. wood, preferably plywood, but a piece of hardwood, such as oak, will serve. The shape is plotted in ½in. squares and is mostly compass work, as can be seen by the indicating arrows.

The 'phone unit apertures, in the writer's case, were exactly 2⅛in. across. In your case, measure the back of the 'phone casing and cut the aperture so the casing is a neat, force fit. It is better to err on the short side so that, if necessary, the rim of the aperture can be filed. Moreover, cut the apertures out first and try the units in them; if a neat fit, remove them and proceed with

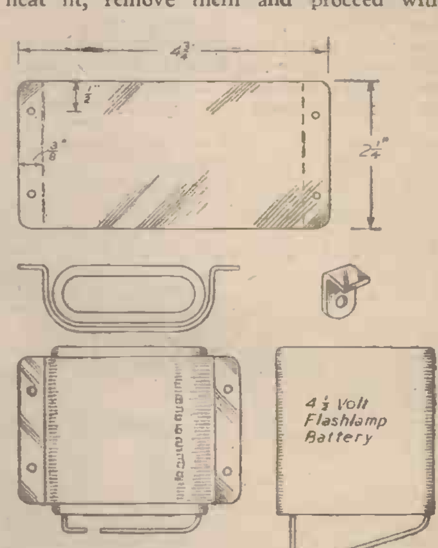


Fig. 3.—The simple battery holder, showing contact stud shape and how battery contacts are bent.

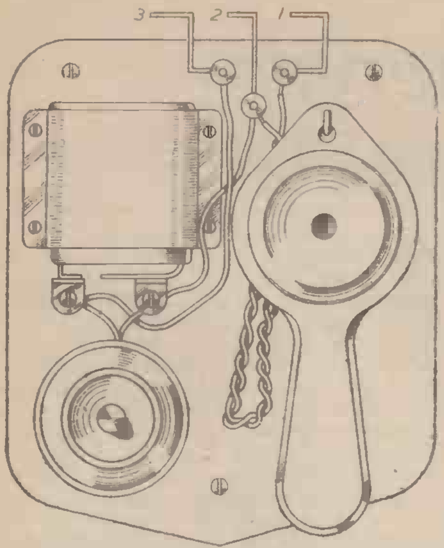


Fig. 5.—Fitment to be installed in house, wired to workshop.

the remainder of the cutting, using a toymaker's fretsaw.

It will be noticed that the handle of the holder is chamfered (see side view). This gives a more comfortable grip and is done with a rasp, file and glasspaper. If desired, the prepared holders could be stained and polished, or even enamelled.

Completing the Workshop Fitment

To complete the fitment designed for the workshop, obtain a G.E.C. electric bell (or similar type), three wireless terminals and a key hook. Fix the hook and terminals in position, including the bell back-board, on the prepared board, keeping the top end of the bell about 1in. down from the top edge, as shown at Fig. 4.

Short flexible leads, from the 'phone unit, are connected to terminals 1 and 2. Remove the bell mechanism cover and connect short piece of bell wire (or 22 s.w.g. double cotton-covered coil wire) to the bell mechanism terminals, and take these to terminals 2 and 3, as depicted.

This completes the workshop fitment. It is only necessary to attach it to a wall with three screws. Select a convenient quarter of the workshop and arrange the fitment at a convenient height from the floor.

The House Fitment

To complete the house fitment a battery holder is made. For this purpose you need a piece of tin or thin sheet brass the size indicated in Fig. 3. Drill it at the ends for screws, such as ½in. by 4 roundhead brass screws, then bend the metal at right angles along the dotted lines.

The tin, or brass strip, is then set over the battery and bent to enclose it, as seen by the top view. When this has been done the holder is fixed to its back-board in the position shown at Fig. 5.

Two small battery contacts, or studs, are made from sheet brass, as shown at Fig. 3. These resemble frameless mirror clips. Attach, with single roundhead screws, about ½in. below the battery holder, keeping them about ¾in. apart.

A 2½in. diam. bell push is attached below the studs, but a smaller size may be incorporated. Two wires run from the bell push to the battery studs and continue from these points to terminals 3 and 2, the 'phone unit leads being connected to terminals 2 and 1. This completes the house fitment.

All that remains is to obtain the flash-lamp battery, bend its springy contacts into the shape shown so that they rest upon the studs, and slip the battery into its holder. Contact is made by the weight of the battery itself, so it must be a fairly free fit in its holder.

The theoretical wiring circuit (Fig. 6) explains the two-way communication system. One first presses the bell-push to ring the bell and places the 'phone unit to one ear and awaits the responsive "Hello!" from the other end. The unit is then held before the mouth and spoken into, the person at the other end having, meanwhile, placed the unit to his, or her, ear.

One could, to avoid confusion, say "Over" at the end of each piece of conversation, thereby emulating the radio communication system on aircraft. There is, of course, no switching on and off to be done. The home telephone, therefore, is simplicity in itself to use.

Its main purpose is to save unnecessary stair-climbing or, in the case of a small out-door shed used as a workshop, walking or running through a shower of rain. The three lines, in the latter case, should be neatly stretched in mid-air from house to workshop, with one of the 'phone wires earthed. This is merely a precaution in case the 'phone wires should collect a charge of current from lightning during a storm, the earth wire acting as a small conductor.

If bare, thin copper wire is used for the extension lines, it is advisable to have them

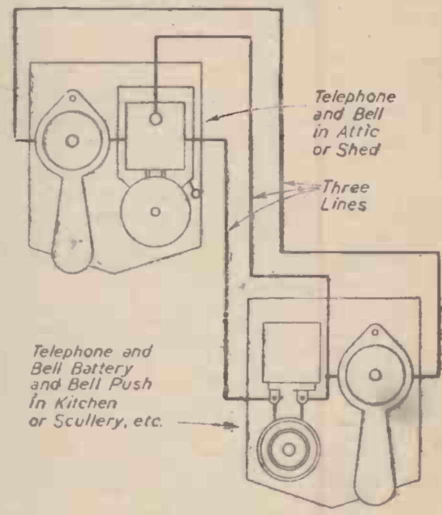


Fig. 6.—The theoretical wiring circuit.

affixed to small insulators outside the wall of the house and workshop. The interior lines must be either double cotton-covered or rubber-covered for insulation purposes, as you know.

Notes and News

New Turbo-electric Propelled Tanker

THE launch took place recently of *Helicina*, a new turbo-electric-propelled tanker. Built by Swan, Hunter and Wigham Richardson, Ltd., for the Anglo-Saxon Petroleum Company, Ltd., the vessel has a length of 550ft., breadth 70ft., depth 40ft. 6in.; 17,860 tons deadweight. B.T.H. turbo-electric propelling machinery is to be fitted, the propeller shaft being driven by a double-unit synchronous type propeller motor operated by two turbo-alternator sets; the machinery is designed to develop 11,000 S.H.P.; steam is supplied by three Babcock and Wilcox boilers, working at 450lb. pressure.

Test Flight of Jet-bomber

A JET-PROPELLED bomber, said to be the first of its type in the world and planned to fly at over 500 m.p.h., recently made its test flight in America.

The Douglas XB 43, as it is called, resembles a glider, as its two jet motors are hidden inside the fuselage, leaving the wings clean. This machine is the successor to the XB 42, a piston-engined aeroplane of similar design which last December crossed America in five hours and afterwards crashed. The XB 43 has a pressurised cabin enabling it to reach a height of 38,000ft. without danger to the crew. It has an effective range of 1,400 miles.

N.P.L. Exhibition

AN interesting exhibit at the recent N.P.L. exhibition was a scale model of the Tigris and Euphrates estuary, with flow and ebb tides every 47 seconds instead of the normal 12 hours.

The model, which was made in connection with civil engineering projects, enables a whole year's tides to be studied in nine hours.

A demonstration of German fire appliances took place recently at London Regional H.Q. Our illustration shows British firemen operating a portable electric circular saw carried on a German Emergency tender. We have no equivalent in our fire service.

Inventions of Interest

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."

Pocket Dart Holder

AN application for a patent for a dart holder has been accepted by the British Patent Office. The primary object of the invention is to supply a compact holder which can be conveniently carried in the pocket of the player and will also prevent damage to the darts.

The holder comprises a block containing a number of parallel slots, the bases of each of which receive the pointed ends of the darts, and there are radially extending parallel slots in the upper section of the block to house the flights of the darts.

Scented Earrings

THE latest thing in earrings is a lobe adorner which serves as a perfume holder to diffuse a fragrant odour.

According to this invention, the portion of an earring suitable for this purpose is provided with a recess in the rear surface. Into this is inserted a short length of tubing adapted to contain a removable absorbent material impregnated with perfume.

The inner end of the tube is open but the outer end is preferably covered by gauze made of the same precious or other metal as is used for the earring and tube.

To Raise Submerged Ships

A CITIZEN of the United States has applied for a patent in this country for an invention whose object is the raising of sunken vessels. After the World War there must be a considerable number of submerged ships reposing on the floor of the ocean. This improved method of elevating ships relates to the art of salvaging sunken vessels by the attachment of elevating pontoons having a collective buoyancy exceeding the ship's weight. Its general object is to provide advanced equipment permitting the attachment operations to be performed under conditions of water pressure which prohibit ordinary diving methods.

A further and important object is to perfect the attachment devices proper.

The inventor affirms that his system of salvaging is made possible by the use of a caisson—a large water-tight case used in laying foundations under water. The caisson carries a working crew. It is so devised as to permit all the under-water operations to be carried on by external mechanism controlled from the interior of the caisson.

How it is Done

In the course of performing the work, the caisson makes repeated trips between the surface and the sunken vessel. And, in so doing, it is arranged to operate similar to an elevator. It rises by its own buoyancy and descends against the buoyancy influence by the instrumentality of cables leading from the caisson to a number of anchoring blocks placed upon the bottom of the sea. The descent is accomplished by winding the caisson ends of the cables about power-drums mounted along the sides of the caisson.

The improved invention resides in a method of raising vessels by connecting a lifting cable to the ships. The means comprises the coupling of a member to the cable and the yoking together of a gang of load-straps at their upper ends to the member. The load-straps are applied perpendicularly and in a laterally spaced relation to the side of the vessel, and they are bolted at spaced intervals in their height to the underlying hull-plates.

To Stop Down-draughts

THE prevention of a down-draught in the chimney is the *raison d'être* of an invention for which a patent in this country has been applied.

In this case, a chimney or ventilating shaft top comprises a dome-topped conical cowl adapted to seat upon the summit of a chimney or shaft to constitute a chamber opening into it. There are air ducts in the cowl extending from the side to the top and at least one air duct extending across the cowl from side to side, openings being provided in the ducts communicating the chamber with the ducts. The arrangement is such that the smoke or air rising into the chamber is drawn thence into the ducts by atmospheric air passing through.

An ingenious device for making compressed paper balls for fire lighting.

The air ducts, which are arranged in different directions in order to catch air currents, admit the entry of air from the atmosphere at one or other of their ends according to the direction of the air currents around the cowl. As a result, in some instances, atmospheric air passes through a duct in one direction and in the reverse direction in other instances, according to the course of the air currents. However, no matter what direction the atmospheric air takes through the ducts, the smoke or air from the chamber of the cowl is drawn into the ducts through the inlets therein to pass out into the atmosphere.

Economic Grate

AN improved form of domestic open fire-grate is the subject of an application for a patent in this country. It is so designed that the fire warms by direct radiation as well as by convection. In the latter case, it heats not only the room in which the fireplace is situated but also an adjacent apartment.

Another aim of the device is to provide a grate which ensures economic combustion.

In water-heating systems and steam-generating plant, the inventor points out that it is a known practice to utilise a furnace embodying superposed grates comprising an upper or primary inclined down-draught grate and a lower or secondary horizontal up-draught grate with an outlet for the combustion gases.

By this arrangement partially burnt fuel from the upper down-draught grate drops on to the lower up-draught grate, upon which the combustion of the fuel is continued and more or less completed. Thereby is achieved practically a smokeless combustion of the fuel and a corresponding increase in the efficiency of the furnace, coupled with economy in the combustion of the fuel.

Two-stage Combustion

The inventor of the new device proposes to utilise the above described principle of two-stage combustion. Accordingly, he provides a fireplace having an open-fronted heat-radiating main combustion grate inclined upwardly towards the back of the fireplace with a damper-controlled flue above the grate and a front bar or equivalent fuel-retaining member extending across the front edge thereof.

There is a practically horizontal grate of closely spaced firebars below the main combustion grate. And there is means for admitting small quantities of combustion air below the lower grate. Consequently, combustion gases pass downwardly through the fire burning on the main grate. Small particles of unburnt fuel dropping from the upper grate will burn on the lower grate.

Safe Step Ladder

THE step ladder is a familiar object in the average household. The ordinary type has flat treads and a leg or other support which is hinged at its upper end to the ladder. It is also connected to the ladder by a length of rope or a folding stay which is under tension when the ladder is in use.

The aim of the inventor of an improved ladder of this nature has been simplicity in construction, easy handling and safety from risk of collapse.

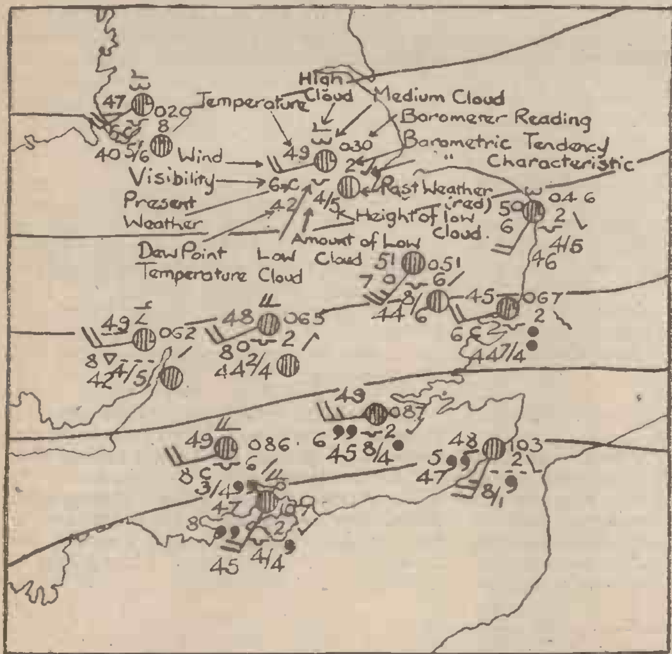
The new device comprises a platform, to the underside of which are hinged at spaced points a ladder portion and a leg pivotally connected by one or more stays to the ladder.

The hinged connection between the ladder and the platform is spaced vertically from the platform. In the open position the upper end of the ladder abuts against the underside of the platform on both sides of a vertical plane containing that connection. As a result, the ladder, when open, is rigidly locked, any closing movement being prevented by the engagement against the platform of the part of the upper end lying between the hinged connections of the ladder and the leg.

In order to fold the ladder, the front edge of the platform must first be raised and the platform rocked over rearwardly until the rear edge of the upper end of the ladder passes over the centre with respect to the hinged connection of the ladder to the platform.

The ladder, leg, platform and stay then fold completely into parallel planes, so that it can be stored in a minimum of space.

The Mechanics of Meteorology—7



By courtesy of Controller, H.M.S.O.

Fig. 45.—Information entered on a weather chart at the Meteorological Office, London, from data received from station observers over Great Britain.

General Inference : British Forecast Districts : Local Conditions

By G. A. T. BURDETT

(Concluded from page 315, June issue.)

ALL weather forecasts, whether in the press or broadcast, are preceded by a familiar preamble known as the general inference. This states in broad terms the change in distribution pressure and draws attention to the frontal systems. An inference usually covers a period of from 24 to 36 hours. The following is the general inference given in a forecast at 7 a.m. on Friday, October 19th, 1928, and covered 24 hours commencing at 12 noon G.M.T. of the same day :

" A further depression off Western Ireland is likely to move rapidly eastwards and cause mild unsettled conditions to spread from the west, bringing further rain and fresh winds southerly bound to all districts."

This is a typical inference when depressions are forming over the Atlantic which, in this instance, were ascertained as a result of observations made on the Atlantic by the liners *Majestic* and *Carmania*.

The weather given in the same forecast was : " South-east England, East England and East Midlands fresh South-westerly winds becoming strong Southerly, becoming cloudy at first, then rain, mild."

In Ireland, Scotland and other areas in England, the weather forecasts were similar except that the wind was expected to reach gale force at times, especially in exposed places. At the time of the forecast the weather was fair except for occasional showers in most places. But for the observations out at sea the only other indications, that is land observations, were 10/10 low cloud over Valentia, with a slowly falling barometer in the South-west of Ireland and much high cirrostratus and altostratus cloud farther east.

The forecaster expected the rain to arrive during a period of 24 hours. He had, therefore, to judge the speed of the rain-bearing air and when it would arrive over the British Isles.

Further Outlook

Another feature of weather forecast and one which is quite as important as the inference is further outlook. In the above forecast this was " showers with bright intervals ; temperature becoming lower." The forecaster was able to predict this as he expected the trough line of the depression to be over the British Isles after noon the following day, to be followed by bright showery weather of the polar air in its rear.

British Forecast Districts

As the weather over the British Isles is not uniform, the area is divided into 21 forecast districts for the forecasts where published in the "daily weather report." The newspapers in their forecasts include 22 districts as London is segregated from South-east England. This district is accorded the district number 0. As will be noted in the map, Fig. 46, each district is not of equal area. This is because of the ranges of hills and mountains in the British Isles, all of which affect the local weather. Otherwise the districts would be of equal area and the weather variations would be entirely due to the difference in the pressure system.

In dividing up the districts all importance was given to the orographic or hill features of the area. A range of hills causes a heavy rainfall in the immediate vicinity with an absence of rain on the leeward side. Rain will occur, therefore, on the side of the hill depending upon the direction of the rain-bearing wind. Manchester district is particularly noted for its wet weather. Apart from being a music-hall gag of long standing, there is certainly more than an element of meteorological truth in the statement. Manchester lies on the western edge of the Pennine Range. Warm moist maritime air travelling across the Atlantic reaches the Pennine Chain, cools, is saturated, and precipitation follows over the area, which includes Manchester.

In England, Ireland and Wales, meteorological conditions allowed county boundaries to be chosen for the division of districts but not so in all places in Scotland. The largest district is No. 2 with the whole of the flat country of Lincolnshire and the Eastern Counties where the weather does not vary considerably over the whole district. A typical example of this is district No. 9, Derby and Yorks, which includes the Pennine Chain. Further, in district No. 8 the Lake District is grouped with the low ground of Cheshire.

Those who study newspaper forecasts would be well advised to know their own particular district and correct the general district forecast by using their own local topographical and meteorological knowledge.

Local Conditions

Everyone should be conversant with local effects. The farmer, fisherman and, in fact, most country dwellers, are aware, consciously or subconsciously, of these local factors. General weather forecasts cannot, for obvious reasons, take into full consideration all of these local variations caused by numerous factors, some of which are briefly dealt with below.

By courtesy of Controller, H.M.S.O.

Fig. 46.—Map showing British forecast districts. It will be noted that West Scotland is divided into two sub-districts, 13A and 13B, making 21 districts. In the newspaper forecasts London is separated from S.E. England and accorded the district number 0.

The Coast

The obstacles on land such as buildings, hills, trees and so forth tend to reduce the velocity of the wind. As a result there are usually stronger winds off the sea than off the land for the same pressure gradient. The winds on the coast and for approximately 10 miles inland are the sea breezes, which reach a maximum of 10 m.p.h., and in the evening we get the land breezes. These breezes prevail unless the general wind is strong enough to cancel them out. There is a difference in the air temperature over the sea than over the land, which gives rise to unstable showers and drizzle near the coast. Movement fogs over the sea drift on to the shore and cause more frequent fogs in coastal regions. Further, there is usually a temperature difference between land and sea which a local forecaster in a coastal area must consider.

Hilly Districts

Orographical clouds or hill fogs occur frequently. These give rise to intensification of rain at more frequent periods. The air temperature is different from that of lower levels. For instance, frosts are less likely to occur on high ground than in the valleys. The general wind is diverted by the hills and gives rise to what is known as the funnel effect through the valleys. Anabatic winds (cool breezes ascending the hillside) occur during the day and katabatic winds (cool breezes rolling down the hill) occur at night. Hills give a sheltering effect to the wind on their windward sides. Further, turbulent clouds are formed in hilly areas.

The Valley

The conditions here, as might be expected, are often the converse to the hill. The air temperature at the base of the hills is lower and there is more probability of night frosts occurring. Heavy rains occur on the windward side where the saturated air cools upon coming into contact with the cool hill tops. Owing to the funnelling effect, the wind in the valley is often stronger than at the hill top and usually plays in a different direction to that of the general wind. Radiation fogs occur more frequently in the valley, particularly in marshy areas. There is usually considerable turbulence in hilly districts which assists in the formation of heap clouds.

The Plain

The winds are usually stronger here since the obstructions are fewer.

In each area, therefore, local conditions give rise to a deviation from the general weather. Local forecasters always make a close study of these conditions and, in consequence, correct their general information. If, therefore, the general surface wind is given as S.E. at 15 m.p.h., he who is conversant with local conditions should always know how far to rely upon such a general forecast.

When studying meteorology it is natural to consider whether the amateur is in a position to make observations and make a forecast. This will depend upon how well he has grasped the fundamentals of meteorology, whether he is really interested in the subject, and what instruments he possesses and whether he can obtain current synoptic charts.

Age-old Maxims

With all that has been written in this series and elsewhere there is no doubt that town folk as well as country folk will still pay considerable regard to the age-old maxims. For instance, "Red night, shepherd's delight; red morning, shepherd's warning." "Long foretold, long last; short notice, soon past." If they do they can rest assured that the last-named at least is one of the golden rules of meteorology.

Acknowledgments are made to the Controller H.M.S.O. for permission to reproduce Figs. 42, 43, 44, 45, and 64 from H.M.S.O. publication: Air Ministry for Figs. 40 and 41 from official photographs; Royal Meteorological Society for use of photographs of clouds; and Negretti and Zambra for use of various photographs of instruments.

A Simple Guillotine

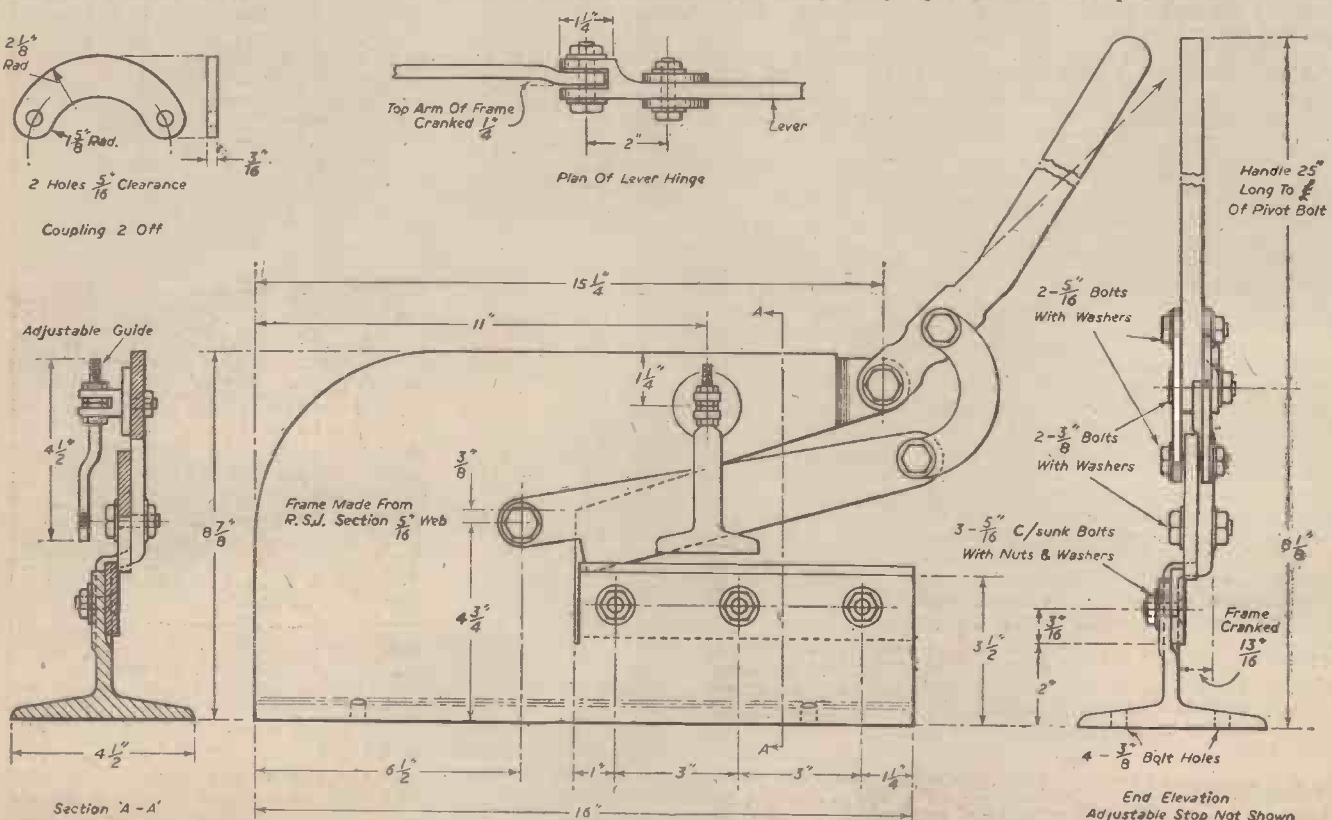
By T. HARDING

THE small bench guillotine, shown in the accompanying illustrations, was made entirely from scrap material with the aid of a small portable forge and a few hand tools. The main frame is made from R.S.J. section with $\frac{5}{16}$in. web., the cutting blade being finished to the shape required from a piece of scrap motor spring.

It will be noticed that the operating lever is bifurcated at its lower end for attachment to the upper arm of the frame, the lever being connected to the end of the movable blade by two curved connecting links. An adjustable guide is provided and, if necessary, packing can be used between the frame and the fixed blade to line up correctly with the movable blade.

Holes, $\frac{3}{8}$in. diameter are drilled in the flange of the foot of the main frame for bolting to a base plate.

The guillotine is capable of shearing metal up to $\frac{1}{8}$in. mild steel plate.



Side and end elevations and cross-section of the small bench guillotine, with details of coupling link, lever hinge and bolts.

Masters of Mechanics—110

Earl Stanhope

The Story of the First Iron Printing Press

SOME people invent because of necessity or interest. Others do so because they cannot help it.

It was to this latter curious category that the strange Earl Stanhope belonged. But not only was Stanhope an ardent and a fertile inventor. He combined with his mechanical pursuits the career of a literary man, and that of a prominent politician. Both in the Commons and, later, in the House of Lords, Stanhope evidenced feelings and convictions which were anything but popular. For that reason he was dubbed eccentric. In an age of aristocracy, he was a fiery democrat, and, indeed, more than that, for he sympathised with the French revolutionists, and sided with the American colonists in their campaign against British control.

Such was Charles Stanhope, 3rd Earl of that name, who flourished vigorously as an inventor and a statesman in the latter half of the eighteenth century, and the beginning of the nineteenth. His greatest legacy to the arts and sciences was, undoubtedly, the printing press which was called after his name, for it was from the invention of this, the first iron press, that modern printing took its rise.

Eton Education

Charles Stanhope was born in London on August 3rd, 1753, the second son of Philip, 2nd Earl Stanhope. He turned out to be an impressionistic lad, and he was packed off to Eton College at a very early age. However, he did not remain there very long, for when he was ten his family removed to Geneva in which Swiss town he was placed under the tuition of a certain Monsieur Le Sage, a well-known man of letters on the Continent. Charles Stanhope had by this time attained the title of Lord Mahon, for his elder brother, Philip, died at Geneva in 1763, the year previous to Charles' taking up residence in the Swiss town.

It would seem that the whole of Charles' political career was influenced by his stay in Geneva which was at that time very much a republican city. But Le Sage took care, also, to develop the lad's inborn interest in mathematics, and in general science. He exercised the future Earl Stanhope in chemistry and electricity—such as those sciences were at that period—and, in general, endeavoured to make him into a "natural philosopher" of the first order.

The gentle Le Sage was certainly successful with his pupil. The young Lord Mahon had hardly reached the age of eighteen years when he wrote (in French) a scientific paper based on original experiments dealing with the motions of the pendulum. The paper won the first prize offered by the Stockholm Society of Arts for the best scientific essay of the year.

Fraud Prevention

After this preliminary canter in the scientific world, Charles Mahon plunged more deeply into his scientific pursuits. He turned his attention to the devising of a means of rendering impossible or, at least, impracticable, the forging of high value coins, particularly those of gold. The result of a series of trials and experiments in this direction was a booklet entitled "Considerations on the Means of Preventing Fraudelent Practices on Gold Coin." It appeared in 1775. The main recommendation contained therein was that all gold coins should bear their designs in very little relief and that the date on them should be sunk in.

Charles, 3rd Earl Stanhope.

But little notice was taken of the coinage pamphlet. There were signs of the forthcoming turmoil and bloodshed of the French Revolution on the Continent at that time, and the Stanhope family decided to return to London, and to settle permanently in that region.

Once established in England Charles, the future Earl Stanhope, threw himself wholeheartedly into a political career, leaning strongly to the side of an ordered social reform.

Elected M.P.

In the September of 1780, the year of the Gordon Riots in London, Mahon put up for Parliament, contesting the Borough of Chipping Wycombe, Buckinghamshire. He managed to get himself elected M.P. for this constituency, which he continued to represent in an exceedingly prominent and even a stormy manner until his accession to the peerage and his consequent entry into the House of Lords, which took place six years later on the death of his father, the 2nd Earl Stanhope.

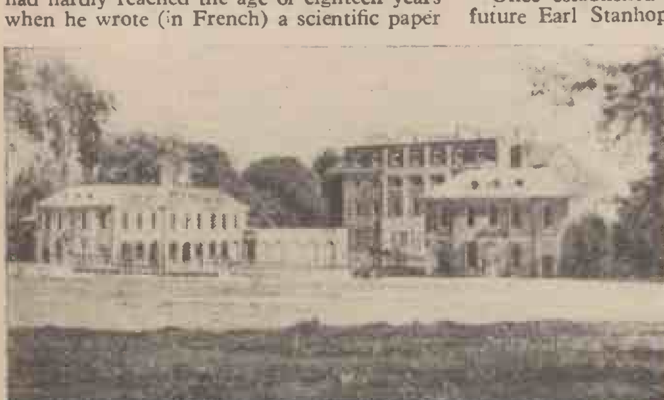
Lord Charles Mahon thus became the 3rd Earl Stanhope and succeeded as owner of the estate at Chevening, in Kent. It was here that his democratic views began to assert themselves, even to the discomfort of his family. He insisted that all his children should become practical minded, that they should be taught trades or occupations, and that they should eschew the life of indolence and lazy ease which was the common preoccupation of "society" in those days.

Referring to himself, he remarked: "Charles Stanhope, as a carpenter, blacksmith or millwright, could in any country or at any time preserve his independence, and bring up his family to honest and industrious courses without soliciting either the bounty of friends or the charity of strangers."

It is good advice, applicable equally as well under present-day conditions as it was then. Stanhope honestly endeavoured to follow his own counsels. He made himself into a "carpenter, blacksmith or millwright," and it was said that his mechanical ability was of an exceedingly high order, although afterwards, in consequence of pressing duties, he employed other mechanics in the working out of his mechanical inventions.

Before his accession to the peerage, Stanhope had been elected F.R.S. in recognition of his continued scientific pursuits.

One of the first of these after his establishment in England seems to have been concerned with a method of rendering build-



(Left) Earl Stanhope's family home at Chevening, Kent, the scene of many of his original experiments.

(Right) An ancient wooden printing press of the 16th century, a type which persisted until Stanhope's invention of the iron press.

ings fireproof. This Stanhope effected more or less successfully by a process of lining the walls of the building with a plaster composition which he called "stucco." You could set the outer portion of the building on fire, but the conflagration failed usually to get beyond the "stucco."

Marine Steam-power Projects

Stanhope was much interested in the continual progress of steam power. Seeing so many inventors concerning themselves with the application of steam on land, he gave his attention to the employment of steam power for marine purposes. He took out patents for steam-propelled vessels in 1790, and also a further patent in 1807. Stanhope expended a lot of money on these "ambi-navigator" ships, as he called them, but he was never really successful with any of them. One of them, *The Kent*, he declared in the House of Lords to be "a vessel 111 feet in length, which drew only 7 feet odd inches of water and yet outsailed the swiftest vessel in the Navy." This statement may have been correct when applied to the ship merely as a sailing vessel, but as a steam-engined boat, *The Kent* was as unsuccessful as any other of Stanhope's marine steam-power projects.

It was, no doubt, in consequence of Stanhope's sympathies with the American colonists that he entered into an extensive series of experiments with Robert Fulton, the American steamship constructor, to prove, in the first instance, that the steam propulsion of ships really was possible.

It is a curious fact that Fulton, after he returned to America, was successful at the game, whilst Earl Stanhope remained persistently unsuccessful in the same direction. Yet Stanhope was a man of greater inventive calibre than Fulton. It may have been the case that the collaboration between Fulton and Stanhope was a very much one-sided one, Fulton retaining for his own future usage the practical knowledge which he had gained in association with Stanhope.

Stanhope's Masterpiece

The greatest inventive success of Earl Stanhope's life was, as we have already noted, the famous Stanhope printing press. It is a strange fact that between the first introduction of printing into England by William Caxton down to the time of Stanhope no really substantial advance had been made in the practice of printing. In Stanhope's earlier days the same type of wooden screw press known to Caxton, with its weak, rickety joints, its unequal pressures and its laborious mode of inking, was still being universally employed in printing offices. Few, if any, practical printers throughout these long years had ever tried to improve it.

But Earl Stanhope, in 1798, having been vitally interested in typographical matters for some years, designed and constructed a printing press which, for the first time in history, was made entirely of iron, and contained no wooden parts whatever. He equipped his press with a combination of levers by means of which the "platen" or plate which receives the pressure is brought down with a much enhanced pressure when the paper comes into contact with the type. In consequence of the greater ease of working of his press, together with the increased pressure available therein, Stanhope was able to produce clearer impressions and to speed up the working time of the press. He could get about 250 impressions per hour, the press being hand operated.

It is interesting to note that the hand-press based on Stanhope's original design is still employed for the very highest grade of "fine" printing. The Stanhope press would seem to constitute one of the "for all time" inventions, its basic principle constituting an unimprovable device. Had not this press been speedily followed by an era of high-speed steam-powered presses, the fame of Charles Stanhope's mechanical masterpiece would have persisted in everyday printing offices for a far greater time than it actually did.

It revolutionised practical printing. The first iron printing press devised by Earl Stanhope in 1798.

Stanhope refused to make any profit out of his printing press invention. On the contrary, he turned the whole thing over, lock, stock and barrel, to the Clarendon Press, Oxford, in exchange for a pension for his assistant, Robert Walker, an exceedingly clever mechanician.

In addition to inventing the press which has since borne his name, Stanhope introduced an improved process for making stereotypes, a stereotype being a metallic printing plate which is cast from an impression of movable types. This he also gave to the Clarendon Press at Oxford, on condition that the sum of £4,000 was at once paid to his foreman, Andrew Wilson.

Stanhope, during the days of his "printing era," brought out what he called a system of "Pantatype" printing. "By which means one hundred thousand impressions of an engraving can be taken, all of them proofs; that is to say, the last impression will be as perfect as the first."

A mid-19th century iron printing press based on Stanhope's original invention.

But "Pantatype" had not come to stay. After Stanhope's death, other systems of engraving printing were devised, speed and cheapness being, to an increasing extent, the chief requirements of such methods.

The Mechanical Calculators

Earlier on in his career, Stanhope devised two mechanical calculators. It is true that calculating machines had been constructed long before the inventive Earl's time. Nevertheless, Stanhope's calculators were the most practicable yet introduced. One of the machines added up and subtracted. But it would not divide and multiply. It took a second calculating machine to carry out these latter processes. Here again, however, Stanhope made no commercial success of his calculators. To him, they were merely accurately designed scientific toys. And once he became satisfied that they were capable of practical use, his mind almost automatically turned itself towards other problems of scientific import.

Canal Locks

At one time, Earl Stanhope became greatly interested in canal systems. He projected a canal from his estate at Holsworthy, Devon, to the British Channel. For this he used a novel system of inclined planes linked up through an improved series of locks.

The Stanhope canal lock was, indeed, a most valuable improvement on the older system devised by James Brindley, the first of the great canal constructors. Right up to the time of the coming of railways, when canals began to go out of use, the Stanhope lock, with its greater ease of mechanical operation, maintained and even increased its popularity among canal constructors.

Among other inventions of the Earl was the famous Stanhope lens. This is an ordinary magnifying lens having two outer convex surfaces ground to different radii, being essentially a combination of two lenses of different foci.

Then there was Stanhope's at one time much publicised "artificial tiles or slates." None of these have survived, but they appear to have comprised a form of pigmented cement suitably moulded into tile formation. They came, however, long before the invention of Portland cement, and before all the multitudinous forms of cement-aggregate mouldings.

An improved method of lime burning was another of Earl Stanhope's inventions. He also went in for forestry, and devised an effective means of "curing wounds in trees."

Literary Works

In addition to his practical pursuits, Stanhope kept up for twenty years or more a current of pamphlets on political subjects. These he interspersed with a few treatises on scientific subjects. Instance, for example, his at one time very popular "Principles of Electricity," one of the first textbooks on electricity, which came out in 1779, and, at a later date, his "Principles of the Science of Tuning Instruments with Fixed Tones," published in 1806.

It is a pity that so versatile a genius as Stanhope was could be so painfully and discomfortingly irascible. In spite of his life of unremitting toil, scientific, literary, and political, he was anything but a happy man. He died, perhaps of overwork, at Chevening, Kent, on December 15th, 1816, and was buried in the family vault in the church near by with simple ceremony.

THE WORLD OF MODELS

By "MOTILUS"

Some Fine Examples of Old Time Ship Models, the Work of a Chef in his Spare Time

WHILE spending a few days at the charming fishing port of St. Ives, in Cornwall, I had the good fortune to meet a keen model boatbuilder in rather unusual circumstances. I was staying at the Tregenna Castle Hotel and the waiter who served me knowing how interested I was in models of all descriptions, told me that the chef of the hotel, Mr. A. Hope, was the builder of some very attractive ancient ship models. I made the acquaintance of Mr. Hope immediately and he invited me, on his free day, to visit his house near Carbis Bay and view the models. I must admit that he was at first loathe to show me his work, for the simple reason that his models had been stored away in the attic and he had not looked at them for over five years, but my enthusiasm overcame his objections and he promised to get them down for me to see. The photographs were taken before he had had the opportunity to put the models into "ship-shape" condition, but nevertheless they are enough to whet the appetite of the genuine ship lover!

They are a collection of models of ships of various periods, but the manner in which he came to make them is almost unique in my experience. It appears that his enthusiasm was fired when a friend of his, Mr. B. Tonkins, lent him two popular nautical books, part of *Shipping Wonders of the World*, which contained some pictures of fine ship models. With complete ignorance of nautical drawing and with very few tools he decided to copy these pictures, even if the models *did* leave something to be desired.

He set to work and acquired sundry pieces of wood and remarked: "by the saving grace of having an eye for line, I arrived at the results you see here." He did not start on one model and stick to it. He wanted results and he needed diversion, so he commenced the whole batch together and progressed more or less evenly with each subject.

Fig. 3.—Mr. Hope's Flemish Carrack model. Unfortunately the rigging was not in good condition when the photograph was taken, but he has now some new rigging cord and is engaged on re-rigging this ship, which is 17in. overall.

Mr. Hope started on this model project in October, 1939, and it came to an end, due to his war service, in May, 1940, so the work shown in these photographs was all carried out during that space of seven months, but since his return to civilian life he plans to complete the models. He must have spent many hours on concentrated work on them but, like many others, he felt the strain of the early days of the war as an impelling force, and to escape from too much thought, he applied himself to his "pieces of wood." He worked regularly each afternoon from three to five and planned out the more detailed jobs for an hour or so after his work at night. His trade of chef is a versatile and comprehensive one, dealing with such diverse mediums as sugar, waxes, icing and so forth, and he did not find it difficult to adapt his manipulative skill in this manner to other subjects. It stood him in good stead particularly as regards the model decorative work.

Viking Long Ship

The selection of ships covers a period of several centuries but I consider the Viking Long Ship (Fig. 1) the finest model and, also, it has the advantage of being in the best condition. These ancient Norse vessels had beautiful lines and must have looked most colourful on the water with their golden figureheads (Fig. 2), tails and weather vanes. They were often painted in stripes, golden, red and purple,

Fig. 1 (Left).—Mr. A. Hope and his model Viking ship. The vessel is 30in. long.

Fig. 2 (Right).—Bow view of the model Viking Long Ship, showing the fine carving of the dragon head and the embroidery work on the sail. The mahogany veneer glued on to represent planking can also be viewed at closer quarters.

Fig. 4.—A Flemish Galleon. Again the masts were in bad order and the picture does not do the model full justice, but the general craftsmanship can be appreciated. It is 22in. long, without beak.

and the warrior shields with their metal rims and bosses hung along the gunwhales. The sails were often elaborately embroidered, and it is said some were of velvet.

We know exactly how these Viking vessels looked because several have been preserved in the Scandinavian clay, and there are good examples in the museums at Oslo, and Bergen in Norway.

They were propelled by oars if the wind was not favourable. In the wind they had one mast which carried a square sail. Steering was by a large paddle-shaped board worked by a tiller. The rudder was always rigged up on the right side, and our word " Starboard " is the derivation from the Norse " stjonbordi " or " steering side." Large ships of this kind had several anchors.

This Viking long-boat was Mr. Hope's third attempt, and he had to fashion it from a piece of deal from a timber yard ; the wood was both hard and brittle. He said : " Each time, after shaping the hull, when I came to empty it I found great knots, which split it. Determined not to go to a lot of labour in vain I hollowed out the hull first, then trimmed it and finished the inside. Afterwards I glued on mahogany veneer to represent planking. After that I cut the keel plate and fixed it in position, decorated my prow and stem with barbola modelling clay, and fashioned the oars from builder's laths. The discs for the shields I found in a shop in Penzance."

Flemish Carrack

Looking at this model, I considered the dragon figurehead was very beautifully carved and was the finest piece of craftsmanship in any of the models of his collection. Another of them—a Flemish Carrack (Fig. 3) —is taken from a photograph of one modelled by Nance, whose original is in the Science Museum at South Kensington. The word " Carrack " is used to describe large ships of the period between the 14th and early 16th centuries. A vessel designed to carry heavy burdens, it was a part of the shipping of all European nations with a seaboard, and was also used for purposes of war. Some carracks were probably vessels of 900 to 1,000 tons.

As for Mr. Hope's model, he shaped the hull from a piece of deal and the deck and fittings were cut from teak which he received as a present. He made the masts from dowelling, the fighting tops from a piece of broomstick, while three-ply wood and barbola clay were used for the odd decorative pieces.

An Elaborate Model

Another of his models is of a type of vessel *circa* Charles I. It was the age of the " Sovereign of the Seas "—an age when ships were very elaborately finished. This appealed to our model-maker, for it allowed him to introduce a fair amount of barbola work in the decorations. The bottom or waterline part of the hull he made from a very old piece of builder's planking which he discovered in " the yard," and then he built the model up deck by deck. The upper deck fitments, bulkheads and so forth were concocted from cigar boxes, satisfactorily disguised by paint and barbola. Other parts and decks were made from tea chests. This type of ship is probably the most popular to model-makers of period ships and Mr. Hope has taken full advantage of it.

Model Galleon

Last, but not least, of his models is one of a Flemish galleon (Fig. 4). The galleon proper was primarily a war vessel of the period late 16th and early 17th century. It was, no doubt, a better sea boat than most earlier vessels. One of the peculiarities of the galleon, which is shown in the model, was that instead of the long projecting forecastle of the larger ships of her time the galleon's forecastle ended at her stem and a long beck (or beak), similar to the galley ship, projected far ahead.

The items used in the model's construction included wooden barrel bungs for the round tops.

Tools and Equipment

No doubt many keen model-makers of ancient ships will be able to find faults in the detail and also the construction of these models, but it must be borne in mind that they are an amateur's first attempt. At first the tools of this chef model-maker were three chisels, the ones he used to chip out his ice models. He also possessed pliers, a hammer, fretsaw, tenon saw, panel pins, glue and paint. " Naturally," he adds, " I felt the need of better ones and, having bought an old table for the timber in it, I decided something more comprehensive must be obtainable. So I got a catalogue, and when in London I made a call and found the tools I wanted, which were wood-carver's chisels. Since then I have used these and regret I did not have them when I was shaping my models, for with them I have been able to make some useful and attractive articles."

Now that he finds he can get proper working drawings of almost every type of ancient ship—and even modern ones, too—Mr. Hope wants to make a fresh start, and I have no doubt with his experience, unaided except by photographs, he will find working to scale drawings a much easier task, and with the skill he undoubtedly has will produce something really worthy of professional standards.

Fig. 5.—Mr. Hope with his fleet of model old-time ships on the lawn of his home at Carbis Bay, Cornwall.

Letters from Readers

"P.M." Trailer Axle

SIR,—I have a trailer axle for sale, and as you are in touch with enthusiasts who do constructive work, perhaps you may know of a likely purchaser.

I had intended building the "P.M. Caravan," for which purpose I obtained the axle, but circumstances have necessitated an alteration in my plans, and I would rather some use be made of the axle than let it rust into scrap-iron.

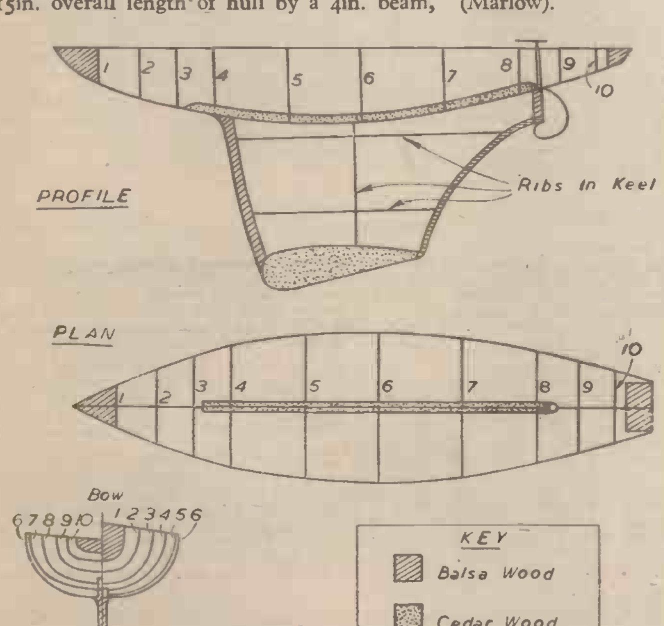
The axle is an Austin 12 rear, complete with wire wheels, tyres, springs, and has been modified so that the differential is used (by the extraction of the crown wheel and pinion). I overhauled the thing generally, fitted one replacement bearing, and had the bearing housings built up to eliminate the wear which had taken place. Generally, it is in very good condition and would be ready for use in building a caravan or contractor's trailer, with no further work on it being necessary.

It has cost me £8 to buy and overhaul, and I am willing to dispose of it at that figure.

If you can put me in touch with an interested party I should be grateful.—J. P. DEADMAN (Twickenham).

Paper-built Model Yacht

SIR,—After reading your book on "Model Boat Building," and studying the plans of a model plank-built schooner yacht, I decided to build a yacht out of paper, using a minimum of wood. The dimensions are 15in. overall length of hull by a 4in. beam,



Sections of a paper-built model yacht by D. D. Gerrans.

and draught of hull 2in. with a 4¾in. keel, to be rigged like the yacht illustrated in Chapter V, Fig. 31.

I cut out a profile of hull and keel in $^{1}/_{16}$in. cardboard, using two pieces of cedar wood from a cigar box roughly 8in. long, and glued them either side of the profile and on the line of the bottom of the hull. Then I used two small pieces of balsa wood to strengthen the bow, built up ribs of $^{1}/_{16}$in. cardboard to the shape of the hull sections, sternwards, finishing with two more pieces of balsa wood at the stern. I then glued on the deck made of $^{1}/_{10}$in. cardboard, then covered the hull with cartridge paper from the centre to bow and then to the stern.

I bought very cheaply some nearly dried up model aeroplane dope and painted the hull very thickly with three coats. I have built up the keel on the basis of a wing of a model aeroplane, adding strips of thin mahogany pipe spills to strengthen it. I have covered it with thin cardboard, and then coated the whole hull and keel with pale green dope. I have made the rudder tube with paper, doped it thoroughly, rigged it as in the book. Having up to now not been able to obtain suitable sailcloth, I have not yet been able to sail her.

The strength of the paper is much more than I anticipated, as I can flick it very hard with my finger without doing the slightest damage to it.

The advantage of this type of model yacht is that it costs next to nothing and can be repaired easily should it receive any damage.

I am also enclosing a photograph of a model Brixham trawler, built by myself entirely with matchsticks. Overall length of this model is 2ft. 6in.—D. D. GERRANS (Marlow).

Modified "P.M." Canoe

SIR,—I was very interested in the design for a wooden canoe, which appeared in the June, 1945, issue of PRACTICAL MECHANICS.

We have a private harbour, about three-quarters of a mile long by about two hundred yards wide, and I thought that if I modified the dimensions somewhat, it would do for fishing in this harbour.

So I got a carpenter friend of mine to make it for me, and the dimensions are as follows: Length, 10ft.; beam, 2ft. 2in.; depth, 1ft. 3in. The bottom is in one piece, 1in. thick, the sides are ½in. thick, and the whole canoe is made from seasoned elm.

The sides, to assist bending, have four right-angle iron brackets, and the general design of the canoe is the same as illustrated in your Journal. I have been out in it several times and it only draws 1½in. of water, but for all this, it shows no signs of tipping up. The paddle is made of ash and is 9ft. 6in. long.

I have been out when the sea has been decidedly choppy, and must say I was, and am, very pleased with its performance.

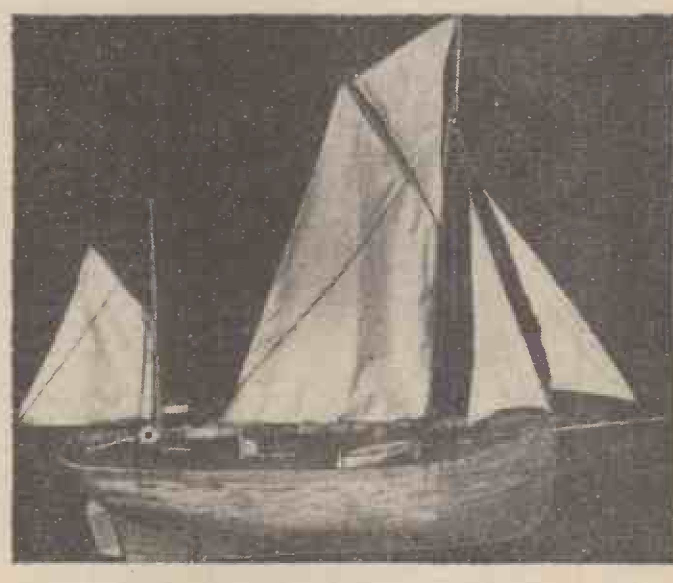
It is a bit heavy to move about out of the water, but I constructed a special skip to wheel it down the slipway into the sea.

I am writing this in case any of your more mature readers would like to modify the canoe to suit themselves. My weight is over 10 stone, but I find there is plenty of room, and the boat is extremely light to handle in the water, and has a good turn of speed.—F. W. BANKS (Ilfracombe).

CLUB NEWS

Whitefield Model and Engineering Society

ON Saturday, June 1st, members of the club paid a visit to Mr. Alex Jackson, of Heaton Norris, Stockport, to see his amazing gauge 1 outdoor railway.



(Above) A model Brixham trawler, the hull of which is made with matchsticks.

This railway is the real thing in miniature, as all points and signals are fully interlocking as in real practice, and all the system, including locos.—about 12—and most of the rolling stock, was constructed by Mr. Jackson himself.

Rain prevented us from seeing the system in full operation, but we saw some clever shunting done in the shed. We are trying to arrange future visits to interesting places, such as local loco. sheds, power stations, etc.—Secretary, A. STEVENSON, 2, Newlands Drive, Prestwich.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on back of 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.

Pressing "Cloth Felt"

WOULD you please let me know what is the process of pressing woollen cloth so as to form hats, etc.? If any chemical is used, where it is likely to be obtained?—John Schembri (Mosta, Malta).

REAL felt is *not* a woven material. It is made from beaver or rabbit fur, with or without admixture of wool, the individual fibres being agglutinated or matted together with the aid of moisture and heat by a process of pounding, rolling and consolidating pressure.

What is often known as "cloth felt" is merely a "felted wool." This is obtained by shrinking the wool by immersion in hot water. The material is then mechanically rubbed and pounded under water or in the moist stage, after which it is pressed in the hot, moist state by means of heated rollers. The whole of this process results in a softening of the fibres and in their subsequent interlocking. By subsequent compression a comparatively thick wad of the matted wool fibres is obtained. This is then slowly dried and given a final rolling in the dry state. No chemical is used in the process, which is purely of a mechanical as opposed to a chemical nature.

You could probably obtain particulars of felting machines from the Secretary, The Textile Institute, The Old Parsonage, Manchester.

Oil-bound Water Paint

COULD you please supply me with particulars of a method of making a good-quality *oil-bound* water paint, together with a method of dyeing to produce various colours?—F. Parker (West Hartlepool).

THE basis of oil-bound water-paints or distempers is ordinary whiting, for which reason all such preparations are relatively cheap to produce. The following formula will provide for a white distemper: Whiting, 5lb.; glue size, ½lb.; raw linseed oil, 1 gill; paint drier, 1oz.; water, ¼ gallon. Heat the water and dissolve the glue size in it. Then add the water to the whiting so as to obtain a perfectly smooth mixture. Finally stir in the linseed oil and the drier.

The above formula is capable of much variation. The more whiting you admit to the paint, the greater its opacity and body. The more oil, the shinier the finished surface. The more glue size, the greater the adhesive power of the paint. The more water, the thinner the paint. Hence, by adjusting the above formula to your own requirements you will, with a little experiment, be able to get the exact type of paint which you require.

The distemper is coloured merely by the addition of one or more mineral colours to it. Thus, the addition of a little ochre gives the distemper a cream, stone or yellow colour. Be careful that you do not overdo the addition of these mineral colours if you wish to obtain pale shades. Very small additions of the mineral colours usually suffice.

All the necessary materials for the making of a distemper can be purchased at any good paint shop.

Painting Model Galleons: Imitation Vellum

I HAVE constructed a galleon and have painted it with cellulose paints. Now I wish to obtain an aged appearance, such as model galleons are usually given. Can you advise me as to the necessary materials and their application?

Also, I have been trying to obtain oiled vellum for sails, but find this impossible, so could you tell me of any method of imitating this using other material? I have tried varnishing heavy tracing paper, but this does not give desired results.—R. Faunta (Letchworth).

THE only means by which you can give an aged appearance to your painted galleon is by the use of judiciously selected colours or an "antique brown" and/or "old gold" variety. These can be obtained from any colourman's shop. There is no chemical method which can be applied to the existing painted areas, since the cellulose itself is highly resistant to chemical attack.

However, for purposes of experiment you might like to try painting on selected areas of the model a yellow solution made by boiling equal parts of lime and sulphur in water (quantities immaterial) for about 20 minutes. The solution contains soluble sulphur and it will tend to darken anything it comes in contact with. For metal parts, it must be used very weak. This method, however, is not entirely reliable, and we do not propose it as such.

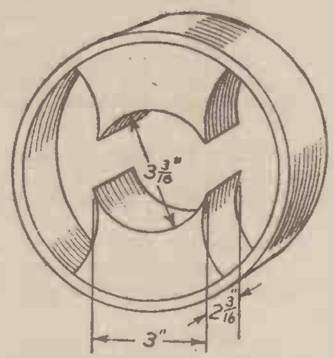
Genuine vellum (in a variety of shades) can be obtained from Messrs. G. W. Russell and Co., Ltd., Hitchin, Herts, the price being about 10s. 6d. per skin. This firm also supplies "Linson" fabric in a variety of colours, the cream variety giving a good imitation of vellum. It is priced at about 1s. 3d. per yard.

We think that this "Linson" fabric will meet your needs, if you decide against the genuine vellum or parchment.

The method of varnishing a white paper is useless for your purpose, but you could probably get results by rubbing a mixture of castor oil and petrol into both sides of an ordinary white paper. Do not use much castor oil. Use only a trace, so that it will remain within the fibres of the paper and not be sticky after the petrol has evaporated.

Re-winding Small Motor

I HAVE a ½ h.p. compound wound motor and I wish to run it on 230 v. 50 cycles. I have tried it on A.C., but the motor does not develop any power. The field system is laminated and the air-gap between the armature and field system is very small. Could you possibly supply the data necessary for re-winding the motor?



Field magnet for a small motor. (G. T. Sinclair).

Dimensions of motor, which is compound wound, are: Slots in armature, 16; segments in commutator, 32; number of poles, 2.—G. T. Sinclair (Aberdeen).

ASSUMING the motor is at present designed to run on about 230 volts we suggest you wind each field pole with 100 turns of 21 s.w.g. enamelled wire. The two coils should be connected in series with each other so as to create poles of opposite magnetic polarity, and in series with the armature. The present armature could probably be used without modification.

Small Arc-welding Equipment

I DESIRE to do some arc welding, using a 6-volt car battery as the source of supply, and would be much obliged if you will kindly give me details of the electrode holder, and also where suitable welding wire may be obtained?—D. Grunwell (Manchester).

IT should be appreciated that only small welding work could be undertaken from a car battery and we do not advise this method for serious welding work. We suggest you use copper coated carbon electrodes of about 9/32in. diameter, the electrode being connected to the positive pole of the battery. The electrode holder can be quite a simple arrangement with an iron rod provided with a handle, the end of the rod having a clamp for the electrode. The rod could be fastened to a tube through which the electrode passes, a pinch screw being used to secure the electrode.

It is possible you could obtain suitable electrodes and welding wire from Daco (Dept. P.M.1), 4, Buchanan Buildings, Holborn, E.C.1, or from New Era Products, 4, Wilton Mews, Wilton Way, Hackney, E.8.

Asbestos Mix

I WOULD be pleased if you can give me any information about the following: (1) The correct mix of cement and asbestos (in lbs.) to produce asbestos cement flat sheets. (2) Where the asbestos is obtainable, and the method used in the manufacture of asbestos.—G. L. Ridgway (Shrewsbury).

(1) To make an asbestos mix, incorporate 1 volume of asbestos flour with two volumes of cement and 1 volume of limestone dust or other fine inert "filler." This is slaked with water to mortar consistency and then laid in flat moulds.

(2) Asbestos, fibrous or powdered, can be obtained from Turner Asbestos Co., Ltd., Rochdale, Lancs, but we do not know how far this company will go at the present time towards supplying only small quantities of this material. Hence, it might be advisable for you to obtain it from a local firm of builders' merchants.

Asbestos is a mineral which is now being mined extensively in Canada. It is mechanically dug out of the open faces of large quarries, mechanically separated from dirt and extraneous matter. Subsequently, it is broken down or shredded into a fibrous condition, the material being separated into long fibres, short fibres and dust. These grades are then packed into bags and shipped over to our country. With the increasing demands for asbestos, the whole of asbestos production is being more and more mechanised, and a large number of varying grades are now being made available to cope with the varying types of this material which are now being called for.

Writing on Lantern Slides

I WISH to make up a preparation to coat glass, for the purpose of making slides, as used in cinemas. It must not flake when scratched, as I wish to write on the slide by removing the preparation with a fine pointed instrument. Can you recommend a preparation that is fairly quick setting (i.e., drying) and is opaque?—L. Hawkes (Middlesbrough).

DISSOLVE 10 parts (by weight) of cooking gelatine in 90 parts of water and stir into the solution sufficient lampblack, or drop black (or, alternatively, a mixture of equal parts of lampblack and red oxide), to give the required opacity to a drop of the material placed on a glass sheet. Add one or two drops of oil of cloves or of carbolic acid to the medium to prevent it from becoming mouldy when stored.

This medium, which will have to be stirred well before use, should be warmed (for when cold it will set to a jelly) and brushed over the glass sheet, the latter then being laid aside for an hour or less for the layer of medium to become hard. It will then be able to be used in the manner you desire.

Alternatively, instead of adding the insoluble lampblack or other pigment, you can dissolve a quantity of soluble dye in the gelatine solution. This will give you a coloured background for the slide announcements.

If you find that the heat of the lantern tends to cause the gelatine film on the slide to wrinkle, you can very effectively harden the gelatine (before scratching the writing on it), by immersing it for two or three minutes in a solution made by diluting 1 part of commercial formalin with 6 parts of water. This renders the gelatine hard and insoluble in water.

Battery Tester

I REQUIRE a full load capacity tester for motor-boat batteries (12 volt). Can you please give me any suggestions for making one and, if possible, the name of the manufacturers of such equipment? What resistance would be necessary in series with a 6 volt ignition coil, Lucas E.R. 6 volt 1,114 BR60, if it is to work successfully from a 12 volt battery?—W. A. Eason (Portsmouth).

YOU could construct a battery tester from a voltmeter which is shunted by a resistance and connected across the battery. The ohmic resistance of the shunt should be such that full load current will flow through it. The resistance should thus be equal to $\frac{\text{12 volts}}{\text{Full load current}}$. Assuming the normal full load current is about 15 amps the resistance should be 0.8 ohm and should be capable of carrying 15 amps for a brief period without dangerous overheating. Under the conditions quoted 3.65ft. of 17 s.w.g. Brightray resistance wire, as supplied by Messrs. Henry Wiggin and Co., Ltd., would be suitable for the shunt. The switch used to connect the voltmeter and shunt across the battery should have robust contacts and be capable of carrying full load current with ease. The voltmeter should have an open scale round the 12 volt mark. The dial could be recalibrated and marked "Low Charge" below the 11.7 volt mark; "Medium Charge" from 11.7 to 12.3 volts; and "Full Charge" above 12.3 volts. Such instruments can, of course, only be relied upon to give an approximate indication of the state of charge. You may be able to obtain a suitable tester from Runbaken, Ltd., of Deansgate, Manchester.

We do not favour the use of a 6 volt ignition unit in series with a resistance from a 12 volt battery, and would suggest this coil be wired up to the middle cell of the battery and connected thereto by means of a suitable clip.

Telescope Lenses

I HAVE a coastguard's telescope giving a magnification of 20x. The object glass is of 2in. diameter with a focal length of about 18in. I believe it is possible to use this object glass with an eyepiece which would give a magnification of 40x or more with an inverted image. As it would be used for astronomy the inversion would not matter. I should be very glad if you could tell me :

1. What type of lens I require for the eyepiece and its approximate focal length ?

2. Where I should be able to purchase such a lens, and its cost ?—S. A. Coot (Canterbury).

THE function of the telescope object glass is to collect the light and to bring the distant image to a focus within the barrel of the telescope. This being effected, the eyepiece lens merely magnifies (and sometimes re-erects) the focused image which normally appears upside down.

There is, however, a severe limit to the amount of magnification which the focused image will stand. If this magnification is too much strained, the result will be a dull, blurred image which will be useless for all practical purposes.

For this reason, you can only increase the magnification of your instrument by about double, or, perhaps, somewhat less, particularly for astronomical purposes. You require an astronomical eyepiece about one half as much again in focal length as your present eyepiece. The use of this will give you a satisfactorily enhanced magnification without any blurring of the image or any distortions. Your best plan is to purchase a lens second hand, and to get two or three of them on approval so that you can try them out for yourself. A good source of supply for these articles is Messrs. Broadhurst Clarkson and Co., Ltd., of Farringdon Street, London, E.C.4; Messrs. W. Watson and Co., Ltd., of High Barnet, might also be able to offer you a few astronomical eyepieces in secondhand condition. The prices of all these articles have increased considerably since the war, but you might be able to get a suitable eyepiece for between 35s. and 65s.

Filling for Floorboards Cracks

I WISH to fill up the cracks between some floorboards, and would like to know of any reasonably quick method. It has been suggested that I use papier mâché and squeegee it into the cracks.

Would you please give me the formula for making papier mâché, and any suggestions you have on the subject ?—F. M. Struthers (Sutton).

FOR filling your floorboard cracks a paste made of sawdust and ordinary glue solution is as good as anything, being cheap, effective and long-lasting. The material will, of course, set hard with a rough surface, but this can be smoothed over with sandpaper afterwards.

Papier mâché is also quite good for the purpose. It is best made to the following formula :

Paper Powder ..	100 parts (by weight)
Zinc oxide ..	75 „ „

This is made up into a paste by adding sufficient ordinary glue solution. It will be white or creamy in colour, but it can be coloured by adding suitable pigments, such as ochre, burnt sienna, red oxide, etc. Paper powder (or paper "stock") can be obtained from any paper mill, or, perhaps, from a firm of paper stock dealers, such as Rappings, Ltd., 9-10, Bond Court, Walbrook, London, E.C.4.

If, after the material has set hard, you brush it over with commercial formalin solution, the glue binder will become harder still and absolutely insoluble, so that the floors will be able to be scrubbed without softening the glue binder.

Silvering Paste

SOME years ago you gave a formula for a silver plating paste, which I have mislaid, the basis of which was silver nitrate converted into silver chloride by ordinary salt.

Would you please repeat this formula. I require a paste which can be rubbed on an article which is too awkward to be immersed in a solution. —R. A. Harvey (Patchway).

A SILVERING paste such as you require has the following formula :

Potassium bitartrate ..	80 parts (by weight)
Common salt	80 „ „
Silver chloride	20 „ „

The silver chloride is made by adding a solution of common salt to a solution of silver nitrate and by collecting and drying the precipitated silver chloride.

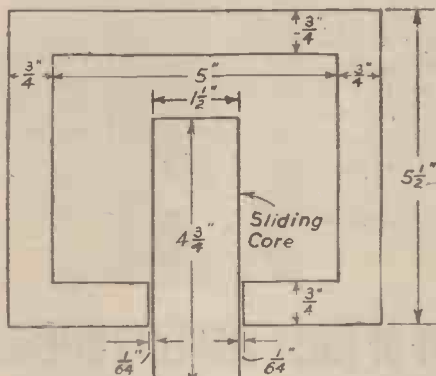
For use, the above materials, intimately mixed, should be moistened with a little water and then rubbed over the cleaned article. The silver is usually deposited in a "white" form (i.e., like a clock dial), but with subsequent rubbing it can be brought into a fairly lustrous condition. The deposit is, of course, very thin indeed. It will not withstand wear and it is in no way to be compared for endurance and lustrous appearance to the normal electrically formed silver-plate.

Solenoid for Light Control

I WISH to construct a solenoid to control a 100-watt lamp on 230 v. 50 cycle A.C. circuit, from bright to dim, and I believe this can be done by withdrawing the centre coil, thereby reducing the current flowing. Can you give me approximate dimensions of the coils and length and gauge of wire, to try out an experimental model ?

Are there any books dealing with this method of light control, as distinct from the usual wire-wound resistances ?—R. D. Bell (Altrincham).

WE suggest you build up a core of Stalloy stampings about 0.014in. thick to the dimensions given in the diagram, the stampings being lightly insulated



Dimensions of stampings and sliding core for a light-controlling solenoid (R. D. Bell).

on one side. A former of hardwood or other insulating material could be wound with about 2,500 turns of 24 s.w.g. enamelled wire, a layer of thin paper being wound between each of the layers of wire. The wound coil should then be fitted in the core and arrangements made for the laminated core of 1½in. by 1½in. section to slide in the coil. The coil should be connected in series with the 100-watt lamp, the voltage across the lamp being reduced as the core is slid into the coil.

A problem of this nature involves several formulæ involving various A.C. principles and we do not know of any book which would give you all the information necessary to design such a coil. If you are familiar with A.C., however, we would mention that a few useful notes on choke coils are contained in the book "Industrial Electrical Measuring Instruments," by K. Edgcumbe (Constable & Co., Ltd.).

Writing on Celluloid Film

COULD you please tell me of any ink which is manufactured or could be made up, which would be of a more or less permanent nature when written on celluloid ? My object is to make reference numbers on the edge of 35 mm. photographic film for the printing of negatives, etc.— T. H. Coney (Leicester).

THE very simplest way to mark film is to matt a small area of it by means of a small fragment of fine glasspaper and then to write on the roughened area with an ordinary pencil. Alternatively, make up a celluloid solution by dissolving scrap celluloid in a mixture of approximately equal parts of acetone and amyl acetate. Dissolve by shaking, *not* by heat, and add scrap celluloid until the solution has the consistency of varnish.

Then obtain a small quantity of surgical spirit (or methylated spirit) and dissolve a spirit-soluble dye in this, making up a strong dye solution. Add a little of the dye solution to the clear celluloid varnish until it is sufficiently coloured. This will be your "ink" for film writing. It will be as permanent as the film base itself, and you can, of course, make it in any colour you like. Use a clean pen for writing with and wipe the pen immediately after use. If the ink drags on the pen thin it down with a little amyl acetate or acetone.

Pickling Solution for Brass Parts

COULD you let me know the formulæ of the liquids required for pickling and bright acid dipping for small pressed parts of soft brass sheet ?—H. A. Browning (Romford).

FOR a pickling or "scaling" dip for brass or copper use the following : Hydrochloric acid, 2oz. Sulphuric acid, 136oz. Nitric acid, 26oz. Water, 1 gallon. For a brightening dip, the following is preferable : Hydrochloric acid, ¼oz. Sulphuric acid, 142oz. Nitric acid, 23oz. Water, 1 gallon. When making-up these dips, first of all add the sulphuric acid slowly to the water. Allow the liquid to cool down to normal temperature, then add the remaining acids. Water or acids must never be added directly to the pure sulphuric acid, otherwise semi-explosive spurting will be liable to occur.

Recoating Gramophone Records

I DO a good deal of home recording and have a large number of blanks which I can easily clean off. I want to know the way to recoat these with the celluloid preparation. How is it put on and how is the preparation prepared ?— C. E. Baker (West Moors).

YOU do not say whether you are doing disc or cylinder recording. However, the recoating with a layer of celluloid is not a very difficult job, particularly in the case of discs, although it will be necessary for you to experiment to some extent in order to get the right degree of hardness (or softness) of the recoated celluloid layer.

Take a quantity of scrap celluloid (old cinema film material, for instance, with the emulsion cleaned off) and dissolve this material in a mixture of approximately equal parts of amyl or butyl acetate and acetone. Do not heat the mixed liquids, for they are highly inflammable. Merely shake vigorously in order to get the scrap celluloid to dissolve. If you cannot obtain scrap film, you can use old car windshields for the purpose, and even old photographic films with the gelatine cleaned off.

The resulting clear celluloid solution should have a varnish consistency. It is then flowed (not brushed) on to the disc and allowed to dry in a dust-free place. If the resulting layer of celluloid is too thin, use a stronger solution. If the surface is too hard, add a few drops of castor oil to the solution in order to soften the celluloid.

Plastic Developing Dishes : Photographic Enlarger Screen

I WOULD be obliged if you would inform me if photographic developing dishes, print paddles, etc., could be made from Perspex or is this material "chemically" unsuitable ?

I should also like to know the minimum distance at which a 100-watt bulb, in an enlarger, could be separated from a 3/32in. opal glass screen without much fear of cracking the glass screen.—B. M. Robertson (Glasgow).

PERSPEX and similar plastics are quite suitable for the photographic uses which you mention, their only disadvantage for such purposes being that they are as yet a little too expensive. In time, however, they will become permanently discoloured from the use of alkaline developers.

The minimum distance at which a 100-watt bulb can be separated from an opal glass screen all depends upon the degree of ventilation which is provided in the lantern of the enlarger. Usually, the lantern will have a number of hooded side-apertures to provide ventilation, and if this is the case with your enlarger you may bring the 100-watt bulb as near as 1in. away from the glass screen. If there is no ventilation a distance of 2in. should be regarded as the minimum.

The screen should be of thin glass. In such an instance, it will not generally crack even with excessive heat. It is the sudden transition from hot to cold which cracks the glass by imposing thermal strains on it. A good way of lessening the liability of the glass to fracture under such strains is to anneal it. This can be done quite simply by immersing the sheet of glass in a saucepan of water and by bringing the water to the boiling-point *very slowly*, say, taking an hour over the process. Immediately the water begins to boil, the heat should be turned off and the pan should be allowed to be undisturbed until it has cooled down to its normal temperature. The glass may then be removed, dried and inserted in the condenser, or, still further to improve its degree of annealing, the slow heating and cooling process may be repeated once or twice.

Non-adhesive Solution

I HAVE been modelling a figure in clay and have taken a plaster cast of same. I have had some difficulty in getting the plaster to part from the clay, although I gave the figure time to dry and pull away from the plaster. I now want to fill the plaster cast with cement and sand.

Will you please tell me what is the best thing to use to ensure the cement parting from the plaster?

Can you suggest anything better than clay water to part the various pieces of the plaster cast ?

I have seen an advertisement in an American magazine for Rubberplastic Mould Compound, also Liquid Marble. Are there any similar materials to be obtained in England ?—W. C. Davis (Falmouth).

DISSOLVE 5 parts (by weight) of gelatine in 95 parts of water. Paint this solution (warm) over the interior of the plaster cast. Allow it to dry completely. It will fill the pores of the plaster with gelatine and thus lessen the risks of adhesion.

After the plaster has dried out thoroughly, give it a good smearing with Vaseline. This will effectively prevent adhesion to the plaster base.

Another method is to use ordinary soap, a strong solution of this being made and coated on to the plaster.

In general, anything oily, greasy or otherwise water-repelling will prevent adhesion when applied to the plaster base.

So far as we have been able to trace, there is no British firm manufacturing any substance like a "Liquid Marble" or "Rubberplastic" mould compound.

THE Cyclist
Editor : F. J. CAMM

VOL. XIV. AUGUST, 1946 No. 294

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Comments of the Month By F. J. C.

What is a Best All-rounder?

THE best all-rounder competition, inaugurated some years ago by a contemporary, was a paper contest intended by a certain formula to find the best all-round cyclist from performances in open events each year. The events selected were the fastest times in open events for 50 miles, 100 miles and 12 hours. This contest has not met with the support of the majority of members of cycling clubs. It has been proved that club members with an eye on securing a place in this contest have neglected particular events on courses which would not permit them to return a time which would enhance their prospects. The whole contest was ill-conceived from the start. We say that it has exercised a disturbing influence in cycling sport. This could be excused if the rules of the contest were such that it did as a fact find the best all-round cyclist even under its own arbitrary conditions.

Fastest Average Speed

NOW the best all-rounder is the one who returns the fastest average speed over the three distances of 50 miles, 100 miles and 12 hours, and the fastest average speed is found by calculating the speed of each of the three performances, totalling them and dividing the results by three. Anyone with an elementary knowledge of arithmetic (for it does not need a knowledge of higher mathematics) knows that this would not give the average speed, which can only be found by dividing the total of the times into the total distance.

It is said that the sponsors of this competition were aided by "a panel of notable mathematicians," and we should like to know the names of these "notable mathematicians." Every schoolboy knows the catch questions about average speeds, and he also knows the difference between averages and aggregates.

For the sponsors of this competition to say that this is "a proper method of comparing triple best performances" is farcical, for it is nothing of the sort. The best all-rounder contest is intended to find the fastest man over the total distance, not the fastest average time over three distances.

There can be no doubt that the only method of finding the best all-rounder is to total all the times and divide this into the total of the distances.

Weakness of B.A.R. Contest

ANOTHER of our contemporaries published a letter of criticism in the correspondence columns exposing the weakness of the B.A.R. contest which is now operated by the R.T.T.C., and we are astonished that this body, with all the experienced cyclists whose services it can command, should have taken over this contest and relieved our contemporary of the responsibility of running it without investigating the obvious fallacy upon which it is based. The letter published in our contemporary to which we refer states, and quite correctly: "By exaggerating times I can prove that the average speed calculations of the B.A.R. are incorrect, as is shown by the following example:

A Two-distance B.A.R.

	1 mile Min.	Avg. (m.p.h.)	100 miles Hrs.	Avg. (m.p.h.)	Avg. Speed (m.p.h.)
B. Bloggs	3	20	5.0	20	20
H. Hotcog	1½	40	20.0	5	22.5

H. H. could take as long as he likes over the 100 and his average would still be better than B. B."

The figures are, of course, an example of *reductio ad absurdum*. But, nevertheless, if the B.A.R. method is right the above example would yield a correct result. In other words, the B.A.R. formula should apply in every case.

The above example is entirely rational and correct and it is wrong of the sponsors to try to support the original B.A.R. formula and we challenge their "panel of notable mathematicians" to deny this. Although the time of 1½ minutes for 1 mile does not seem attainable at the moment, that does not invalidate the argument, for a sound mathematical procedure will not lead to absurdities, even when pushed to extremes, and the fact that the B.A.R. formula does so is proof of its unsoundness.

The contemporary which sponsored the original B.A.R. contest (now taken over by the R.T.T.C. in the interests of disinterested sport), in criticising the above comments of a critic, appears to assume that the only alternative to the present B.A.R. methods is the "aggregate time and aggregate distance" method. Over twelve years ago it was pointed out that the best method of assessing merit was by the average number of seconds per mile for the distances concerned; for this method avoids all of the criticisms that can occur when the other two methods are applied to extreme cases. Incidentally, it is easier to work out than the other two methods. No method can be considered correct if it fails to deal sensibly with such cases, because it must contain a tendency to falsity, even when applied to normal cases. The superiority of the seconds per mile method in a critical case is shown in the following table.

Case Demonstrating Failure of the Present Method of Calculation.

Rider	A	B	C
	h. m. s.	h. m. s.	h. m. s.
25-mile time ..	1 5 0	1 3 30	1 15 0
50-mile time ..	2 12 0	2 12 0	2 12 0
100-mile time ..	4 40 0	4 40 0	4 40 0
12-hour distance	232 m.	232 m.	232 m.
24-hour distance	415 m.	404 m.	422 m.
Average of average speeds (m.p.h.)	20.772	20.789	20.215
Aggregate distance divided by total time (m.p.h.)	18.703	18.463	18.791
Average seconds per mile ..	175.360	175.773	179.469

The riders A, B and C have identical performances at the three middle distances.

A is 2.31% slower than B at "25" but is 2.72% faster at "24" and on balance is better than B.

B is 18.1% faster than C at "25" and is only 4.26% slower at "24" and on balance is therefore better than C.

The order of merit of the riders is therefore A, B, C. Only the "seconds per mile" method places them in that order.

The validity of applying the title "best all-rounder" to a man who may never have ridden a "twenty-four" is open to question.

We do not therefore concur in the comment that the figures quoted for H. Hotcog and B. Bloggs are unreasonable in relation to our road sport distances and times. The science of mathematics if applied to any sets of figures must be exact. It may be that H. Hotcog's position is fantastic, and the disparity between the distances selected is 100-1, but this does not "exaggerate the mathematical quibble one-hundredfold," and we are astonished that anyone should endeavour to support a method which the most elementary mathematician must know is inaccurate and yields an entirely false result. The only "whimsical arithmetical experiments" in this matter are those of our contemporary, and we do not agree that the "B.A.R. brings to the top the superlative man with closely paralleled performances at all three distances," as an anaylsis of the figures of the B.A.R. contest for the past twelve years clearly shows.

We advise the R.T.T.C. at their next annual general meeting to re-frame the rules of this contest and to bring them into line with schoolboy standards of arithmetic. In doing this, it will not need any notable panel of mathematical experts; for we are quite certain that among the pundits of the R.T.T.C. there will be some, at least, with a knowledge of Class 1 arithmetic!

B.A.R. Rules

HERE is the rule governing the British Best All-Rounder Competition: "The competition shall be open to all amateur members of Clubs affiliated to the Road Times Trials Council or to the Scottish Amateur Cycling Association, and shall be based upon each rider's fastest single bicycle performance during the season in eligible events at fifty, one hundred miles and twelve hours, such performances to be calculated (to three decimal places) in terms of miles per hour, and the average taken of a resultant speed. The advertised limit of acceptances must not be less than sixty nor more than one hundred. Events that are restricted as to gear or as to category or specialised events shall not be eligible. The distance between the start and finish of events shall not exceed a radius of two miles in the case of fifty mile events, five miles in the case of one hundred mile events and twenty-five miles in the case of twelve hour events. Any part of a second in timing shall be recorded in the official results as the next whole second. In twelve hour events the distances shall be expressed in miles and yards."

Job For Grimsby

"THE motorists, cyclists and pedestrians of this town are in great need of education in road safety," said a Grimsby town councillor, at a debate on pedestrian crossings in the town. Another speaker said there was no safety anywhere for the pedestrian, who just had to take his chance. The matter is to receive the attention of the Road Safety Committee.

Wot! No Brakes?

OUR old Service friend, Mr. Chad, is doing his bit to help Leicester's road safety campaign. The Chief Constable has distributed 10,000 leaflets bearing the familiar Chad face and the plaintive inquiry: "Wot! No Brakes?" amongst the cycling clubs and youth organisations in the city and county. The leaflet gives hints on the maintenance of cycles and on road sense.

And there was an Accident!

AT the inquest at Peterborough on a woman cyclist who died from injuries received when she was in a collision with a car, it was stated that the woman was riding with one pedal missing, a useless front brake, and her cycle generally in a poor condition of repair. In addition she did not have good eyesight, and she also failed to stop at a Halt sign at the cross-roads where the accident happened.

Shark on Bicycle

A BLACKPOOL angler who cycled out the other night to visit a line he had set on the sand came back on his own feet with a 5ft. shark on his bicycle. The shark had got caught on the line and was still struggling as the angler wheeled it home, presumably to form part of a shark and chip supper.

One Chance in Fifty Million

AT the inquest at St. Ives, Hunts, on a 7-year-old girl cyclist who fell off her machine in the main street of the town on to a piece of broken milk bottle, bleeding to death within a few minutes, a doctor who was giving evidence said it was one chance in fifty million that such an accident would happen.

The "Death Riders"

CHILDREN who live in the northern outskirts of Peterborough have made themselves a miniature Wall of Death—but without the Death. They have commandeered a disused static water tank, and they cycle madly round its sloping sides to the accompaniment of the appropriate noises.

Memory of Cyclists' Battalion

MR. M. MARSHALL, who has just died at Nottingham at the age of 60, was a colour-sergeant in the Huntingdonshire Cyclists' Battalion during the 1914-18 war.

"Mind Your Bike" Campaign

SCARBOROUGH police organised a "Mind Your Bike" campaign in the three months ended on May 31st, in an attempt to forestall would-be thieves. But in those three months more cycles were stolen in the town than during the previous quarter.

Humber Bridge

GRIMSBY CORPORATION was represented at a meeting called to consider the proposed much-needed bridge across the Humber and agreed to the scheme, provided the Government finds the whole of the money needed.

Full-time Job

TWO whole-time accident prevention police officers are to be appointed at Boston, Lincs. Their duty will be to get all road-users and pedestrians into the right frame of mind to take care of their own lives and the lives of others.

Doncaster Inner Circle Road

WORK is to start this year on the southern portion of Doncaster's new Inner Circle road, which will considerably ease traffic difficulties. No new bridges will be needed at the Doncaster approaches, but the bridge over the Don may be widened to 70 feet. The northern portion of the road is not considered to be of such urgency as the southern portion.

Same Cycle for 56 Years

MR. DAVE LUCAS, of Kettering, Northants, who has died at the age of 87, was one of the town's best athletes and a keen cyclist for some 60 years. When he went to live in Kettering in 1887 he bought himself a new cycle, which he rode regularly for 56 years until one day it was stolen from outside a café, almost two years ago.

Cycling Rook

COLIN OUTRAM, a 12-year-old schoolboy, of High Street, Belton, Lincs, recently caught a rook during rook-shooting at the Rectory, and now the bird is so tame that it rides round perched on the handlebars of the boy's bicycle. The rook sleeps in a barn and flies about in an orchard during the daytime, but directly Colin calls it down it comes on to his shoulder.

Bailey Bridge for Bedford?

DISCUSSIONS are in progress regarding the erection of a Bailey bridge over the river at Bedford, between Queen's Park and Kempston. There is not much hope of having a permanent bridge for some time, and it is suggested that the Bailey bridge, if erected, should be reserved for cyclists and pedestrians only.

Shilling Bicycle

A BROUGHTON (Northants) ice-cream dealer, who bought a bicycle from two children for a shilling and two ice-creams, must have repented of his bargain later when he was sent to prison for three months by Kettering magistrates. According to a police witness, the cycle was stolen by one of the children, aged seven, who was accompanied by his five-year-old friend. Several previous convictions against the ice-cream dealer were proved.

New Old 'Un

A SEVEN-YEAR-OLD Gateshead boy took such a fancy to the old penny-farthing cycle belonging to his grandfather that the grandfather set to work and made a smaller model. This model penny-farthing, ridden by the small boy, headed the town's Safety Week parade a few days ago. The grandfather is Steve Starr, of Low Fell, Gateshead, a champion rider of the penny-farthing.

No Rest for the Policeman

ARISING out of the appearance of two airmen at the police court at Steeple Ashton, Wilts, on a charge of both riding on one cycle, the magistrates pointed out that a policeman is always on duty, whatever he is doing. In this case the policeman was gardening when he saw the offence, and no doubt the airmen wondered why he couldn't concentrate more on his gardening and forget his work for a while.

The One-man Jail

WORTHINGTON, in Leicestershire, one of the few villages in the country with its own miniature lock-up, is anxious to have it repaired because of its historic associations. But no one knows to whom it belongs. The lock-up is a tall, cone-shaped building, and the local council wish to have it kept in repair as an ancient monument.

Dangerous For Dogs

DOGS in the village of Ingoldisthorpe, Norfolk, would appear to be a little slow on the uptake. So many of them are getting killed on the road running through the village that the villagers are asking for built-up area restrictions to be imposed.

Derogatory

A POSTER showing a funeral hearse and bearing the words "Drive carefully, or else . . .", which is erected at the entrance to Wellingborough, Northants, was described by a speaker at a meeting of the local Prevention of Accidents' Committee as being derogatory to motorists. He said he thought the poster should be in a milder form as motorists would not like being slandered. His objection was over-ruled.

Beer Is Where You Find It!

A SWOOP by a crowd of Leicestershire miners on bicycles immediately any of the locals were stocked with beer puzzled residents who were not in the know, and they wondered if the miners could smell the beer. Then one day someone saw a miner release a homing pigeon outside one of the public houses, and remembered that many miners are enthusiastic pigeon keepers as well as cyclists. It is to be hoped the pigeons were suitably rewarded for the messages they carried.

Riders taking the hairpin bend at Governors Bridge, Douglas, during the 5th Annual Manx International T.T. in the Isle of Man. French riders dominated the cycle race, and took first, second and ninth places, the team award, and all intermediate prizes except two.

Around the Wheelworld

By ICARUS

The Late C. J. Fox

I BRIEFLY reported in the previous issue the death, during the course of an Australian pursuit race organised by the B.L.R.C., of C. J. Fox, who had done so much in the interests of the League and was one of its earliest and most staunch supporters. At the inquest there was no suggestion that there was anything wrong with the organisation of the event or against cycle racing generally. The verdict was accidental death from a fractured skull and the coroner added a remark that he did not see that any blame could be attached to anyone. Two of the competitors gave evidence (one riding immediately behind and the other immediately in front of Mr. Fox), and it appeared that there was a bunch of eight riders on Penny Pot Lane, riding towards Harrogate, Mr. Fox being second from the last. They were riding close together and there was a strong wind blowing diagonally across the road. It appears that Mr. Fox swerved, either owing to this gust of wind or owing to some inequality in the road, and his rear wheel caught the grass verge, thus throwing him to the ground. Owing to the use of toe-clips he had little opportunity of jumping clear and the following cyclist ran into his machine as a result of this. There was no suggestion that a collision caused the accident. The road is 15ft. wide at this point and the surface had recently been laid with tar chips. The police officer agreed that such an accident could be caused by the wheel catching the grass verge.

Adviser for Cyclists

CYCLING club secretaries and members of clubs in Southern England are to have an expert adviser on tyre and rim equipment at their service. He is Mr. F. A. Borton, whose double qualifications are that for 20 years he has been a keen cyclist (before the war he was secretary of the Harrow Cycling Club), and that for 18 years he has been a member of Dunlop's staff.

Now after six years in the Army Ordnance Corps he is back with Dunlop and has been given his present duties. He will also be in touch with lightweight bicycle builders and assemblers.

The Suspension of C. S. J. Scott

AN announcement was recently made concerning the suspension of C. S. J. Scott, and he asks me to give publicity to the following comments, which I gladly do:

"For those members of the N.C.U. who are interested in my suspension, and/or the operation of the Union's rules, the details are briefly as follows:

"Having entered the National Tandem Championship, held on June 15th, partnered by D. Thorpe, and not having been able to train with him prior to June 12th, due to inclement weather, difficulties in obtaining equipment, and the grim necessity of earning a living, I was most anxious for a test ride. For this purpose we visited Paddington track in the evening of June 13th, the last opportunity to finalise details of position, etc., available to us. Here it was found a B.L.R.C. meeting was in progress. In view of the importance of having a ride, the promoters were asked if we could have the use of the track for a private trial during an interval in their programme. This was agreed. A solo trial was, therefore, made, although not successfully completed due to a puncture. Details to bear in mind are:

(1) No other riders were on the track at the time.

(2) We were not timed by the meeting's official timekeeper.

(3) We neither entered nor formed part of the B.L.R.C. programme.

"In view of the fact that on training nights at Paddington, B.L.R.C. and N.C.U. members are forced to ride together, the action of the London Centre Racing Committee appears most unorthodox, especially when one considers that:

(1) There is no rule of the Union which prohibits the 'riding' of a cycle at, or to, an unregistered meeting.

(2) Racing rules 11 and 145, which it is held have been contravened, refer only to competition at a meeting.

(3) The N.C.U. do not define the word 'compete,' and in the absence of such definition it is difficult to see how rules 11 and 145 can be made to apply in this case.

"One important point does emerge, however, as in view of the recent amazing flouting of the antique rule of racing number 2(G), and the amusing appearance of a competitor at Hertford, who took part in a track event complete with freewheel and brake, it most certainly seems that the application of the Union's rules is anything but uniform."

I accordingly wrote to Scott and informed him that the N.C.U. under such circumstances had no power to suspend him, and that such a suspension could be set aside in the Courts with costs against the N.C.U.; for even a domestic tribunal (and that is all the N.C.U. is), cannot act against common law. I also wrote to the N.C.U. asking them what they were going to do about reinstating Scott, but I have not received a reply to date. Scott further writes:

"The period of my suspension being operative from June 28th to July 28th inclusive, precluded any immediate benefit from an action in court, and in view of the fact that an appeal, by the rules of the Union, need not be heard for four weeks, it may well be that the duration of suspension was so framed to dissuade further action being taken."

Hercules 3-speed Hub

INDICATIVE of the precision engineering standards achieved by the cycle industry during the war is the Hercules 3-speed hub, which is now being delivered on Hercules cycles in increasing numbers.

It embodies the results of the lessons of wartime production in the matter of working to fine limits such as two thousandths of an inch. It is an enclosed epicyclic 3-speed hub, embodying a reduction of 25 per cent. from normal to low, and an increase of 33⅓ per cent. from normal to high.

Sixty-five different types of parts make up the entire unit, but counting each ball bearing, etc., separately, there are over 150 separate parts. Special modern methods of heat treatment are applied to all parts. The standard of skilled engineering at the Manor Mills Works of the Hercules Cycle Company, Birmingham, augurs well for the success of this hub from the factory with the world's largest cycle output.

Deliveries will, of course, remain restricted so long as the present position concerning labour and material exists, but the Company is doing everything possible to give increased deliveries.

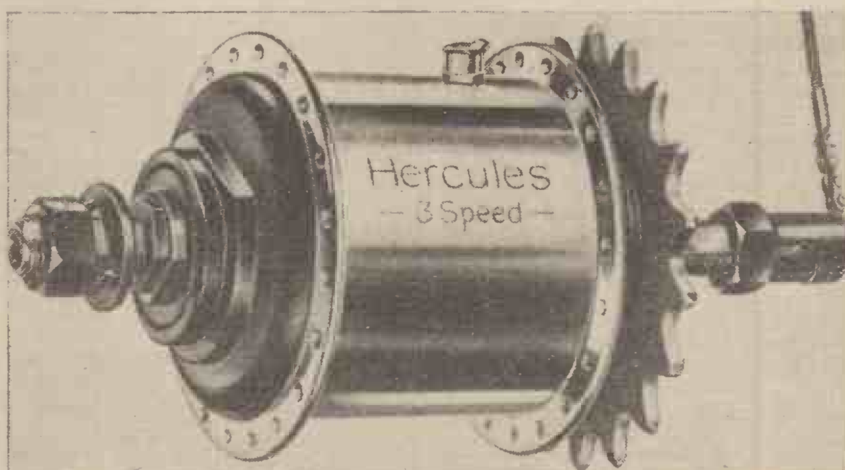
Hertfordshire Wheelers Cycling Club

THIS club has just restarted activities after a lapse of four years.

Officials are as follows:

Hon. general secretary and treasurer: Mr. E. Mascall, 7, Chadwell Hill, Ware.

Hon. time trials secretary: Mr. G. Smith, 68, Hedworth Avenue, Waltham Cross.



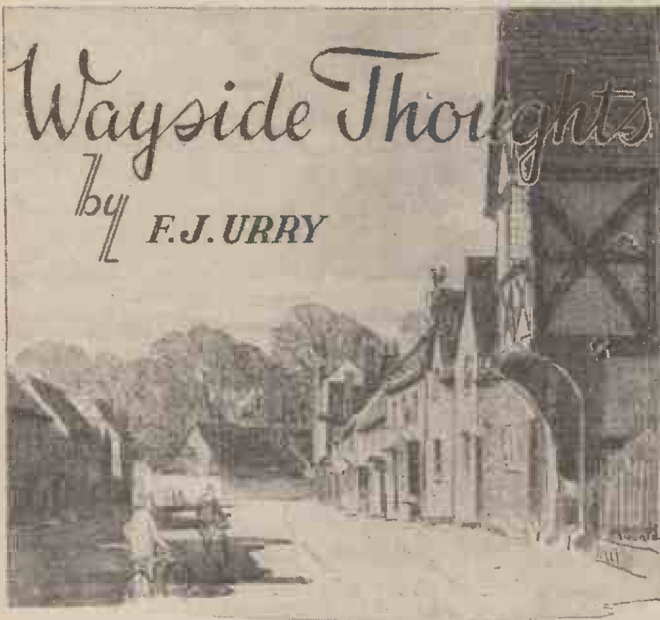
The Hercules 3-speed hub.

What is "Value"?

MY colleague "Wayfarer" sets me the following conundrum:

"A cycling club offers prizes of a specified value for its road events. For example, the first prize in the Anfield Hundred is 'Value 5 gns.,' to be chosen by the winner subject to the approval of the Committee. I personally would read that to mean intrinsic value. If, however, the figure includes purchase tax, then it appears to me that the statement is misleading. On the other hand, who pays the tax if the sum of 5 gns. is the actual value of the prize?"

My reply is that purchase tax is imposed on certain goods and the word value in law is taken to mean replacement value. That is to say, if the winner desires to insure his prize it would be insured for its replacement value. Obviously, when prizes are bought the tax is paid by the purchaser. In law the word value is taken to mean present value, for no one can postulate for the future in matters of valuation. Values sometimes increase in the course of time and sometimes they drop.



The Waiting Times

SOME of my closest friends are a trifle peeved because they are unable to buy the type of bicycle I have been recommending to them for the better part of seven years. In effect, I have told them, "Wait until the war is over and then buy the best possible —and I'll help you to it; you can afford the cost, and full enjoyment of the pastime is worth every penny of it." All of which is true; but I did not understand how the impost of war conditions, plus the urgent need for the export drive, would affect the quick return to the production of bicycles of the best type. So my friends are justified in condemning me as a prophet of a quick change-over, and I must bear their sidelong glances as the price of my optimism. They and I will have to wait a little longer, probably until the end of the year, before our specifications can be filled, and we can once again feel the schoolboy glamour in the ownership of the perfect bicycle. I know such models are in sample production, for some of them I have seen, but the goods to make them are still to be delivered in quantity, and in any case they lack the finish of the light and lovely tyre. When shall we be getting a return of that comfort—the open-sided type of pre-war quality? No one seems to know, for all the promises I can extract from the makers are based on hope, not time. For it is a fact that we cannot have the perfect bicycle until we can buy with its steel and rubber the perfect tyre. The older I grow the more convinced I become that to travel on air in the self-propelled way needs, for comfort and ease, the lightest and liveliest tyre available, built within the limits of reasonable longevity. Some people tell me I make a fetish of this tyre business, and if that be so I can only reply by asserting that experience has made me positive, and when that occurs I can only hand on the knowledge as an essential part of bicycle equipment for easy riding.

The Continent

FROM all reports and the conversation of many friends who have been "over there," Continental touring, anyhow in the cycling sense, is going to be difficult and perhaps a trifle uncomfortable for the next two years. Of course, people will go to the fashionable resorts which aforetime made it their special business to cater for the visitor, and no doubt we shall hear many favourable stories regarding the welcome, the food and the accommodation; but that kind of foreign visiting is not generally the type of holiday for which the cyclist is looking. He wants to roam widely, to see the country and sample the tone of its natives, and that means seeking food and accommodation in places remote from the greatly favoured holiday districts. Many business men, making their first Continental trip since the war, have been agreeably surprised to find the reception so genial and the provender so plentiful. But the price! They do not say much about that aspect of the situation (probably because the firm pays) and, wisely, they are not anxious to broadcast the terrific black marketing that appears to be a feature of most of the Continental places to-day. Probably the young and enthusiastic, with camping equipment, may look upon a Continental trip as an adventure to be experienced, and I'm not certain I should not feel similarly if forty summers could be sloughed from my years. To-day I prefer comfort to the robust adventure of lightweight camping, and like to know I shall at least have something to eat and a bed to sleep in at the end of the day. Even in this land the difficulties of accommodation will not be lightly overcome, and it seems that the less adventurous among us will still have to wait awhile before we can revert to the good old-fashioned "straight" tour when the question of forward booking can be forgotten, and a welcome awaits the wanderer at every village along the road. One day—in the not too distant future, I hope—this ideal of touring accommodation will return to all the lands where roads run, and then the gaiety of nations will be nearer a fact than a phrase.

Why Do We?

I WONDER occasionally why we travel. Some folk would say for change of environment, to see places, to mix with people, to exchange domesticity for hotel life—for a hundred things—and most of them would be right in their degree. Man is a restless animal and he must be doing something so long as he is active, for few of us can sit in constant contentment for longer than an hour at a time. Just now I can sit at home and look into a beautiful garden; yet how seldom I fill that function. It is the restlessness in us that drives us out, even though the scenes we pass through may be as familiar as our gardens. Yet I think, as a cyclist, there is something more in this urge to be out and about than mere restlessness. I love the rhythm of cycling, that easy circle of the feet driving delicate machinery at four times normal walking pace, and often I marvel how simple and easy is this miracle of travel. And if the road is the same road I have known for years, its atmosphere and surroundings never are—the light and shade, the glow and gloom, the frowns of storm, and the laughing happiness of high summer. How can a normal individual resist these things and retain a proper pride in living? I marvel always that the whole world does not go cycling during these joyous days, when all the earth is as an opening flower, and to be out and see and smell it is surely a full justification for wandering, if one be needed. And then there comes the day when, with a map in your pocket, you go to seek a track over which you have never been. Ah, that is an adventure and a hope, something that may disappoint or exhilarate, though all new ways may not tally with your imagination —it is a new road, a new experience, a new exploration, and there are so few of them left in life when you are beyond the three-score mark. That, I think, is why I travel my way, the cycling way, the way of freedom for me, for I go without worry or ostentation, and the simplicity of it all is a blessing in activity and quiet joy.

This Happy Breed

AND so we come back to that little smithy at Courthill, 16 miles north of Dumfries, in S.W. Scotland, where Kirkpatrick Macmillan envisaged travel on two wheels, balanced travel, the rear wheel driven by leg power as is the mode to-day, the only difference being he used levers for the first rear-driven bicycle and we use the chain. I was at Courthill in mid-May when Sir Harold Bowden, G.B.E., on behalf of the National Committee on Cycling, unveiled a plaque to the memory of that great man whose lineal descendants we are who ride and make bicycles. It was a great occasion in the annals of cycling, that Sunday in the Nith valley among the rolling hills of the Lowlands, a genuine tribute to genius neglected too long by an industry which has done more for human emancipation than any other single thing that has occurred in a century. When the memory of that moment has entered into the comfortable shape of contemplation I may be able to say something about it; now my regret is that no foreign representatives were present, for that moment was of international interest, particularly to the democratic peoples. We were a happy crowd, and the leaders of the industry present were surely impressed by the enthusiasms of the generations with whom they mingled and saw functioning, of simple, care-free travellers along the beautiful ways of that S.W. corner of Scotland. Thinking of these things makes one regret that a great pioneer like Macmillan did not live to see the full journey of his invention, and to feel the comfortable impact of the millions who bless his name, and the many more millions who would if they knew the story of the first rear-driven bicycle. The curious thing is that subsequent inventors shied at Macmillan's conception, turned their attention to tricycles and ordinaries (the high bicycle) and it was only with the advent of J. K. Starley and the Rover that we really returned to the outline of Macmillan's machine. The "safety" was slow in coming into fashion; that is why Macmillan builded better than he knew, and better, too, than subsequent inventors understood. There in that little smithy is the shrine of cycling, and methinks the fame of it will broaden as we swing "down the ringing grooves of change."

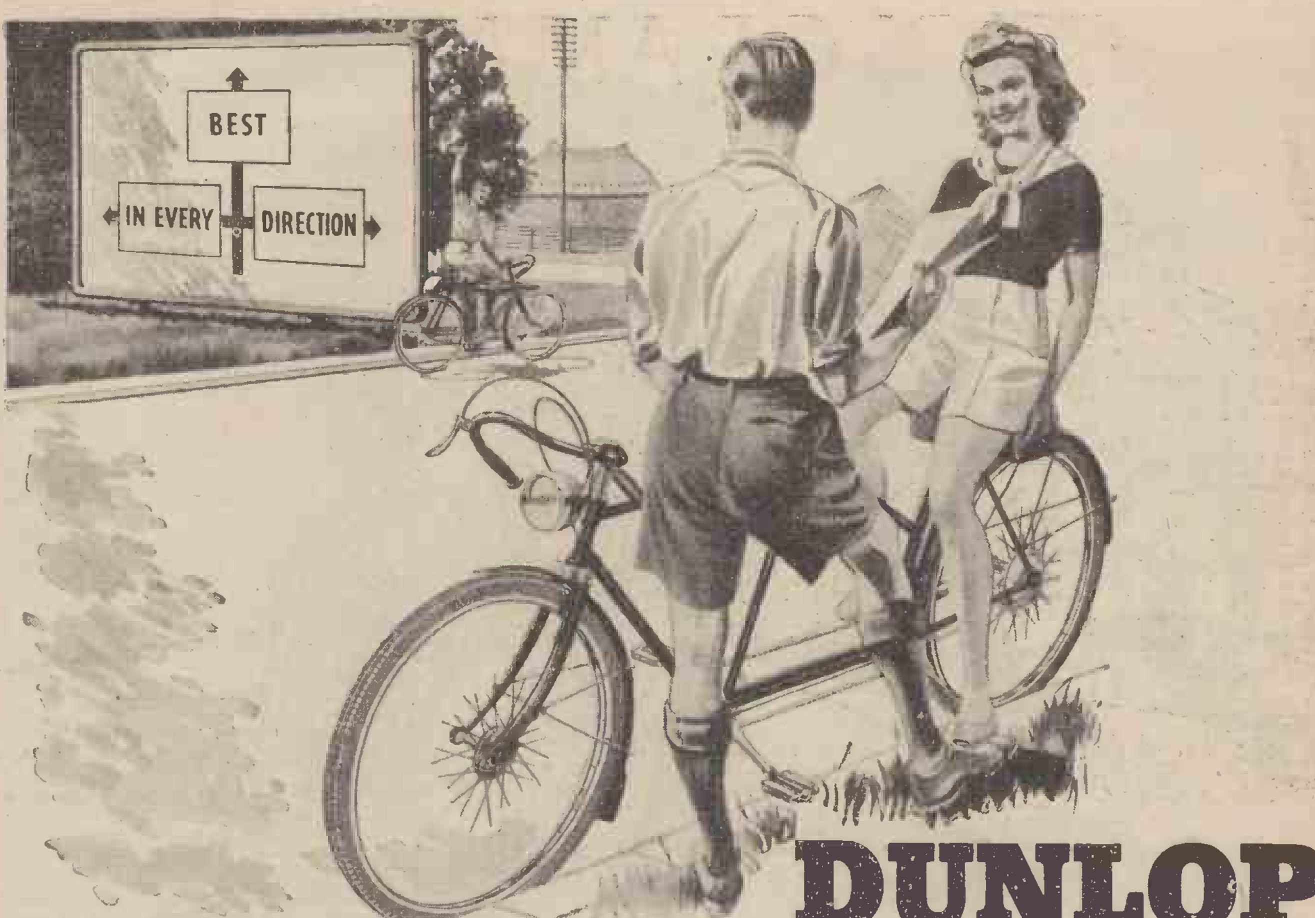
Defeating Speeds

I SOMETIMES wonder what will happen to road traffic in the cities and towns if the increase in motors during the next few years runs to the astronomical figures the optimists prophesy. I do quite a lot of town journeys most weeks of the year, and since the release of basic petrol supplies, have seen the steady return of cars to the road almost defeat their own ends, if those ends are written down as speed. The hold-ups in the streets are fast becoming a problem, the solving of which will give traffic managers a headache for many a day. I know this, that over a given town journey, involving some of the main streets, my bicycle is as fast as the car, and a good deal more comfortable, if comfort is to be measured by the impatience of the car folk who so senselessly sound a horn for passage way when it is obvious that waiting for it is the only solution. If the restriction of traffic lights were removed, then I am afraid the passage would be to the bold and careless, and all traffic would suffer as a consequence. Sometimes I am genuinely glad my inclinations are to ride a bicycle, for I should possibly become one among the impatient to think my expensive vehicle was restrained from its purpose, if I were a motorist. It seems to me that the time is not far distant when either the private car or the bus—or perhaps both—will be debarred from town and city centres, and that by such means general business will be facilitated. Indeed, something of the kind is sure to occur if the increase of motor traffic during the next few years grows anywhere near the numbers the M.O.T. or the manufacturers anticipate. Perhaps this is another good reason why we should remain cyclists, for at least we can preserve a greater mobility of movement in overcrowded areas without suffering that sense of frustration which seems to be the lot of many travellers in town.

A Good Old One

MR. JOHN SMITH, 81-year-old Grantham motor engineer, who began his career by making bicycles, still has in his workshop a cycle which he built 46 years ago. It is still in good condition and, when new, would have been sold for between 12 and 15 guineas.

Danby
North Riding Yorkshire.
A noted little village in the Cleveland Hills.



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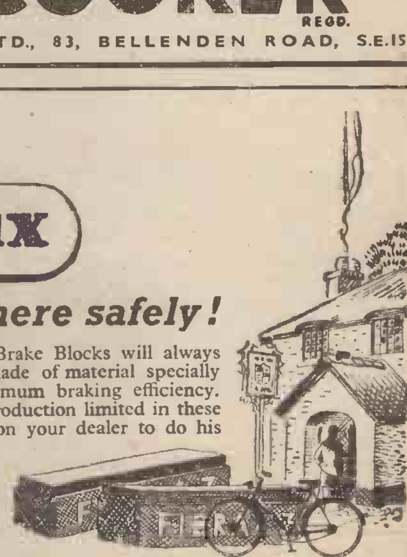

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CYCLORAMA

By H. W. ELEY

The "Roadfarers" have an Informal Evening

NO "set speeches," no formality, just a jolly "get-together" sort of function . . . that was the order of the day when I last attended the Roadfarers' Club, on May 30th. And everything went off well. In fact, I do not think I can recall a happier evening with the Roadfarers, and I congratulate "General Camm," who organised the function. As to whether I thank him for giving me, at short notice, the onerous office of chairman of the evening, I do not know! But a request from Camm is a command, and one has to obey. There were several good speeches on the vexed questions of road safety and traffic congestion, and one of the best of them was made by the Duke of Richmond, who has deep knowledge of all matters relating to road and car. I hope that there will be more of these informal affairs, for they tend to draw out the more reserved of the members, and promote good-fellowship and real friendliness.

A Hopeful Note

ONE had, I think, a distinct feeling of hopefulness about the rubber situation after reading the speech of Sir George Beharrell, the chairman of the Dunlop Rubber Company, made at the annual meeting of the Company. More tyres . . . and not too long to wait for them; better tyres, with greater production from Malaya. This is good news, and will be welcome to the cyclist just as much as the motorist.

The Cyclist and the Bluebells

I CAN well remember that the cyclist used to be regarded as the arch-enemy of our woodlands and meadows. He was always blamed for the wanton destruction of the bluebells in May and early June. How many times have I read indignant letters to the editors of local papers, raving about cyclists carrying "huge bunches" of bluebells, torn up by the roots from some woodland glade! This year I have not seen a single letter. Does it mean that (a) the letter-writers realise that newspaper space is at a premium, and therefore their letters would have small chance of being printed?; or (b) the letter-writers have now come to the conclusion that the cyclist is not a criminal?; or (c) cyclists have lost their love of the bluebell, and given up the practice of taking some of the blooms home, to bring a breath of the country to some town room? It is an interesting point, but what I like to feel is that the cyclist is at last being spared some of the nagging criticism which has been directed at him for so long.

Bicycle Design

IS it true that there has been no real or fundamental change in cycle design for fifty years? I read something on this subject recently, and the writer of one letter suggested that this was the case. Little improvements, minor "niceties"—yes; but serious changes, no. It would be intriguing to hear the views of some of the older school on this interesting question. To me, the general design of the bicycle does seem the same as in my early youth.

The Vicar Takes My Tip

TALKING to a suburban Vicar the other week . . . and we were discussing his problems relating to his "youth" organisations. How could he keep his young people together? How could he interest those young church-going folk who did not play tennis, and were not interested in the Scout or Guide movements? And I suggested a cycling club—and to-day, one exists, attached to the good man's church, and it is in a flourishing state. I helped to draw up the simple Rule Card, and even made suggestions for runs and excursions. More than this . . . I inspected the bikes, gave hints about tyre inflation, saddle comfort, and other important things!

The Inn and its Sign

MORE than once I have written in this feature something about inns, and inn signs . . . and, invariably, I have had a modest "fan mail!" Folks do seem extraordinarily interested in country inns and their signs. And the knowledge displayed by some of my correspondents is wide and deep. One has only to mention an ancient inn, and others—reputedly older—are at once brought to one's notice. Some of my recent correspondents have written interestingly about the derivation of inn signs and names . . . and I have had that old favourite again brought to my attention . . . "The Goat and Compasses," which is usually regarded as a corruption of "God encompasseth us." Now, I am not too sure that this is not just a legend, but it is certainly an interesting one! Several years ago THE CYCLIST ran a feature on inn signs and their meaning, and it contained a wealth of information and historic detail. When paper is more plentiful—and nobody seems to know when that will be—the Editor might possibly consider reviving this feature. There is something very alluring about our "King's Heads" and "Coach and Horses" and "White Harts" and "Golden Lions." Let us hope that under a Government pledged to measures of standardisation, the good old names will not disappear.

A Shropshire Lad

HE was a cyclist of many years' experience, and I met him whilst riding around some Essex villages . . . those dear, unspoiled villages which so few Londoners seem to know; villages with alluring names, and as remote in spirit from London Town as if they were situated in Northumberland or Durham. But I digress . . . this Shropshire lad and I communed together as we sipped ale in an Essex inn, and he waxed eloquent over his native county. Talked to me of Much Wenlock, and the Clee Hills, and the old town of Bridgnorth, and of Stokesay Castle, and the old crooked streets of Shrewsbury, for this man knew his Salop well, and loved it dearly. And it is a good county—this county of old black-and-white timbered houses, and majestic views, such as one can meet with at Church Stretton and Ludlow. But the Shropshire lad liked Essex too, and was well pleased with the good country around Ongar, and with such villages as Stanford-le-Hope and Hatfield Peverel. And, surely, Cornwall itself, that county of wondrous names, could give us nothing more lovely! But one day, my Shropshire lad told me, he will go back to his native land, and dream again of the ancient days of border raids, and Welsh warriors, and all the glory pictured by Housman and Mary Webb.

"Mac" of Hercules

I REFER to D. D. MacLachlan, the very vigorous advertising manager of the Hercules Company, who must be one of the livest people connected with the publicising of the bicycle and cycling. "Mac" is as well known in Fleet Street as he is in Birmingham, and has a host of friends. I always like to exchange views with him, because he is a real enthusiast for the bicycle and the joys of the road. Also, he has a warm corner in his heart for all engaged in the cycle and allied industries, and is active in connection with the good work of the Motor and Cycle Trades Benevolent Fund. And so, of course, is his "chief"—Sir Edmund Crane.

Bullington Church. Sussex.

One of England's smallest churches. A lonely little building surrounded by trees off the main road from West Dean to Alfriston. Only the chancel remains of the original building which was destroyed centuries ago, by fire.

My Point of View

By "WAYFARER"

The Missing Word

THE daily newspaper men, with their one-track minds, have been telling us that "Dearer Travel" is on the way. The missing (and important) word is, of course, "Rail." Travel by the best of methods is not going to rise in price.

"Mobile Snacks"

I WAS interested to observe, in a field abutting on a main road, a van, after the manner of Y.M.C.A. and Church Army tea-vans, labelled "Mobile Snacks," with a reference to tea, coffee, biscuits, cakes, etc. This innovation (from the civilian viewpoint) ought to serve a very useful purpose if the effort is sufficiently multiplied.

The Voice of Authority

A FRAGMENT of conversation reached my ears in the course of a recent Sunday evening jaunt. Two boys were gyrating about a suburban road, and one called out: "When I back-pedal I go backwards." His companion evidently rejected this assertion as bordering on the insane, whereupon the first boy shouted: "Of course I do, you liar! This is a fixed gear!" So now you know!

Odious Comparisons

AN acquaintance of mine, alarmed to find that he was putting on weight, dashed off to his doctor for a spot of advice. The medico said: "Let's see: you play cricket, don't you? *That* ought to keep your weight down." The patient replied: "Haven't had a game for weeks: every Saturday afternoon recently has been wet." Without bothering to verify the latter part of this statement, it may be put on record that not for many weeks past have I failed to go for my usual Saturday afternoon ride. The weather has certainly been of the mixed variety, with an occasional thunderstorm to add to the joy of living, but the cricket formula, "Rain: no play," has no application as regards cycling—not as regards my sort of cycling, anyhow. If, as Shakespeare may have said, comparisons are odious, let them remain so. Others may have their recreation programme interrupted by the weather. As for me, I carry on—irrespective! I have not much use for an outdoor pastime which is ruled by the climate.

Rather Nauseating

THE multitude of writers—at least two of 'em—who contribute to *The Radio Times* under the pen-name of "The Broadcasters," said recently, in a comment on the Isle of Man T.T. Cycle Race, that "a half-mile ride to the station is enough for us." The same ghastly idea was voiced in the preliminary broadcast of the race, which I happened to hear. Having stated the total distance of the course, the speaker added something to the effect that any of his listeners who used a bicycle to go to the shops (or the post office) and back would appreciate what that meant. A first-class platitude which is quite devoid of the truth—and which would have been better left unsaid! Why cannot the B.B.C. arrange to publicise a special event such as this race by employing somebody who knows something about cycling, and is in sympathy with the pastime? (By the way, Jack Holdsworth, who came on the air a little later—nobody will doubt *his* interest in cycling!—made a curious statement which is worth repeating. He said that many of the competitors carried drinking vessels on their "front" handlebars! Nevertheless, there were no tandems or triplets or quads in the race!)

Talkie-talkie

WHAT a delight it was, on an evening early in June, to give a lantern-talk to an audience of enthusiastic cyclists and photographers, who completely filled the hall, even to the extent of standing in the gangways and cluttering-up the entrance and the stairway landing! This was an extremely pleasant experience (reminiscent of my earliest lecturing efforts 25 years ago), especially as the populace had manifestly come with the intention of enjoying themselves, thus making things so much easier for me. Moreover, the amenities had been efficiently looked after and were just what I desired. When my hour's talk was over, I stepped off the platform to be greeted by many friends, old and new, and that experience was also pleasant.

In view of the tremendous appeal made to millions of people by the cinematograph, it is interesting to discover that so many folk retain their interest in still pictures, accompanied by the spoken word in natural and undistorted English. It is evident that the well-named *magic*-lantern retains much of its popularity despite the vogue of "the flicks." It is still a power for good.

Reiteration

THE extremely pleasant Welsh county of Montgomery indulges in the useful habit of erecting metal roadside signs giving, in very clear lettering, the name of the village which lies just ahead—a habit which might advantageously be copied generally. But Montgomeryshire spoils the effect of this excellent plan by adding the words (picked out in reflecting devices): "Drive Slowly." In my view, it is not of necessity imperative to "drive slowly" through every village (such a place as Thame, Oxon, for example), and it appears to me that the general application of such an injunction destroys its purpose. In other words, "Wolf!" is cried so frequently that it falls on deaf ears. The information that a village is at hand should surely be sufficient to put each one of us a bit more on the *qui vive* than usual, but I am convinced that it is not necessary for one's speed automatically to be reduced. The fact that nobody, broadly speaking, takes the slightest notice of the injunction stresses the complete lack of value of the message proclaimed in so wholesale a manner. Moreover, this regular parrot-cry may come to be ignored where it is really necessary. That is the danger which the authorities in the "Drive Slowly" county, and elsewhere, might bear in mind.

Well-oiled

FRANKLY, I am a neglecter of bicycles, having no use whatever for the eternal cleaning in which some people revel. But I do see to the process of lubrication from time to time, and my chain, in particular, is well soaked in a thick oil, to which is added a modicum of dirt—and sometimes a bit of bracken! The wisdom of this policy—I mean so far as the oil is concerned; I claim no virtue for the dirt and the bracken!—was seen at Whitsuntide, when I carried out a four-day and one-evening jaunt of 311 miles, mostly in wet. When it was not actually raining, quite a lot of juice was being thrown up from the roads. At the end of that short tour the chain was still running satisfactorily. Indeed, with lots more rain at the two following week-ends the chain continued to "do its stuff," and then I condescended to renew the fat which ensured sweet and silent running. Let "well-oiled" be the watchword in connection with chains, and little trouble will be experienced.

A Matter of Ethics

A FIRST-CLASS caterer of my acquaintance, whose house exhibits the C.T.C. sign and also one provided by a well-known bread firm, but who is no longer very keen on supplying "chance" meals (unless somebody thinks of mentioning my name!), owing to the growth of her residential trade and to current food difficulties, was challenged recently by a caller. The would-be eater wanted to know why a "Teas" sign was displayed when teas were not available, and the caterer's reaction to that obvious question was that surely she could attach to her own house whatever signs she liked. I suppose that there is a measure of truth in her remark, but it may be placed on record that the Good Book contains something to the effect that, while all things may be lawful, they may not be expedient. My own view is that caterers who are not catering should take down (or cover up) their signs, not only in fairness to the travelling public, but in their own interests. If they will not do so, then they deserve to be pestered with a procession of callers, on an organised plan, whose importunities would be calculated to cure obstinacy as to "rights." I am sure that, in the long run, it does not pay to mislead the public. This suggested concealment of signs applies more especially to those which specifically proclaim "Teas." The signs of the cycling organisation do no more than indicate establishments which cater, in one way or another, for cyclists—without any definite promise.

Joy-town

I HAD time on a Saturday afternoon in May to loiter in the gracious Shropshire town of Ludlow. What a joy-town it is! Built on a hill, with old-world buildings (including an ancient castle), a magnificent church (which deserves to be a cathedral), and the narrowest and most awkward streets imaginable, Ludlow is a place of infinite charm. No wonder that Mr. A. G. Bradley characterised it as one of the most beautiful and distinguished of our country towns. Strictly speaking, it has no place in the modern scheme of things, and its "faults" can be cured only by destruction and reconstruction, which nobody dare suggest. For traffic in a hurry some of the difficulties have been alleviated by the provision, in part, of a through route, but so far as I am concerned, I can never be anxious for a quick get-away where there are Ludlows to be seen.

Homeless?

ONE often asks, facetiously, on finding a lot of cyclists and other outdoor folk littering a catering establishment—especially on a wet day—whether these people haven't homes in which they can stay, or to which they can go. (Of course, the question is a boomerang, which recoils on the inquirer!) The point recurred to me on a wet June Sunday—or shall I say on one of the wet Sundays in June?—when, on arriving (hopefully) for tea at my usual house of call I found it smothered in cyclists and ramblers. The latter, with their moist rucksacks and waterproofs (tell me, somebody, what these jolly hikers put in their bulky rucksacks when they go out for a day's tramp, part of which is done by train or bus!), were in possession of the whole of the accommodation, while the cyclists, with more or less patience, found bits of shelter in odd corners of the cottage and under the adjacent trees and hedges. I counted a company of nearly 60 "homeless" but enthusiastic people, and it was good to see them—and to share the inconvenience which was general. Some of the cycling boys and girls had been abroad since early in the morning, participating (or helping) in their Club "50," and as a persistent believer in and exponent of enthusiasm, I thanked "whatever Gods may be" for this display on the part of both sections, the trampers and the wheelers. I applaud red-hot enthusiasm—however wrong-headed it may seem to the stay-at-homes—wherever I find it.

Well, or Not at All!

"IF we're going to signal," said my companion, holding out his right arm like a railway semaphore, "*signal!*" I concurred. Actually, I do mighty little signalling, my preference being for making sure, visually, that any contemplated change in my course can be effected safely. Better, it seems to me, no signalling at all than the anæmic methods which are so popular with certain cyclists. Just as, according to a French scientist, speech is given to us so that we can conceal our thoughts, so (it appears to me) some cyclists signal with the idea of not letting anybody know what they propose to do! So, if we signal, let's do it clearly, leaving no doubt in the minds of others as to our intentions. Also, let us remember that the giving of a signal carries no privilege. We must still make sure that it is safe for us to do what we have in mind. This statement applies particularly, of course, to a right-hand turn. To signal and then immediately turn to the right is to invite yourself into the next world long years before you are due there.

Care Required

CYCLISTS who meet with even slight injuries in these days would do well to bear in mind that care is required if the possibility of serious effects is to be avoided. Whether or not we are aware of the fact, the probability is that not one of us is really on top of his form. Six years of indifferent feeding, combined with the strain set up (unconsciously, perhaps) by war conditions, have resulted in the populace being below par. We do not possess that resistance to infection which normally is ours, and we are therefore liable to "catch" things. The special point to be made here is that even a trivial hurt should receive speedy attention. The smallest wound should be cleaned up and treated with antiseptic at the earliest possible moment, and looked after during the healing process.

Counsel of Perfection

IN such a climate as we "enjoy"—nevertheless, I believe it to be the best in the world—it seems to me the counsel of perfection to advise cyclists not to roll up their capes when wet. What does one do with a cape in the April-like conditions which have recently been our portion?

Why Not English?

ONE sees periodical references to the "Tour de Wrekin" and the "Tour de Trossachs." This quite unnecessary recourse to a foreign language strikes me as being just as fitting as the printing of menus in French. Why not use English? In any case, is "Tour *de* Trossachs" correct?

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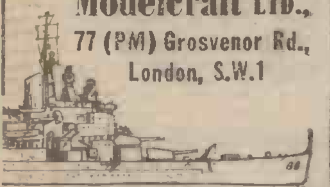

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Practical Mechanics. August, 1946.

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