MODEL ENGINEERING PRACTICE
NEW SERIES

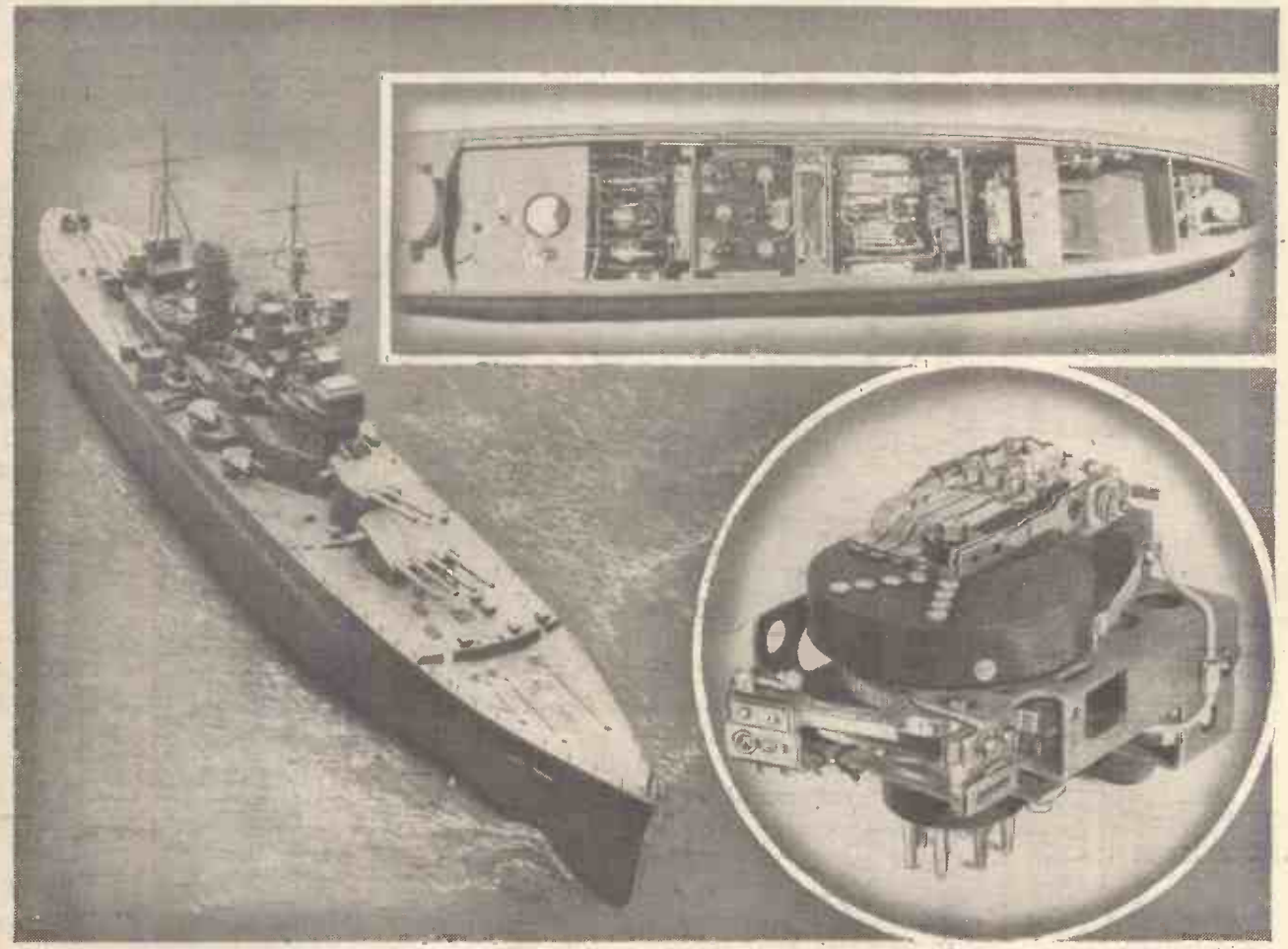
NEWNES

PRACTICAL MECHANICS

9D

EDITOR : F. J. CAMM

JULY 1949



A RADIO-CONTROLLED MODEL BATTLESHIP. FOR CONSTRUCTIONAL DETAILS SEE PAGE 299.

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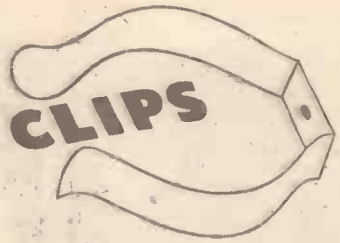

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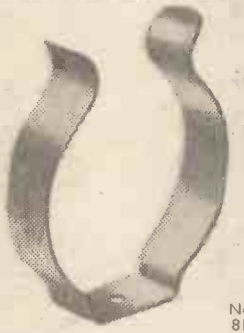

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PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XVI JULY, 1949 No. 189

FAIR COMMENT

By THE EDITOR

Big Ben's Birthday

THE ninetieth birthday of Big Ben or, more accurately, the Westminster Clock, installed in the Houses of Parliament and first set going on May 31st, 1859, reminds me that during the war I wrote, at the request of the Ministry of Information, an article on this clock for a journal which was circulated to the troops and to the members of the resistance movement in France, Poland and other continental countries. The chimes of Big Ben are known the world over and they symbolise the spirit of Great Britain and the principles of democracy. During the war the chimes of Big Ben were silent for security reasons, and it was felt that an article dealing with it would help to maintain the spirit of our soldiers and our allies in the dark days when defeat seemed not impossible. The time signal from Big Ben which Londoners treat with the contempt of familiarity arouses nostalgia in all those British citizens abroad, whether on land, afloat or in the air. As a result of that article I received many hundreds of letters of appreciation from sailors, soldiers and airmen.

The clock was designed by Lord Grimthorpe and constructed by J. and M. Dent. The design was commenced in 1854 and he introduced what was considered to be a new form of escapement—the double three-legged gravity type. Lord Grimthorpe, however, really took his idea from an earlier invention by J. M. Bloxham, who was a barrister, and Lord Grimthorpe was compelled to adopt it after the failure of his own efforts to produce a satisfactory escapement.

The clock tower is 40ft. square and there are four dials 180ft. above ground level. Each of the dials is 22½ft. in diameter, or nearly 400 sq. ft. in area. The divisions and chapters are part of a cast-iron framework and the spaces are filled with opalescent glass. The hour figures are 2ft. long and the minute spaces 1ft. square. The hour hands are of cast gun-metal and solid, but the minute hands are for purposes of lightness tubular and made of copper, with inserted diaphragms at intervals for the sake of strength. The copper tubes are tapered and closed at the tips, their open ends being fitted to gun-metal centres which also form the counterpoises. Each minute hand measures 11ft. from its centre of motion to the tip, and the counterpoise extends for 3ft. The load on the clock when the hands are subjected to the pressure of a high wind or covered with snow can readily be understood.

Big Ben is not, of course, so accurate as the pips and its signal may be a few seconds out each day. The Big Ben signal could not, for example, be used as a check when rating a watch for the Kew A or Admiralty tests, but it is sufficiently accurate for all practical purposes. A reminder that it is the *first* of the strokes which indicates the time and the *last* of the pips.

The New Screw Thread

THE adoption of the new "Unified" thread form has now been officially ratified by the signing of the "Declaration of Accord." The present position is that a provisional specification for the new thread series is being issued by the British Standards Institution, and that it will be available for use by industry. It will eventually be adopted by Government departments.

While the immediate impulse for unification of British and American screw thread practice came from interchangeability difficulties during the late war, it will be appreciated that such a unification would be of great value to Anglo-American trade in peacetime.

The technical side of the investigation leading up to the adoption of the "Unified" thread form was carried out in the Engineering and Metrology Divisions of N.P.L., Engineering Division concerning itself with the strength aspect. It has been found that in general the new form is somewhat stronger than the Whitworth, though the difference is only marked in cold rolled threads.

Owing to the high degree of interchangeability between the B.S.W. and Unified thread forms, during the period following the introduction of the new form, combinations are likely to occur of nuts of one form on bolts of the other. Tests show that no loss of strength is occasioned by such "crossing," except possibly in the case of high tensile nuts, the use of which is in any case undesirable from the strength aspect.

ION Exchange Resins

THE discovery of ion exchange resins by the Department of Scientific and Industrial Research is one of the most remarkable results of the Department's work. These resins were discovered by Holmes and Adams in 1934, and one class of these substances is synthetic resins which are really insoluble organic acids. If, for example, a weak salt solution is passed through a tube containing granules of one of these resins the sodium ions in the salt are exchanged with the acid group in the resin, so that what comes out of the tube is weak hydrochloric acid. Holmes and Adams prepared other inorganic materials which contained basic groups so that weak acids passing through them came out as water. Thus, if ordinary tap water was passed through two tubes in series containing two varieties of resins, what emerges is comparable in purity to distilled water. Sea water, for example, treated in this way becomes drinkable. After a time, of course, the ion exchange resins become exhausted, and then they have to be regenerated like the natural base exchange substances, but this can be done quite simply. The Department took out world-wide patents for this discovery which have proved of considerable value to the nation, and the royalties are bringing in a goodly sum in dollars each year.

Hitherto, the application of the discovery has been to water softening for domestic and industrial purposes, but it has also been applied to the recovery of metals such as copper and nickel from solutions, and the purification of sugar in the treatment of many trade effluents. They are also of use in the preparation of rare metals and the products of uranium and fission. These ion exchange resins will play an increasingly important part in industrial chemistry in the future.

Thomas Gray Memorial Trust Award

IN recognition of the remarkable skill which is so constantly displayed at sea the Council of the Royal Society of Arts offer an award of £50 to a member of the British Merchant Navy for a deed brought to their notice which, in the opinion of the judges to be appointed by the Council, is of outstanding professional merit. The award will be made under the Thomas Gray Memorial Trust, the objects of which are "The advancement of the Science of Navigation and the Scientific and Educational interests of the British Mercantile Marine."

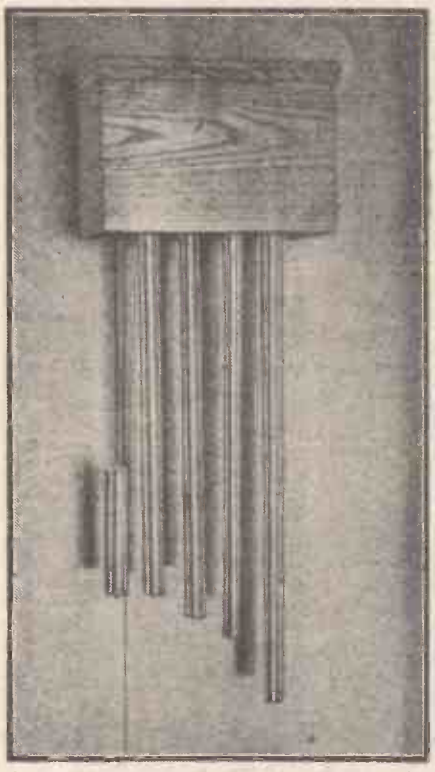
The period to be covered by the offer will be the year ending September 30, 1949, and the judges will proceed to consider their decision on or after January 1st, 1950. Deeds of a character worthy to be considered for this offer may be brought to the notice of the Council by any person not later than December 31st, 1949.

Growth of Research Associations

CO-OPERATIVE research associations have forged ahead since the war, but their work has not been looked upon altogether favourably in some quarters. A suggestion has been made that the money spent on the associations would produce better results if it had been spent by firms in their own laboratories. Let us quote a few figures: A subscription of, say £250 a year in the case of a big firm, or £25 or even less in the case of a small firm, entitles them to participate in research costing many thousands of pounds a year. Very little research could be obtained for the same expenditure in the firm's own laboratories, and we must remember the survey carried out by the Federation of British Industries which revealed that the cost of employing a single qualified scientist in properly equipped scientific research laboratories worked out at £2,500 a year.—F. J. C.

Making Westminster

Constructional Details of an Interesting



The completed chimes.

IN the May, 1948, issue of PRACTICAL MECHANICS a description was given of a simple door chime giving two notes. While this type of chime is effective, beautiful and quite musical, a desire for something more unusual inspired the writer to attempt a device which would ring "Westminster" chimes every time the door bell-push was pressed.

Since a search revealed no literature on the subject, the task was undertaken from first principles, and so entailed some entertaining experimentation, which eventually led to the satisfactory result which is here described.

The Westminster chimes are played on four notes, G, C, D, E, played in the order:

1	2	3	4	5	6	7	8
E	C	D	G	G	D	E	C

It is therefore necessary to have four gongs and to strike each gong twice in the cycle. This can, of course, be arranged in many ways, but for simplicity it was decided to use a camshaft fitted with four double cams, and to rotate the shaft by means of a clock weight so that, on release by a relay-operated trigger, the shaft makes one complete revolution before coming back to its stop, resetting the trigger in the process. A uniform speed of rotation is achieved by making the shaft drive a clock mechanism from which the spring and escapement have been removed, and to which an air-paddle on the fastest spindle has been fitted. The gongs consist of brass tubes, as in the usual two-gong type. A feature of this design is that the operation of the chimes is not affected by the duration of the contact at the bell-push. As soon as the button is depressed the apparatus commences its cycle, and will complete it whether the circuit continues to be closed or not. If the visitor continues to press the bell the cycle will simply repeat.

The Gongs

Reference to a book on physics revealed that the frequency of a musical note doubles in every octave, i.e., the frequencies of two notes an octave apart are in the ratio 1 : 2, the higher note naturally having the higher frequency; that an octave consists of twelve equal semi-tone intervals; and that the natural frequency of vibration of a tube varies inversely as the square of its length. It was therefore possible to construct the table (see opposite page), giving the relative frequencies and lengths for a full octave.

The "relative frequency" column is constructed by inserting 11 geometric means between 1 and 2, and the "relative length" column is obtained by dividing 1 by the square root of the corresponding relative frequency.

In the present case we are only concerned with the notes G, C, D and E, but the full octave is given for the benefit of those who may wish to construct chimes giving other tunes.

The actual lengths, diameters and thicknesses of the tubes are immaterial, provided that the lengths are in the proportions 1.000: 0.866: 0.817: 0.773, and that the diameters and thicknesses of all the tubes

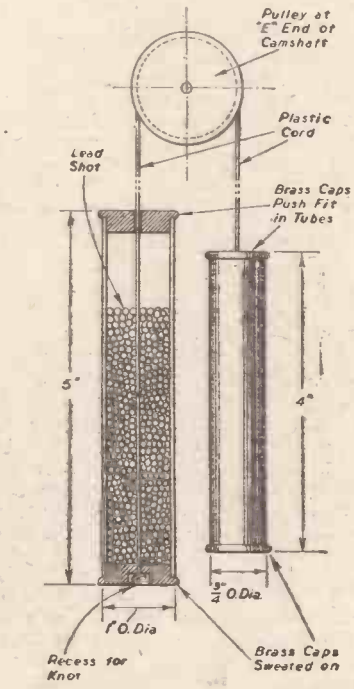


Fig. 4.—Details of weight assembly.

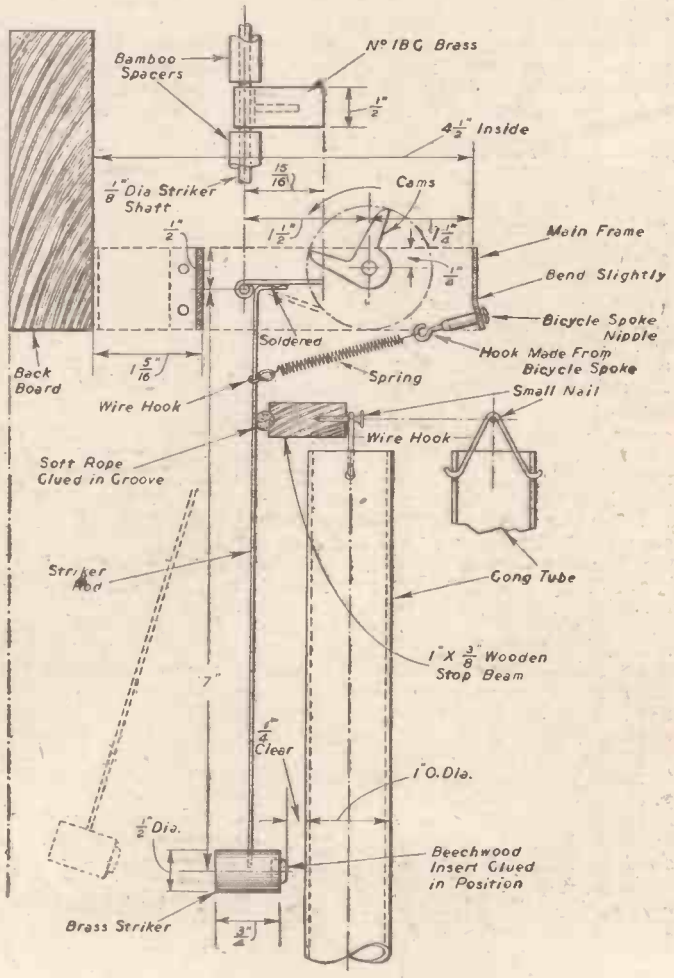
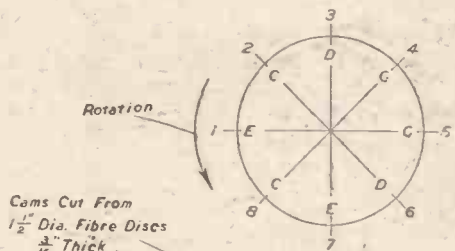


Fig. 1. (Right)—Details of the striker mechanism.



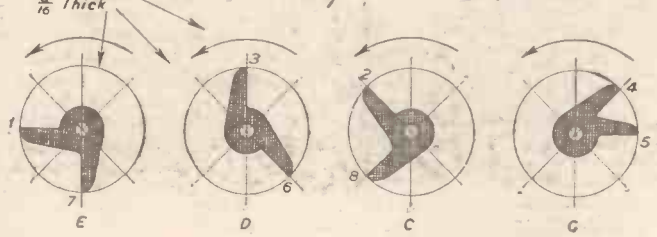
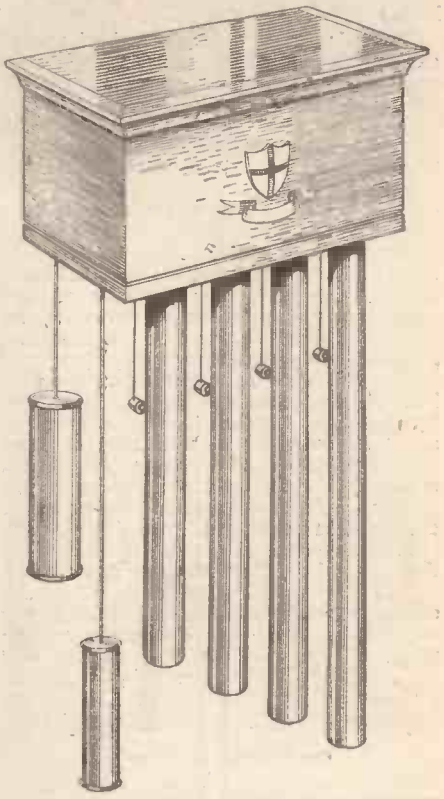


Fig. 2. (Left)—Relative position of cams, looking from "E" end.

Tubular Door Chimes

Mechanically Operated Unit.

By G. MURRAY



This sketch of the completed chimes shows the decorated box and position of the strikers.

are equal. In the present case tubes 1in. o.d. by No. 16 SWG were selected, having the following lengths:

G	20.00in.
C	17.32in. (or, say, 17 5/16in.)
D	16.34in. (or, say, 16 11/32in.)
E	15.46in. (or, say, 15 15/32in.)

It is probable, however, that larger and longer tubes, say, 1¼in. o.d. No. 16 SWG, with "G" 30in. long, would give a better tone. The suspension was done with wire loops as shown in Fig. 1 with satisfactory results, but other means, such as nylon threads, might be slightly better.

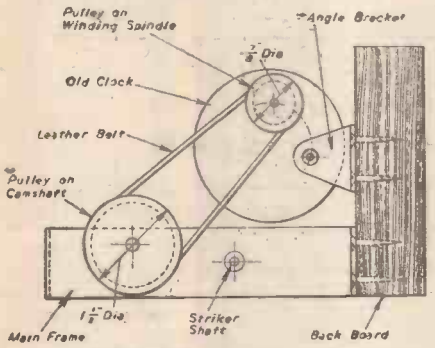


Fig. 5.—Side view of speed regulator drive.

Strikers

The principle of the strikers is illustrated in Fig. 1, from which it will be noted that when at rest the striker should be well clear of the tube. The inertia, or momentum, of the blow carries the head beyond its rest position to strike the gong, and the elasticity of the striker rod withdraws the head so that the blow is sharp. The rope facing on the stop beam "deadens" the vibration of the striker rod and so prevents repetition. The tension of the springs is a somewhat critical factor, and the correct tension was arrived at after some experimenting and adjustment. The springs used were the light type used in some armlets (for holding up shirt sleeves) and the adjustment provided consists of a bicycle-spoke nut on a threaded hook, as shown in Fig. 1.

Table of Relative Frequencies

No. of Note	Notation	Relative frequency	Relative length
1	G	1.000	1.000
2	G♯	1.059	.974
3	A	1.122	.945
4	A♯	1.189	.919
5	B	1.260	.892
6	C	1.334	.866
7	C♯	1.414	.843
8	D	1.496	.817
9	D♯	1.586	.795
10	E	1.680	.773
11	F	1.782	.750
12	F♯	1.888	.729
13	G1	2.000	.707

Cams

The cams were made of ¼in.-thick laminated bakelite (a similar tough material would do equally well) forced on to the 3/16in. diameter silver steel camshaft. Each cam is different from the other three, as indicated in Fig. 2, in which the relative positions on the shaft looking from the "E" end are shown. The method for working out the cam positions is also shown in Fig. 2. A circle is divided into eight equi-angular sectors, the eight radii being numbered 1 to 8 in a direction contrary to that of the rotation, and the appropriate note letters are set against each. The cam shapes are easily derived from the resulting diagram.

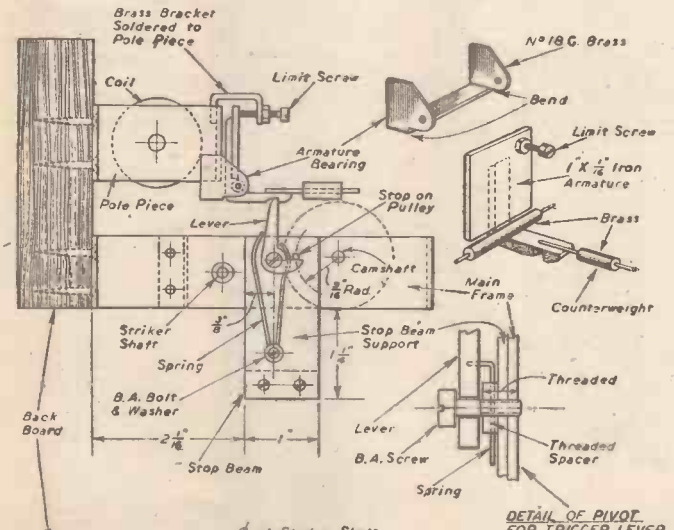


Fig. 3. (Left)—Details of trigger mechanism and relay, and section showing pivot for trigger lever.

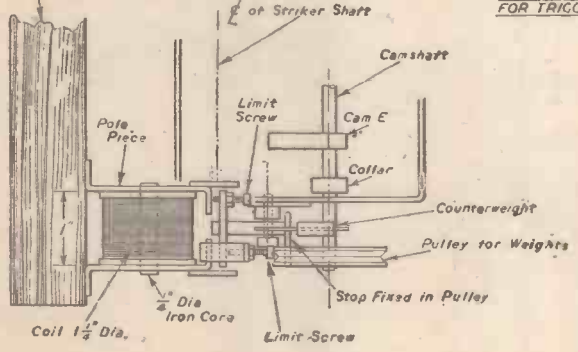
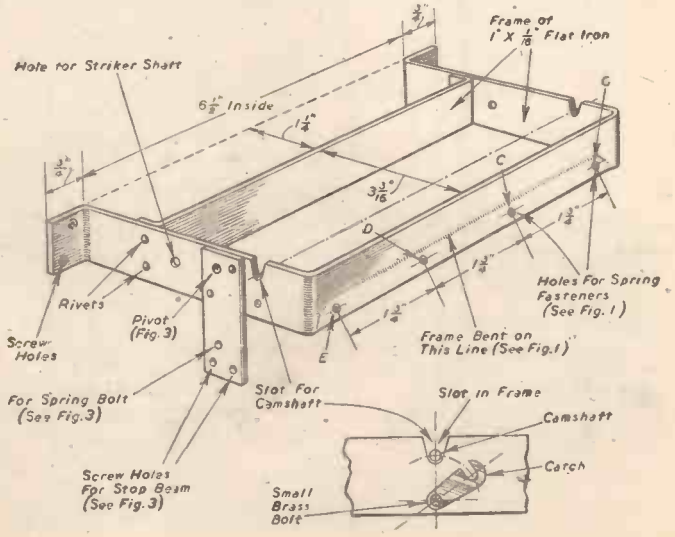


Fig. 6. (Below)—Details of main frame, camshaft bearings, and catch.

Trigger Mechanism

On the "E" end of the camshaft, outside the frame, a fibre pulley to carry the weights is fitted, with a projecting stop to engage the trigger mechanism, which is shown in Fig. 3. The lever turns freely on a spindle firmly attached to the frame and is retained in a "neutral" position by a light wire spring of the shape shown. The trigger is sweated to its spindle, which turns freely in sheet brass bearings sweated to the pole-pieces of the relay.



Relay

The pole-pieces, which form the frame of the relay, are made of 1in. by 1/16in. strip iron and the core is made from a round bar ¼in. diameter. The ends of the core are slightly shouldered and riveted into holes in the pole-pieces after the coil is in position. The armature is a piece of iron 1in. by 1/16in. by 1in. sweated to the vertical arm of the trigger. Adjusting screws with lock-nuts are provided to limit the travel of the armature. It is important that the armature should not come too close to the poles (about 1/16in. minimum) as otherwise residual magnetism may prevent proper operation, and the travel should be kept to the minimum necessary to operate the trigger.

The coil contains about 1,000 turns of No. 26 gauge enamelled copper wire and was wound on a lathe. The coil former was made by wrapping several turns of stout writing paper around ¼in. diameter rod and smearing Durofix on the paper as it was wrapped. The flanges of the former are of 1/16in. fibre-board glued to the paper tube.

It is important to grease the ¼in. rod so that it can be withdrawn after serving as a mandrel for winding the coil. It is also advisable to support the flanges of the former with metal washers to prevent splaying during winding. Electrically-minded readers may criticise and improve on this, and it is probable that the coil suggested in PRACTICAL MECHANICS of May, 1948, i.e., 2 ozs. of No. 26 cotton-covered wire, would be equally effective. The coil actually used, however, is compact and gives excellent results when operated on 15 volts A.C. from a bell transformer. It would probably work equally well from batteries. The ends of the coil wire are simply carried to terminals, mounted on the back-board, and connected into the door-bell circuit.

Weights

Considerable thought and some experimentation was devoted to devising a simple weight system which could be regulated and be easy to rewind, since the weights control the speed of operation. The arrangement finally adopted is shown in Fig. 4. This consists of two weights of different size connected by a cord of "plastic string," which is readily obtainable. The weights are made of brass tubes containing lead shot, the quantity of which can be adjusted until the proper conditions are obtained. It is obvious that the difference between the weights provides the operating torque, while the small, or counter-weight, determines the tension necessary for the driving friction. The cord should be as long as possible, consistent with the space available, so as to give as many chimes as possible between winds. Rewinding is done simply by lifting the larger weight, and therefore the height at which the apparatus is fixed should not be more than about six feet, and it should be placed in a conveniently accessible position. The diameter of the cord and the shape of the groove in the driving pulley should be combined in such a way that the cord bears on the sides of the groove, not on the bottom of it.

Speed Control

A small clock which had been discarded as beyond repair was dismantled, the spring and escapement were removed and a copper-foil air-paddle of the largest size that could be accommodated in the available space was soldered to the fastest spindle. A small fibre pulley was forced on to the winding spindle. The clock was then mounted on the back-board so that the small pulley was in line with the pulley at the "G" end of the camshaft and the two pulleys were connected by a belt made from a leather bootlace. The tension in the belt can be adjusted by rotating the clock on its mounting bracket, which is secured by a nut to one of the columns of the clock-frame (see Fig. 5).

Main Frame

This is made from 1in. by 1/16in. strip iron, bent to shape and riveted together as shown in Fig. 6, in which it will be noted that the camshaft is held in slots by means of bolted catches. This arrangement permits the camshaft, with its cams and pulleys, to be assembled complete before placing in position. The camshaft assembly is shown in Fig. 7. This shaft should run freely in the bearings but with a minimum slack and end-play, the latter being prevented by the collars which bear on the inside faces of the frame.

The striker shaft is fixed and is held in position by collars placed on the outside of the frame. The strikers turn freely on the striker shaft and are held at the proper spacing by sleeves made of bamboo cane to avoid chatter noises, slipped over the shaft as shown in Fig. 8.

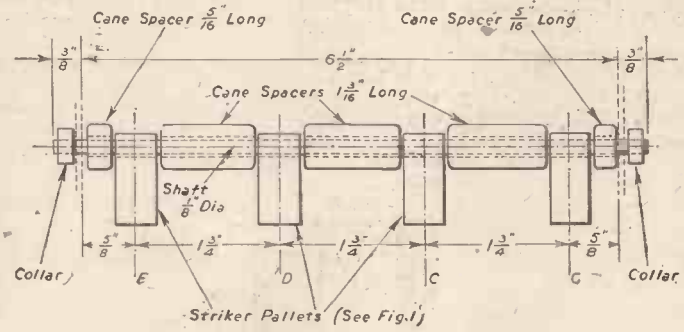


Fig. 8.—Striker shaft and spacers.

Back-board and Cover

The back-board was made from 1in. thick pine and an oak cover box was fitted as shown in Fig. 9. A decorative design in brass may be fixed to the front of the box. If the box is waxed light oak and the brasswork highly polished the general appearance is quite pleasing, but other, perhaps more modernistic, designs may appeal to other readers. The brasswork might be chrome-plated and the cover could be worked in aluminium or coloured Perspex.

The iron parts should be protected by enamelling or lacquer applied before final assembly, care being taken to remove all paint or lacquer from the bearings and other working surfaces, which should be lubricated with a good light oil applied very sparingly.

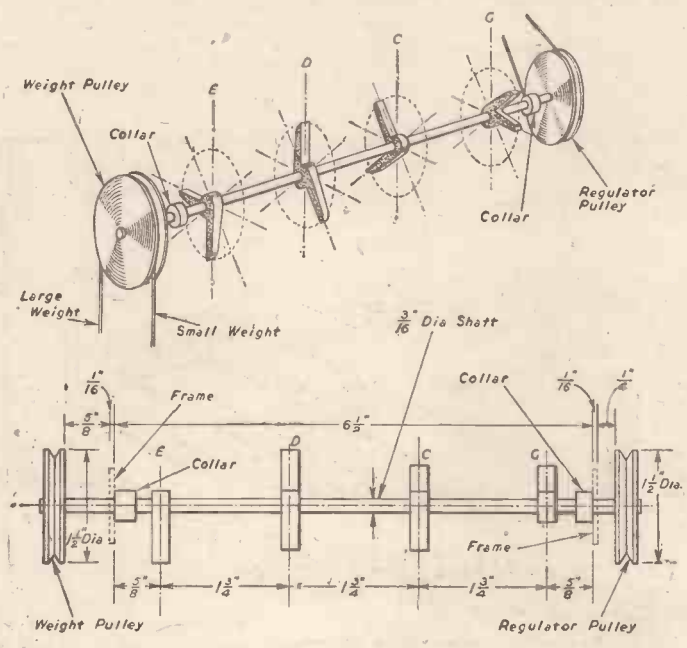


Fig. 7. (Above)—Perspective view and plan of camshaft.

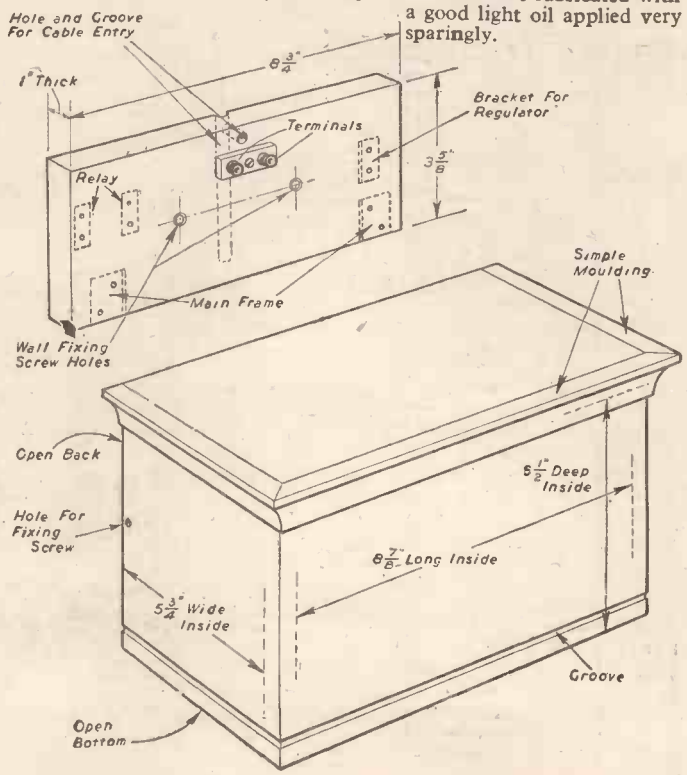


Fig. 9. (Right)—Details of back-board and cover box.

A Radio-controlled Model Battleship

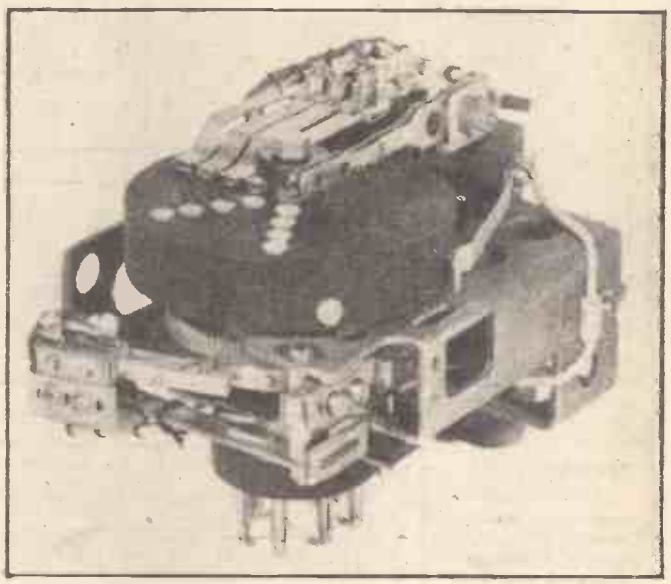
General Layout and Constructional Details

By JOHN J. CHANTRILL, A.M.I.E.E.

(Left)—The completed model battleship.

THE model is based on photographs of the *King George V* type of battleship in "Jane's Fighting Ships," no drawings or blueprints of any kind being used during the construction. The hull was carved from a solid piece of larch, a wood which proved to be rather difficult to work but which was the only kind obtainable in a large enough piece. Overall dimensions are: Length 5ft. 2in., draught 3in., and freeboard 2in.; the hull was hollowed out to leave a wall thickness of approximately $\frac{1}{8}$in. The forward part of the deck, i.e., from the bow to the second breakwater, is a fixture and is made of larch; the bow is fitted with a 3/16in. brass cap. The after part of the deck, i.e., from behind the second breakwater to the stern, is removable and is made of $\frac{1}{4}$in. plywood fitting flush into a recess so that the deck is actually split $\frac{1}{4}$in. from the edge all round. Four clips, disguised as bollards, hold the removable part of the deck in place. The greater part of the superstructure is built on this plywood deck and is made mainly from 1/16in. plywood glued and pinned to balsa-wood internal struts. The gun turrets are made from larch, with guns turned up from dowelling. The funnels and anchors are made up from sheet brass, the masts from brass rod, and the searchlights and small deck fittings turned up from aluminium rod. The anchor chains started life as cheap necklaces, while the various handrails consist of tinned copper wire soldered to ordinary domestic pins.

The after main gun turret fits into a wooden housing in the deck with a bayonet-type clip and is removable to allow access to the main battery switches without the necessity for removing the whole of the deck; similarly, the forward main two-gun turret is removable to allow access to the receiver tuning controls. The smaller guns, searchlights, and cranes may all be turned by hand if desired, while the anti-aircraft gun in the stern is mounted on an extension of the rudder shaft and serves as a useful indicator of the rudder position when the ship is sailing close to the shore.



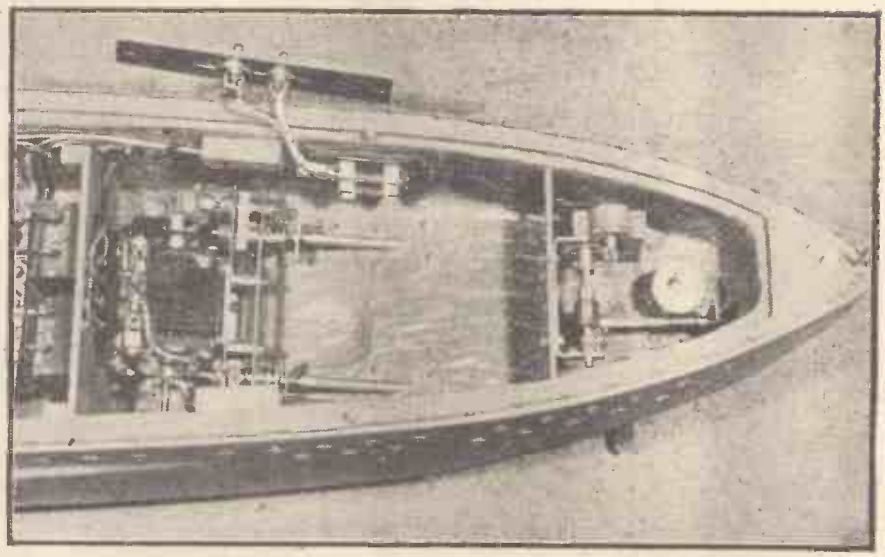
(Right)—Impulse-operated stud switch on ship. The studs on the face of the disc control the supply to the propulsion-motor field, while those around the periphery supply the armature.

Twin screws are fitted, these being three-bladed and 2ins. in diameter. They rotate, of course, in opposite directions. Propeller shafts are of 5/64in. diameter steel, and the tubes are of 5/16in. outside diameter copper fitted with brass end-caps. These tubes pass through, and are soldered to, oval brass plates fitted inside and outside the hull at the points where they pass through it. The rudder, built up from brass sheet, is fitted with a 3/16in. diameter shaft running in brass bearings at top and bottom, the latter bearing being provided with a felt water-seal.

The hull is divided into five watertight compartments by means of three-ply bulkheads glued into position, and the outside of the ship was finished with four coats of "battleship grey" paint.

Propulsion

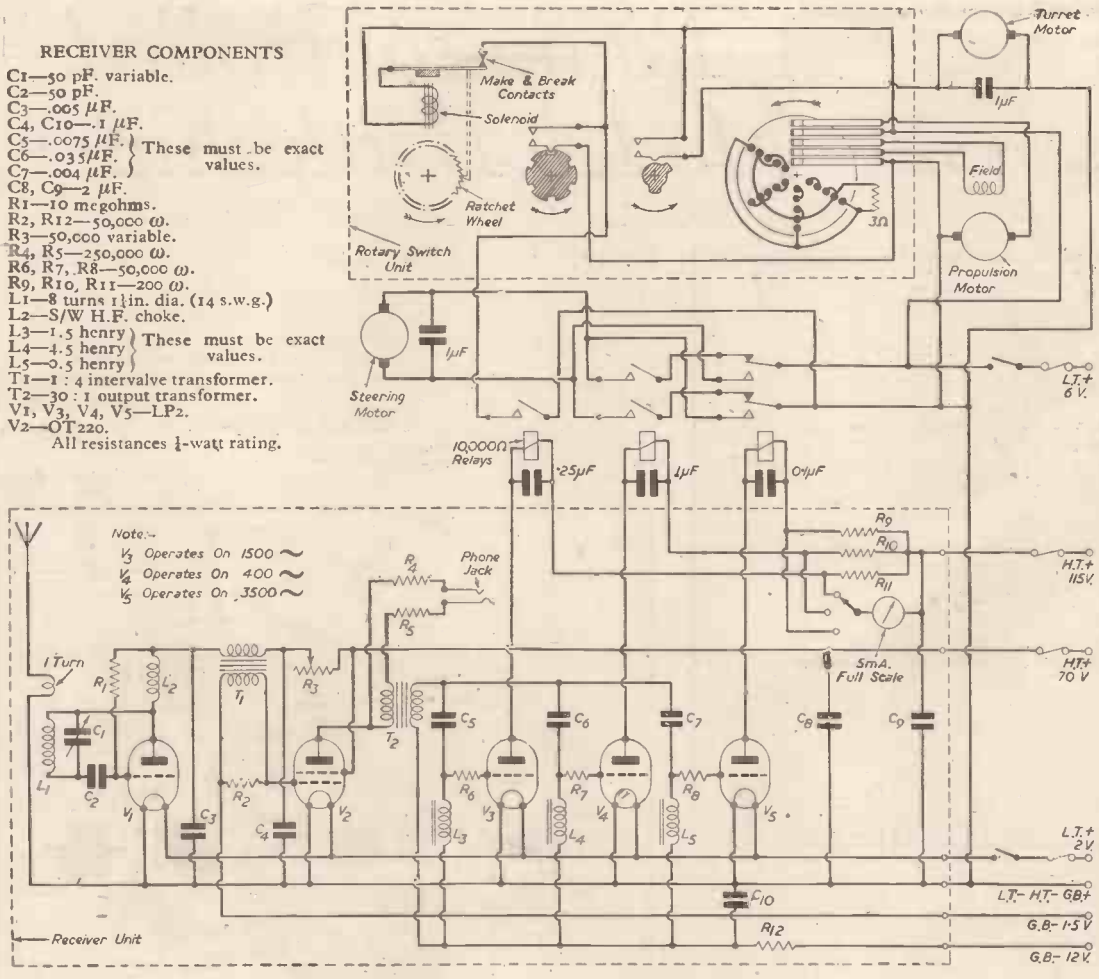
The propulsion motor is fitted athwartships and has a shaft-extension at each end. Drive to the screws is via one-to-one bevel and spur gears, these latter being necessary in order to bring the drive in line with the propeller shafts. The gearing is carried in a frame attached to the motor body, brass bearings 5/16in. long being provided for all spindles. These gears, which it was feared



Driving and steering mechanism. The propulsion motor, with gearing to propeller shafts, is on the left, while the "Electrator" steering motor with reduction gears may be seen at the right. (The battery switches have been removed for photograph.)

RECEIVER COMPONENTS

C1—50 pF. variable.
C2—50 pF.
C3—.005 μF.
C4, C10—.1 μF.
C5—.0075 μF. } These must be exact
C6—.035 μF. } values.
C7—.004 μF. }
C8, C9—2 μF.
R1—10 megohms.
R2, R12—50,000 Ω.
R3—50,000 variable.
R4, R5—250,000 Ω.
R6, R7, R8—50,000 Ω.
R9, R10, R11—200 Ω.
L1—8 turns 1½in. dia. (14 s.w.g.)
L2—S/W H.F. choke.
L3—1.5 henry } These must be exact
L4—4.5 henry } values.
L5—9.5 henry }
T1—1 : 4 intervalve transformer.
T2—30 : 1 output transformer.
V1, V3, V4, V5—LP2.
V2—OT220.
All resistances ½-watt rating.



Circuit diagram of receiver and rotary switch unit.

would be very noisy, are actually extremely quiet, and are almost inaudible when the ship is in the water. The motor is an ex-W.D. 24-volt shunt-wound motor with a four-pole field. The four field windings were found to be connected in series so these were re-connected in parallel and the motor was then found to develop ample power when run from a six-volt accumulator. This gives a screw speed of 750 r.p.m. approximately and drives the ship at about three knots. Half speed is obtained by inserting a small resistance in the armature circuit. Consumption is 1¼ amps. at full speed, and a little under 1 amp. at half speed.

Steering

A small permanent-magnet "Electrotor" motor is used to turn the rudder via a double worm-reduction gear, the final drive to the rudder shaft being via a single-plate friction clutch. This clutch is provided to prevent damage to the gears in the event of the rudder being accidentally turned by hand; it also serves to prevent the motor being stalled when the rudder reaches the limit-stops. These stops are built into the clutch housing and allow a travel of 60 degrees from the straight on each side. Steering is effected by supplying current to the motor from the six-volt accumulator in the appropriate direction until the rudder reaches the desired position. This simple arrangement, which it was thought might be "tricky" to operate, has proved to be very effective, and after a little practice quite accurate navigation is possible. The time taken to move the rudder from one extreme to the other is approximately 15 seconds.

Forward Main Four-Gun Turret

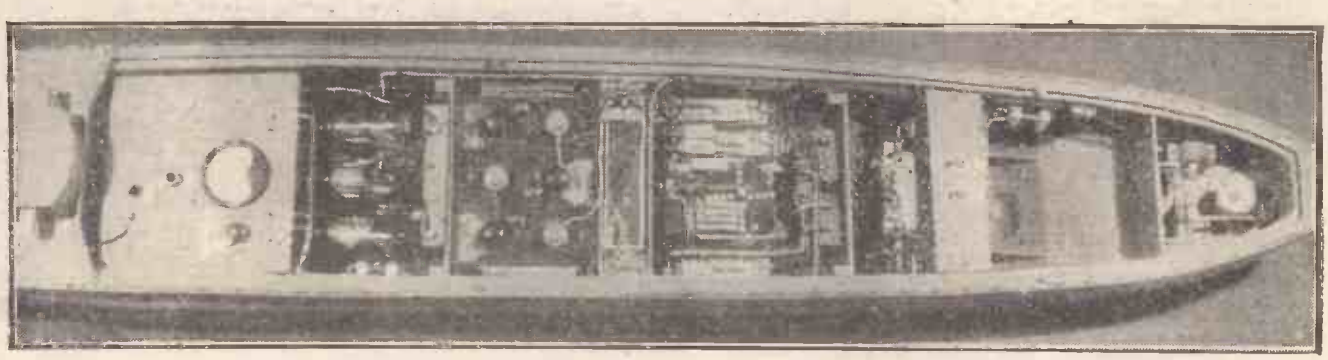
This turret is mounted on a ¼in. diameter spindle and turns in brass bearings fitted in a wooden housing built into the fixed part of the deck. It is turned by an "Electrotor" motor via reduction gearing and a crank-and-link motion which slowly turns it back and forth through a total angle of 160 degrees.

Control System

Controls provided are: Position of rudder and four positions of the propulsion - motor control switch. The forward four-gun turret can also be turned when the ship is at rest or travelling at half speed forward. Operation of the rudder control is instantaneous, while the other operations involve a delay of two seconds at the maximum. The transmitter employs a carrier frequency in the 27 Mc/s model-control band, and control is effected by means of modulation tones. Three of these tones are at present in use, viz., 400 cps., 1,500 cps., and 3,500 cps. Coded pulses of 1,500 cps. tone are used to control the propulsion motor and turret motor. The other two tones are used to turn the rudder, 400 cps. corresponding to "turn right" and 3,500 cps. to "turn left." (The nautical fraternity will, I hope, pardon the use of these terms by a mere landlubber!)

Control Equipment on Ship

The aerial on the ship consists of a section of the hand-rail around the deck, and is approximately ¼-wave. No direct earth is used, the receiver being grounded to the L.T. wiring of the ship. The receiver, in which no "miniature" components have been used, uses two-volt valves throughout, and consists of a self-quenching super-regenerative detector (LP2) transformer-coupled to an output tetrode (OT220). The output from this tetrode is fed, via a 30-1 step-down transformer, to three acceptor circuits tuned to the three L.F. tones in use. The voltages developed across the inductances in these acceptor circuits are fed to the grids of three anode-bend rectifiers and the anode circuit of each rectifier contains the winding of a 10,000 ohm relay. Thus reception of a carrier modulated by any of the three tones will result in the operation of the corresponding relay. In practice the carrier is radiated continuously and operation of the shore controls applies modulation at the appropriate frequency. The rectifiers are biased to



The rear part of the ship showing the receiver, accumulator, stud switch, propulsion motor and steering motor.

slightly beyond cut-off and the receiver gain is such that the rectifiers reach the top bend (approximately 3 m/a) at a range of about 200 yards. This is about the maximum range at which the ship can be seen well enough to be controlled. The minimum current required for positive operation of the relays is 1 m/a and this is obtained at a range of 800 yards.

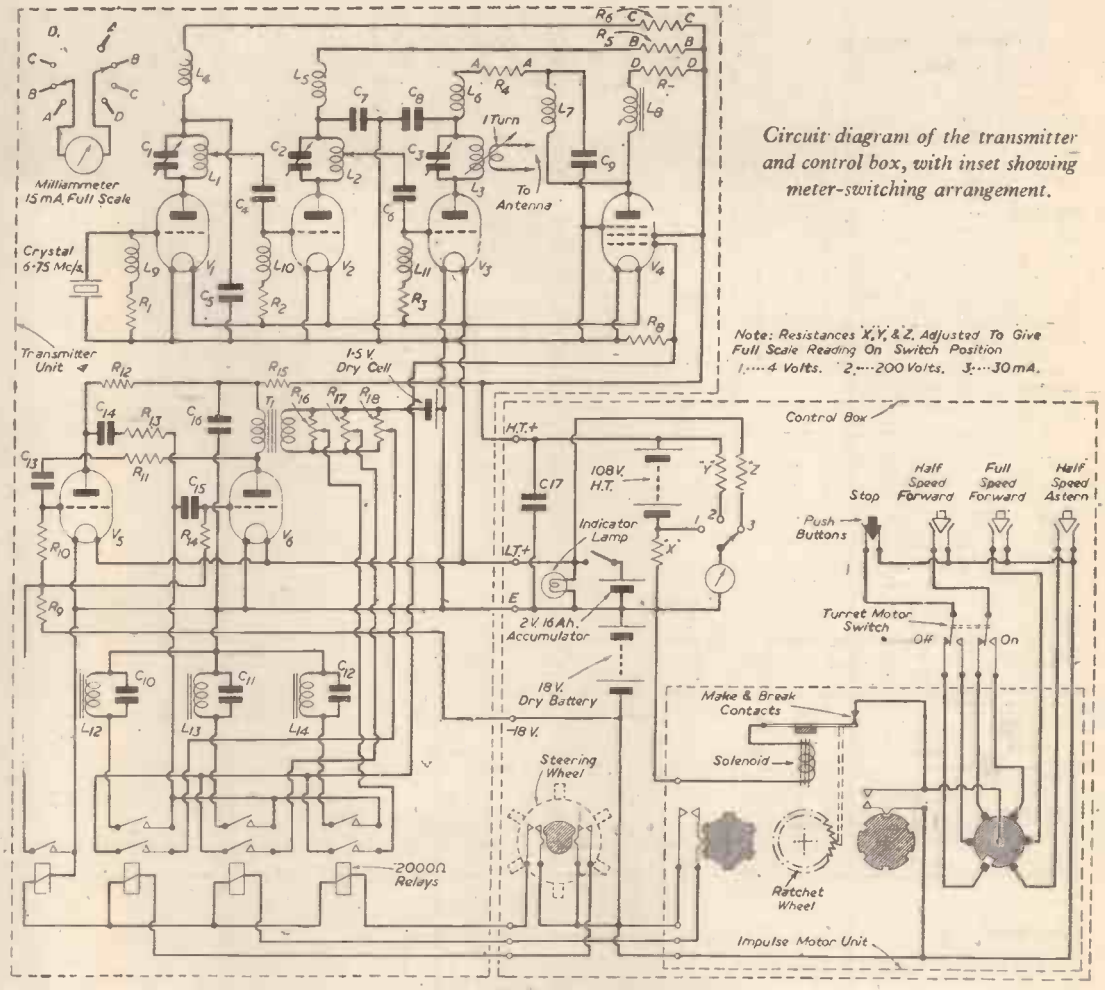
A milliammeter, with associated three-position switch, is fitted in the receiver so that the three rectified currents can be measured during the initial setting up of the transmitter modulation levels. LP2 type valves are used as rectifiers. The relay, operated by 400 cps. tone is used to supply current to the steering motor and turn the rudder to the right; similarly the 3,500 cps. relay turns the rudder to the left. These two relays are electrically interlocked to prevent blowing of the battery fuses should they be operated simultaneously by accident.

The third relay—termed the impulse relay—is used to supply current to a rotary switch which controls the supply of current to the propulsion motor and turret motor. This rotary switch was made out of an ex-W.D. "Impulse-operated Yaxley Switch" rewound to work on six volts. It consists of a solenoid-operated armature, with make-and-break, turning a ratchet wheel, and constitutes in effect a slow-speed motor. This motor has been fitted with a six-position rotary stud switch and modified so that if it is *momentarily* energised it will automatically turn through 60 degrees, i.e., one position of the stud switch, and then stop. (The motor is, of course, unidirectional.) The complete switch unit has been mounted on a seven-pin valve base and plugs into a spring valveholder in the ship. This facilitates servicing and contact cleaning. The six positions of the stud switch give the following conditions: 1.—Ship stopped; 2.—Ship stopped with turret turning; 3.—Half speed forward; 4.—Half speed forward with turret turning; 5.—Full speed forward; 6.—Half speed astern.

From the above it will be seen that to change the rotary switch from one position to another it must be momentarily energised by the impulse relay the requisite number of times to move it to the new position *in a forward direction*. A short pause must be left after each impulse to allow the stud switch to move to the next position before the next impulse.

To summarise, moving the stud switch involves the transmission of the requisite number of short pulses of 1,500 cps. tone with the necessary time intervals between.

(To be concluded.)

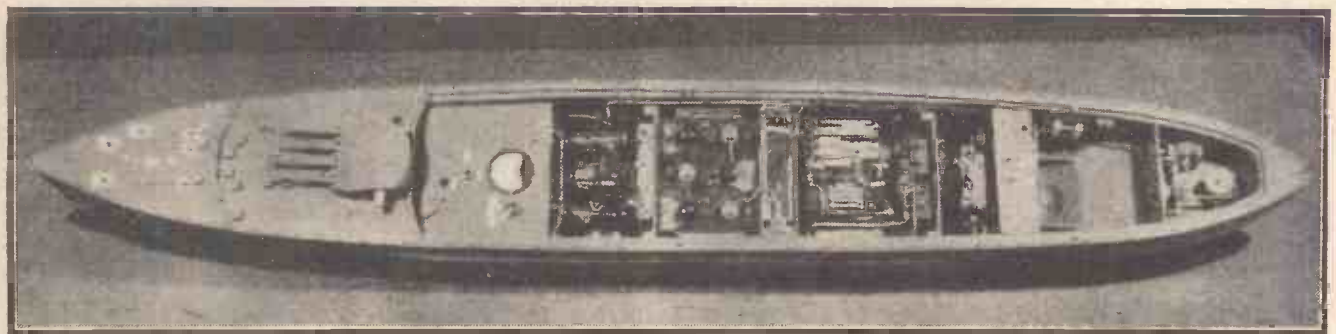


Circuit diagram of the transmitter and control box, with inset showing meter-switching arrangement.

COMPONENT VALUES

TRANSMITTER & MODULATOR
L1—10 turns 1in. dia. (22 s.w.g.).
L2—10 turns 1in. dia. (18 s.w.g.).
L3—8 turns 1¼in. dia. (14 s.w.g.).
L4, L5, L6, L7 } S.W. H.F. choke.
L9, L10, L11 }
L8—60 henry L.F. choke.
C1—75 pF. variable.
C2, C3—50 pF. variable.
C4, C5, C7, C8, C9—.001 μF.
C6—.0005 μF.
R1, R2, R3—20,000 ω.
R4, R5, R6, R7—200 ω.
R8—½ megohm.
V1, V2—LP2.
V3—P2.
V4—PT2.

L.F. OSCILLATOR
L12—4.5 henry } exact values.
L13—1.5 henry }
L14—0.5 henry }
C10—.035 μF. } exact values.
C11—.0075 μF. }
C12—.004 μF. }
C14—0.5 μF.
C15—0.25 μF.
C13—.005 μF.
C16, C17—2 uF.
R9—100,000 ω.
R10—10 megohms
R11—5 megohms.
R12—¼ megohm.
R13—50,000 ω.
R14—½ megohm.
R15—10,000 ω.
R16, R17, R18—250,000 ω. variable.
T1—1 : 3 intervalve transformer.
V5, V6—PM2DX.



Interior view of the ship. Main items contained in the various compartments (from left to right) are: Receiver, ·45-volt H.T. battery and G.B. battery. Six-volt 15 amp.-hour "Gel-Cel" accumulator. 69-volt H.T. battery. Stud-switch, relays, and associated condensers. Propulsion motor and main battery switches. Steering motor with reduction gearing.

World Air News

Fighter Development

By KENNETH W. GATLAND

THE news that a 60-ton American bomber, the Boeing *Stratojet*, has flown at an average speed of 607.2 m.p.h. over a distance of 2,289 miles, puts dramatic emphasis on the requirement for supersonic interceptors. There was a time, just before the introduction of the turbo-jet, when a fighter pilot could rely on a clear 200 m.p.h. margin in speed in dealing with a bomber. How far, by modern standards, that margin has been reduced is now apparent ; in certain cases the situation is inverted, for many present jet-fighters would actually be outdistanced by the *Stratojet*. A vigorous programme of piloted supersonic research is the only answer!

Thunderjet : America's equivalent to the Meteor. Behind this type is a whole range of supersonic interceptors, grown from a vigorous programme of piloted research.

Cutlass : A new U.S. Navy twin-jet fighter by Chance-Vought. Of unspecified top speed, it embodies swept-wings and after-burners.

Mishandled Development

The policy makers who cancelled the contract for the Miles M.52 supersonic aircraft in February, 1946, must surely now regret their decision. At that time Britain possessed a clear lead over all contemporaries in jet-propulsion, which the performance put up by the Beryl *Meteor* in climbing to 40,000 feet in 7½ minutes earlier this year serves to confirm. Indeed, no one will deny that our turbo-jet engines are still foremost in their respective classes ; the criticism is levelled at the way development has been handled such that, despite the lead given by Whittle in power plants and airframe designers like F. G. Miles, American achievement to-day is on nearly all counts in advance of our own. If the answer is economy, then it is economy at the expense of security—the example of the previous inter-war period all over again!

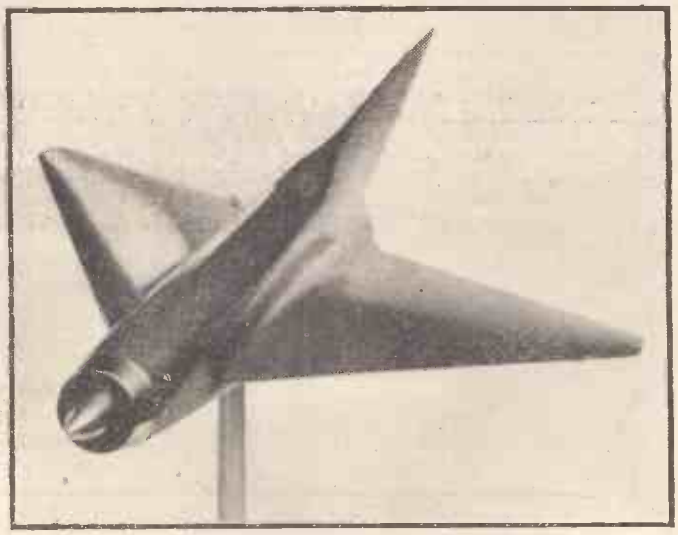
De Havilland Enterprise

Apart from the Miles venture, the D.H.108 research 'plane is the crowning achievement of British high-speed research. This is indeed a credit to de Havilland's, not only for the design of so radical a machine (which attained sonic velocity in a power-dive) but in the recognition of its need in providing data for the *Comet* jet-airliner and further military projects. If any evidence of the value of piloted research is necessary at this late stage, then the de Havilland enterprise is the outstanding example.

Finally, we have the Ministry of Supply experiments with rocket-propelled models. This programme which has now been in progress over two years has received criticism from many quarters, but after a number of failures one of the models has reached a speed in level flight of 915 m.p.h. Few, however, will wish to detract from the considerable technical achievement (credit for which is shared by Vickers, R.A.E., and the Guided-Missile Establishment at Westcott) in producing a supersonic model of so small proportions, yet fully controllable, and if the demonstration had taken place 18 months' ago, the jubilance excited by the correspondents of our national dailies would have been well founded. As it is, the event has only secondary importance when compared with the supersonic flights of the *piloted* Bell XS-1 and the Douglas D.558-2 *Skyrocket*, both of which have flown faster than sound on several occasions: the XS-1 was, of course, the first aircraft ever to do so, in October, 1947. In fact, now that the high-speed wind tunnel at Farnborough, originally designed for Mach numbers up to about 0.8, is actually giving reliable readings above Mach 0.9, there will be less work for the models. The model in question had the same external configuration as the Miles M.52, with a "straight" wing, but others still to be tested will have swept-wings or delta layout ; some, it is understood, will be tailless.

Fighters In Production

The swept-wing North American F-86, holder of the world's air speed record at 670.9 m.p.h., was the first military aircraft to obtain sonic speed in a power-dive. It is now well into quantity production as a land-based interceptor.



This model of delta-wing layout was shown by Martin-Baker at the 1948 S.B.A.C. Air Show, at Farnborough.

On the British side we have as new, or relatively new, developments, the Gloster E.1/44, the Vickers-Supermarine 510 (swept-wing successor to the *Attacker*), and the Hawker family of P.1040, N.7/46, and E.38/46. None of these aircraft are yet in active production and delivery of any single type cannot be guaranteed before 1951; it is evident that at least one, the E.1/44, will not be pursued.

When considering production of a new type the question is whether the performance is a sufficient advance over similar machines already in service to warrant a change. If there is no clear advance, then it will be better to await results of a later project rather than lay down expensive tools for an aircraft which, at the time of its introduction—perhaps one or two years later—will almost certainly be outmoded. This is, of course, not to imply that speed is the only consideration; it depends entirely on the duty of the aircraft. The Hawker N.7/46, for example, is essentially a naval fighter, and though capable of *high speed* scores on *long range* and the ease with which it is handled at *low speeds* associated with deck-landing. In this case—in conjunction with its swept-wing experimental companion, E.38/46—production does seem to be justified, but the long delay between the successful demonstration of the prototype and a production order is one further instance of the slowness and indecision which the aircraft industry has so often to face.

The Future

The discrepancy that exists in production between a machine of "F.86" calibre and a similar British aircraft requires no illustration. How the leeway is to be made up in the immediate future is open to conjecture. Should the short-term policy—of adapting existing structures to swept-wings, with the possible incorporation of after-burners—be continued, or should everything be staked on a longer-term development programme, making use of powerful axial-flow turbo-jets, after-burners, and radical design to bring forward a new range of truly *supersonic* fighter? A similar policy has already been adopted in bomber development but if, at long last, it is decided to build for supersonic flight, then it is to be hoped that some interim fighters are produced to keep our services reasonably up to standard over the next few years, because the new projects will be a long time maturing. One notes, for example, the rumour that America may shortly be supplying R.A.F. Bomber Command with *Super-Fortresses* under the Atlantic Union Defence Pact to tide us over the three- to five-year period before our projected jet-bombers become operational in quantity.

It is possible to take too large a step forward just as it is to be over-cautious, and it as well to have some well-proved fighters in service which embody the latest refinements. One feels bound to emphasise the importance of the after-burner, introducing a re-heat phase behind the turbine, which may improve the thrust by as much as 25 per cent. for short bursts of speed. Just as current prototypes have been adapted to swept-wings, so this re-heat system may be applied to existing airframes in which, perhaps, a large part of the structure is retained with a modified fuselage tail-end.

This, briefly, is the position to-day, and if any lesson at all has been learnt from American research policy since the war, the shackles will be off, and the 600 m.p.h. jet-bombers of 1953 will have supersonic companion fighters.

Mathematics as a Pastime

Problems With the Circle.

By W. J. WESTON

IN the search after knowledge for its own sake, men have, time after time, hit upon knowledge having practical bearing. This may well be the answer to an objector by a student who does "waste his time" in seemingly useless studies. For the student of mathematics, though, no answer is needed; the study is very good in itself. Dr. Samuel Johnson, we are told, practised calculation "when he felt his fancy disordered," when, we say in our hasty way, he was fed up with things. One of his calculations, as reported, contains an error that you will delight in. His Dictionary is in question: "Sir, I have no doubt I can do it in three years." "But the French Academy, which consists of forty members, took forty years to compile their Dictionary." "Sir, thus it is. This is the proportion. Let me see; forty times forty is sixteen hundred. As three is to sixteen hundred, so is the proportion of an Englishman to a Frenchman."

You must often have regaled yourself with pondering over the properties of the circle—that graceful, symmetrical figure in one plane having all points in its circumference equidistant from the centre. Two of the enthralling properties concern angles. The first is that any angle made by joining any point on the circumference to the ends of a diameter is a right-angle. Statement without proof does not satisfy, though, and you proceed to prove it, as shown in the accompanying diagram, Fig. 1.

By joining the selected point to the centre you have divided your first triangle into two isosceles triangles, the three radii being of one length. The angles α and the angles β are, as in all isosceles triangles, equal. The angle at your selected point is, therefore, a right-angle; for it equals the two other angles of the triangle ABC.

The second property concerns the angle on a chord other than the diameter. The angle in the greater part of the circle is always half that at the centre on the same chord.

In Fig. 2, where the radii makes three isosceles triangles, and where the centre is inside the larger triangle, you see for yourself that this is so when you mark two of the equal angles by α, two by β, and when you remember that an exterior angle of any triangle equals the two interior angles opposite. Just for experiment, use an alternative proof, as in Fig. 3, where the centre is outside the larger triangle:

$\angle$DOB (exterior angle) = $\angle$OCB plus $\angle$OBC (two interior angles), that is, twice $\angle$OCB (since $\angle$OCB = $\angle$OBC).

$\angle$DOA (exterior angle) = $\angle$OCA plus $\angle$OAC (two interior angles), that is, twice $\angle$OCA (since $\angle$OCA = $\angle$OAC).

$\therefore$ $\angle$DOB $-$ $\angle$DOA = twice $\angle$OCB $-$ twice $\angle$OCA (i.e. $\angle$AOB) (i.e. $\angle$ACB).

The angle at the centre equals twice the angle at the circumference.

The angle in the smaller part of the circle is always equal to two right-angles less half the angle at the centre. For example, when you draw any quadrilateral in a circle, the two opposite angles are always equal to two right-angles; if one angle is 20 degrees the opposite angle must be 160 degrees. Your lettering of equal angles illustrates the fact, as in Fig. 4.

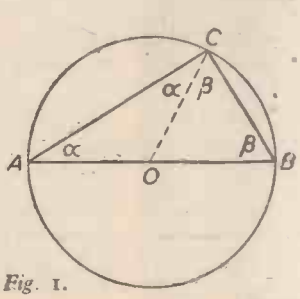


Fig. 1.

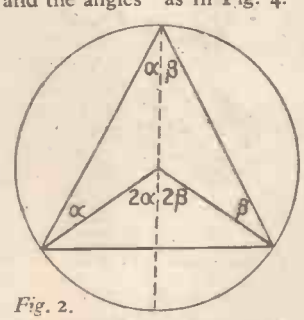


Fig. 2.

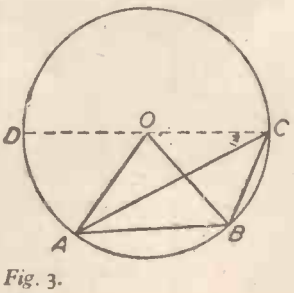


Fig. 3.

Diagrams for solving problems with a circle.

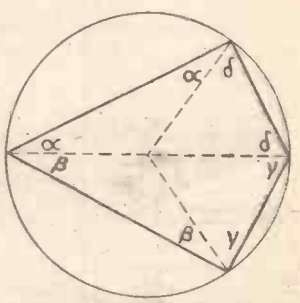


Fig. 4.—A quadrilateral in a circle.

Bristol Engine Repair Base for Egypt

AGREEMENT has been reached between the Bristol Aeroplane Co., Ltd., and Misr Airlines, of Egypt, for the establishment in Egypt of a base for the repair and maintenance of "Bristol" aero engines.

Nucleus of the base will be Misr Airlines' existing workshops at Almaza, but a party of "Bristol" technicians is to go out to Egypt to supervise extension of present facilities. They will remain there to control technical work, and a party of Egyptian engineers of Misr Airlines will be sent to Bristol for training.

Preliminary work on the agreement was carried out last December by "Bristol" sales representative, Mr. C. R. Tapper, and final arrangements were made by Capt. K. J. G. Bartlett, B.A.C., sales director, on January 17th this year, when he passed through Egypt on the freighter *African Enterprise*.

Establishment of the "Bristol" repair base is an important event for both Britain and Egypt. Many airline operators in the Middle East are already using "Bristol" powered aircraft, and their work will be greatly eased; instead of having to send engines to Britain for repair and overhaul, the work can now be done in Cairo. Consequent saving in shipping expenses should mean a considerable reduction in the cost of repairs. With modern and efficient maintenance facilities in the Middle East, it is also possible that other operators, may be encouraged to "buy British."

The Elements of Mechanics and Mechanisms—21

Water Wheels (continued)–Applied Mechanics–Geneva Mechanisms

By F. J. CAMM

Axial and Mixed Flow Turbines

ANOTHER type of pressure or reaction turbine is the axial flow, in which the water enters the wheel at its side and escapes parallel to the axis.

The mixed flow turbine is another type of reaction turbine combining inward and axial water flow, the water entering radially and leaving via the axis.

Impulse or Velocity Turbines

In this type the head of water is converted into velocity before the water impinges upon the turbine runner. The water pressure of course remains constant as it passes through the turbine, and it is at atmospheric pressure. It naturally follows that in this type air must be allowed free access to the vanes upon which work is expended due to the kinetic energy of the moving water, and it is this which causes rotation of the drum to which the vanes are attached. Impulse turbines are usually, but not always, of the radial or axial flow type, whilst in the radial flow turbine the water flow may be outwards or inwards.

The Pelton Wheel

The best known of the axial flow turbines is the Pelton wheel, usually employed where a high head of water is available. Under these conditions it is extremely efficient, often well over 80 per cent. In this type a number of cups are secured to the periphery of a wheel which is mounted on a horizontal axis, the water being fed through an adjustable nozzle into the wheel cups. The water flows axially in both directions so that the thrust is balanced.

The governor fitted to turbines is usually of the centrifugal type similar to that used for stationary steam engines. It operates the sluices, gates, taps, or other mechanisms controlling the water flow. Relay governing is generally employed in turbine operation, because the ordinary centrifugal governor is not sufficiently powerful to operate the heavy sluices and other water controls. The usual type of relay governor is the differential cylinder in which the governor operates a valve in a cylinder of high pressure oil, the latter pushing against a piston which operates the water controls. The oil is kept under pressure by means of a pump operated by the turbine shaft.

It is worth mentioning that the simple revolving lawn sprinkler is really a reaction turbine.

Having now discussed the general principles underlying mechanics and mechanisms, it is now proposed to deal with some practical applications. Of course, it is not possible to give examples of every type of mechanism, but it will be observed that those dealt with incorporate in combination one or more of the principles hitherto explained.

The Geneva or Maltese Cross Mechanism

The Geneva mechanism is a general type of intermittent gearing based on the principle of the well-known Geneva stop device used in watches and similar instruments to prevent inadvertent overwinding of main springs. In general engineering the mechanism is frequently used to convert continuous uniform rotary motion into positive and regular intermittent rotary motion, especially in automatic machine tools where a component such as a spindle carrier, turret or worktable must be indexed, i.e., rotated through a certain fraction of a revolution at regular intervals, while the machine is in operation.

A common design is illustrated in Fig. 1; a crank lever revolving with continuous (usually uniform) motion, carries a roller which engages a slot in the driven wheel and turns the driven shaft through a fraction of a revolution, according to the number of equally spaced slots. The wheel is thus definitely controlled during the period of roller and slot engagement.

It is of great importance, however, that the wheel should be definitely located during the remainder of the crank and roller revolution, otherwise correct entry of the roller into the next slot may be prevented. The commonest method of locking the wheel during its stationary period is also shown in Fig. 1; a flat locking plate shaped as a circular sector is either keyed to the drive shaft as a separate component, positioned correctly relative to the crank lever, or it may be forged integral with the crank lever (see Fig. 2).

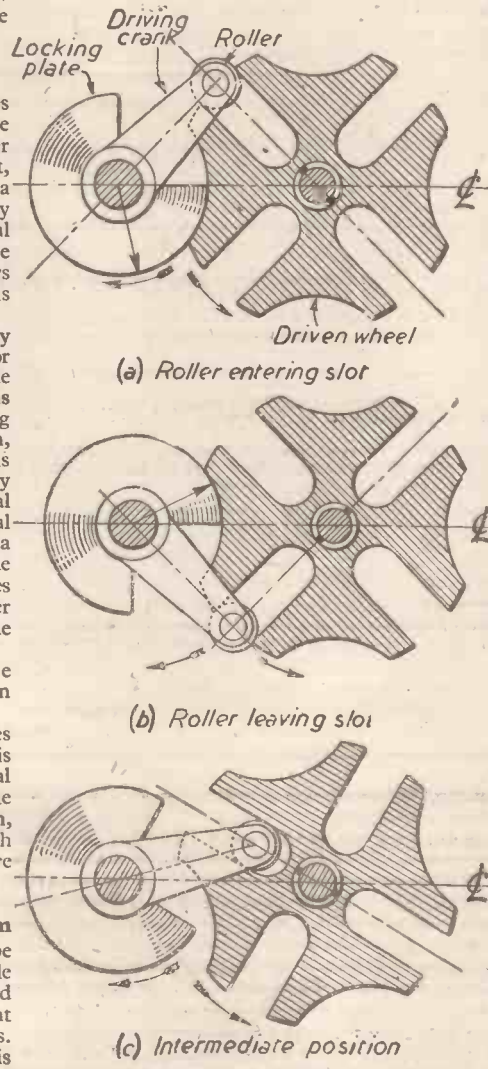


Fig. 1.—Diagram of the action of the Geneva mechanism.

As the roller tangentially leaves a slot, the edge of the locking sector engages a correspondingly shaped profile of the wheel between each pair of slots as shown, and positively locks the wheel, while at the same time permits continuous rotation of the crank.

Kinematics

The torque of the driving shaft is transmitted to the driven shaft by the roller which bears against the leading side of a slot in the wheel. Since the roller is circular, the force applied to the wheel must act in a direction which is perpendicular to the centre-line of the slot. At the instant of roller-slot engagement or disengagement, when the direction of motion of the roller centre passes through the centre of the wheel, the line of action of the roller thrust must pass through the axis of the driving shaft, i.e., tangential to the wheel, hence at these instants the velocity ratio of the mechanism is zero.

To determine the velocity ratio at any intermediate position consider a general configuration such as is shown diagrammatically in Fig. 3a. The velocity ratio is obviously the ratio of the distances of driving and driven shaft axis from the line of action of the roller thrust, and may be written as

$$\text{Velocity Ratio (V.R.)} = \frac{\text{Angular velocity of crank}}{\text{Angular velocity of wheel}} = \frac{OR}{PD}$$

But the triangles OER and EPD are similar, since angle OER = angle DEP and angle ORE = PDE = 90 deg.; therefore

$$\text{V.R.} = \frac{OE}{EP} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

It should be noted here that the maximum velocity ratio will occur when the line of action of the roller thrust is perpendicular to the common centre-line OP of the driving and driven shafts. The maximum velocity ratio can therefore be expressed as—

$$\text{V.R.}_{(\max.)} = \frac{OB}{BP} = \frac{r}{C-r} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where r = crank radius

C = centre distance of shaft axis.

Graphical Determination of Velocity Ratio

A graphical method for the determination of the velocity ratio at any instant is illustrated in Fig. 4. The velocity ratio when, say, the crank is 25 deg. from the point of the slot engagement (or disengagement) is determined as follows: a straight line OA is drawn at 25 deg. from the position of the centre-line of the crank lever at the position of slot engagement, from the axis O of the driving shaft. Point A is the intersection of the line OA with the circular locus of the roller centre. A straight line AD is then drawn perpendicular to line AP from the centre P of the wheel, to

intersect the shaft's common centre-line OP at D. The velocity ratio for the crank 25 deg. position is then determined from

$$\text{V.R. (25 deg.)} = \frac{OD}{DP} = \frac{OD}{C-OD}$$

Similarly, since OF = r and EF is perpendicular to FP,

$$\text{V.R. (35 deg.)} = \frac{OE}{EP} = \frac{OE}{C-EP}$$

Graphical Determination of Crank Position

The position of the crank at the instant of a particular velocity ratio can be determined by a graphical method illustrated in Fig. 5. For example, consider the configuration of the mechanism when the velocity ratio is unity, i.e., when the angular velocities of driving and driven shafts are the same. The construction is as follows: line of centres OP is bisected at B and semi-circles are drawn on the segments OB and BP on opposite sides of centre-line OP as shown. The point of intersection A of the semicircle BAP with the circular locus of the roller centre, then defines the required position OA of the crank when the velocity ratio is unity. As a check using equation (1) the velocity ratio

$$\text{V.R.} = \frac{OB}{BP} = \frac{OC}{AP} = 1 \text{ (by construction).}$$

A similar graphical construction applies for any velocity ratio between the extreme values O and $r \div (C-r)$. For example, if the given velocity ratio is two, then the line OP must be divided by a point B such that OB = 2 BP and the remaining construction as above.

Maximum Velocity Ratio

The maximum velocity ratio can be determined analytically from equation (2) by expressing the centre distance C in terms of the fixed angle between two consecutive slots, as follows:

$$\text{Maximum velocity ratio} = \frac{r}{C-R}$$

$$C = r \operatorname{Cos} A + \frac{(r \operatorname{Sin} A)}{\operatorname{Tan} B}$$

where

A = angle of crank from common centre-line, and

B = angle of mating slot from common centre-line, both at the instant of roller engagement or disengagement.

Also $B = \frac{1}{2}$ (angle between two consecutive slots).

Since the centre-line of the mating slot is tangential to the locus of the roller centre at the instant of roller engagement or disengagement, then A + B = 90 deg.

Therefore

$$C = \frac{r}{\operatorname{Cos} A} = \frac{r}{\operatorname{Sin} B} \text{ and}$$

$$\text{V.R. (max.)} = \frac{\operatorname{Cos} A}{1-\operatorname{Cos} A} = \frac{\operatorname{Sin} B}{1-\operatorname{Sin} B} \quad \ldots\ldots (3)$$

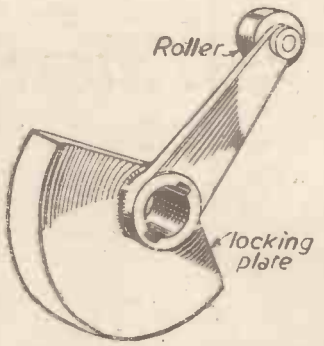


Fig. 2.—Typical driving crank and sector.

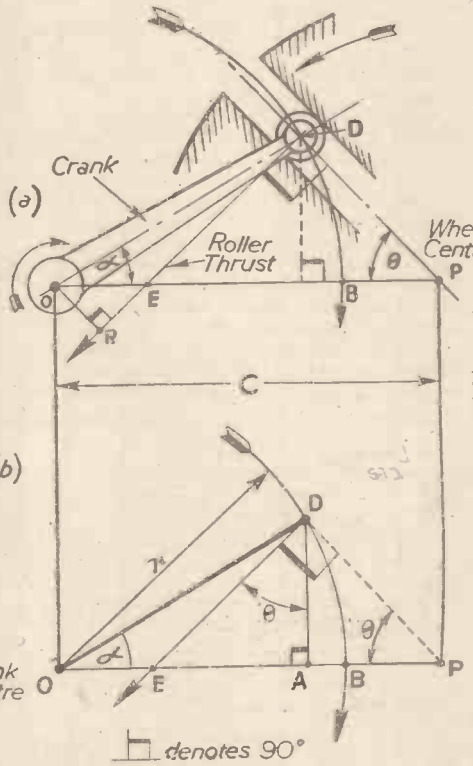


Fig. 3.—Diagram for determination of velocity ratio of Geneva mechanism.

For example, the maximum velocity ratio for a 5-slot wheel mechanism is given by

$$\text{V.R. (max.) (5)} = \frac{\operatorname{Sin} 36 \text{ deg.}}{1-\operatorname{cos} A} = \frac{.5878}{.4122} = 1.426.$$

Centre distances between driving and driven shaft axes and maximum velocity ratio values, are tabulated in a table to be given next month.

It has already been shown that the velocity ratio of the mechanism varies between the values O and $r \div (C-r)$; it remains to determine a general formula which defines the velocity ratio in terms of the constants r and C and the position of the crank expressed as an angle α.

Referring to Fig. 3b, from equation (1),

$$\text{V.R.} = \frac{OR}{PD} = \frac{OE}{EP} = \frac{BO-AB-AE}{AE+AB+BP}$$

But BO = r

$AB = r - r \operatorname{Cos} \alpha$

$AE = r \operatorname{Sin} \alpha \operatorname{Tan} \theta$

$BP = C - r$

Therefore

$$\text{V.R.} = \frac{r - r + r \operatorname{Cos} \alpha - r \operatorname{Sin} \alpha \operatorname{Tan} \theta}{r \operatorname{Sin} \alpha \operatorname{Tan} \theta + r - r \operatorname{Cos} \alpha + C - r} = \frac{\operatorname{Cos} \alpha - \operatorname{Sin} \alpha \operatorname{Tan} \theta}{\frac{C}{r} + \operatorname{Sin} \alpha \operatorname{Tan} \theta - \operatorname{Cos} \alpha}$$

But $\operatorname{Tan} \theta = \frac{AD}{AP} = \frac{r \sin \alpha}{C + r \operatorname{Cos} \alpha}$

Therefore $\text{V.R.} = \dfrac{\operatorname{Cos} \alpha - \frac{r}{C - r \operatorname{Cos} \alpha}}{\frac{C}{r} + \frac{r \operatorname{Sin}^2 \alpha}{C - r \operatorname{Cos} \alpha} - \operatorname{Cos} \alpha}$

Reducing numerator and denominator to the same common denominator gives

$$\text{V.R.} = \frac{\operatorname{Cos} \alpha (C - r \operatorname{Cos} \alpha) - r \sin^2 \alpha}{\frac{C}{r}(C - r \operatorname{Cos} \alpha) + r \operatorname{Sin}^2 \alpha - \operatorname{Cos} \alpha (C - r \operatorname{Cos} \alpha)} = \frac{C \operatorname{Cos} \alpha - r}{\frac{C^2}{r} + r - 2C \operatorname{Cos} \alpha}$$

Thus $\text{V.R.} = \dfrac{Cr \operatorname{Cos} \alpha - r^2}{C^2 + r^2 - 2Cr \operatorname{Cos} \alpha} \cdot \frac{W}{W} \quad \ldots\ldots (4)$

where W = angular velocity of wheel.

w = uniform velocity of crank.

Equation (4) is often preferred in the following form:

$$W = w \left[\frac{C - Cr \operatorname{Cos} \alpha}{C^2 + r^2 - 2 Cr \operatorname{Cos} \alpha} - 1 \right] \quad \ldots\ldots (5)$$

An equation giving the acceleration of the wheel can be obtained by differentiation of the wheel velocity equation (5) with respect to time.

Since $W = \frac{d\theta}{dt}$, $w = \frac{d\alpha}{dt}$ and $\text{V.R.} = \frac{d\theta}{d\alpha}$,

Acceleration of wheel

$$w^2 \left\{ \frac{Cr \sin \alpha \, (r^2 - C^2)}{C^2 + r^2 - 2 Cr \operatorname{Cos} \alpha} \right\} \quad \ldots\ldots (6)$$

The position of the crank at the instant of maximum wheel acceleration is defined by

$$\text{a Cos}^{-1} \pm \sqrt{2 + \left\{ \frac{C^2 + r^2}{4 Cr} \right\} - \left\{ \frac{C^2 + r^2}{4 Cr} \right\}} \quad (7)$$

M.

(To be continued)

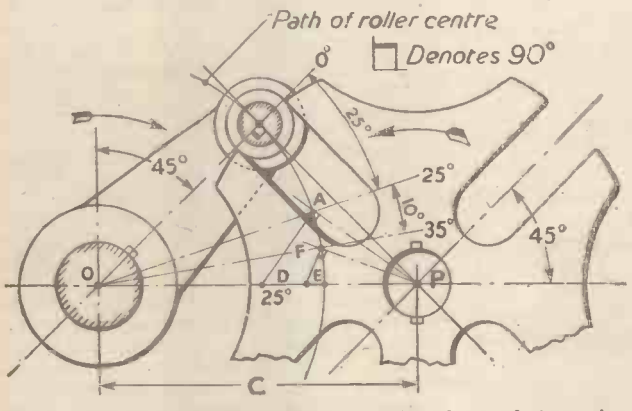


Fig. 4.—Diagram for graphical determination of the velocity ratio.

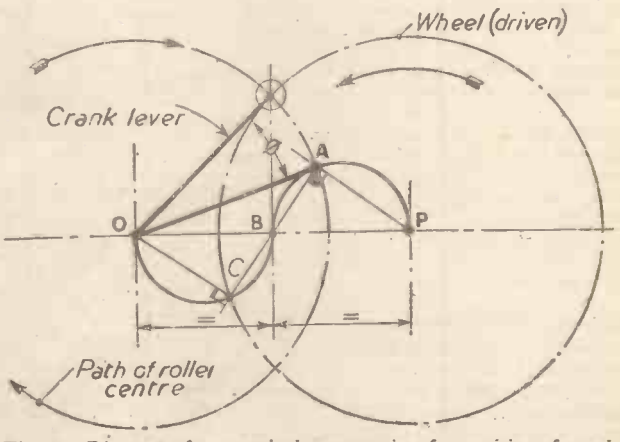


Fig. 5.—Diagram of geometrical construction for position of crank when velocity ratio is unity.

Precision Investment Moulding

Castings by the "Lost Wax" Process and Their Applications

By F. W. COUSINS

PRECISION investment castings are finding an ever-widening field of usefulness, and their use is solving so many problems of production that the fillip given to the method amounts to a boom.

The American aircraft industry has used it extensively in recent years, and some of these manufacturers were amongst the foremost exponents of the art during the war.

It has been demonstrated that the investment moulding technique, coupled with centrifugal casting apparatus, may be utilised to produce small cast components of great precision with an actual saving of hundreds of man hours, coupled with the abolition of difficult tooling operations.

The method is of great use in the fabrication of components from the chromium-cobalt-tungsten alloys, which are corrosion-resistant and extremely difficult to forge or work generally, due to their high melting points and resistance to abrasion. The melting point is too high for diecasting; they cannot be cast into intricate shapes by the usual foundry methods, and extensive finishing of intricate parts is too slow and uneconomical for mass-production quantities.

Benvenuto Cellini in the Sixteenth Century for the manufacture of artistic castings forming the exquisite statuary of that day.

The art appears to have been introduced in the early Twentieth Century by the dental profession, and a very fine article by Dr. W. H. Taggart, entitled "A New and Accurate Method of Making Gold Inlays," appears in the "Dental Cosmos" of 1907.

This ingenious process was soon adopted by the jeweller to assist in his manufactures by producing the intricate inlays so familiar to his art.

Industry was aware to some extent of the dentists' and jewellers' art, but it had not availed itself of the experience gained by these professions until the war years called for the casting of small ordnance parts in rapid time, with minimum waste of strategic materials. It would appear that the method has now come to stay as a part of normal industrial practice, and it is in the use of the method in this broad field that we are primarily concerned.

It is profitable, however, to analyse the method as used by the professions referred to, as it gives a very clear picture of the "lost wax" method in its cleverness detached from any distracting technical devices.

(e) The wax pattern is carefully removed, using the pin as a handle and the whole supported upon a circular stand.

(f) The pattern and the stand are coated with a thin layer of investment.

(g) The coated pattern and stand are surrounded by a metal ring and the ring is filled with additional investment.

(h) When the investment has set, the stand and the wire pin are removed, leaving a sprue hole to the wax pattern within the investment. The investment is heated to 1,300 deg. Fahr. approx., and at this temperature the wax pattern volatilises and disappears, leaving a cavity within the investment.

(i) The investment mould is now placed upon a casting machine and the gold run into the mould under pressure, via the sprue hole.

(j) Finally, the investment is broken away and the sprue cut off, the resulting gold casting being ready for cementing to the ivory block.

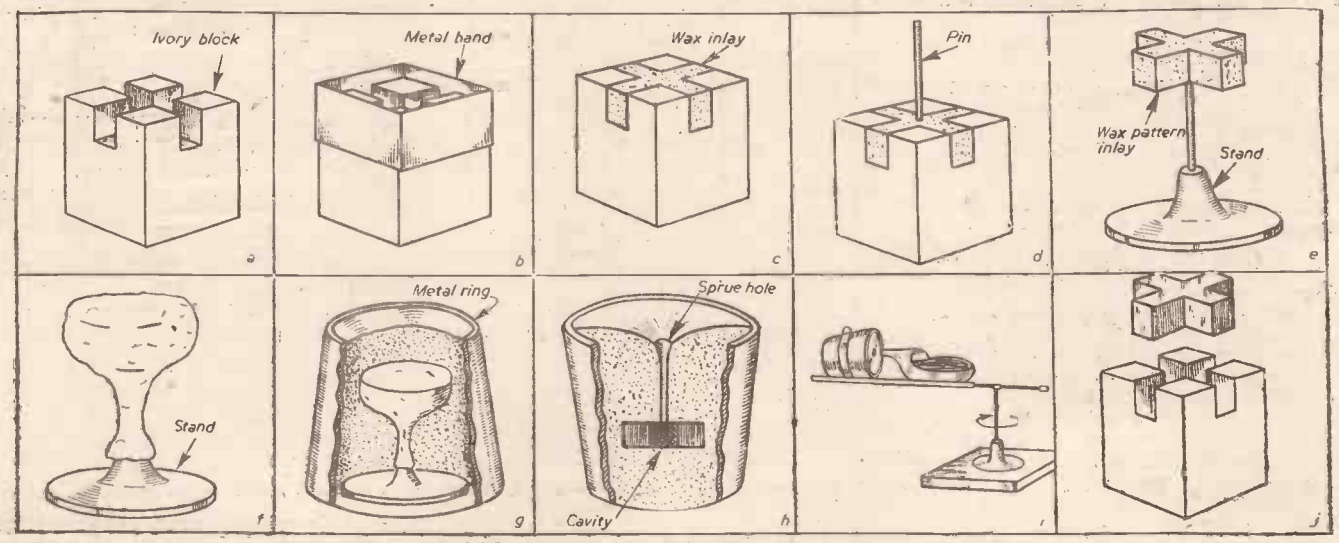


Fig. 1.—The sequence of operations for inlaying a block of ivory with a gold design.

A classical example during the frantic arms build-up of the democracies was the manufacture under the investment method of turbo-supercharger buckets used upon certain high-altitude aircraft engines. These buckets operate in a stream of corrosive incandescent exhaust gases at very great mechanical stress. The uniformity offered by the investment moulding technique allows of manufacture at high precision and reasonable cost with small man hours.

History

The investment moulding process is by no means new. In uniformity with so many now well-exploited manufactures and methods, the originators are of an almost forgotten age. It is thought that the Egyptians used an investment mould and the "lost wax" method for the production of their statuary. That may be so, but it is certainly a fact that wax patterns and plaster as a casting investment were used by

General Procedure as Used in the Jewellery or Dental Profession

(a) A block of ivory is to be inlaid with a gold design. The ivory is carefully removed, the cavity being the exact shape of the required inlay and capable of holding the inlay when completed (see Fig. 1).

(b) A metal band is placed around the ivory block and soft inlay wax pressed into the cavity. The wax is then allowed to harden.

(c)) The metal band is removed and the wax carefully scraped so that the ivory block is as it was in the beginning, except that the cavity is now filled with wax.

(d) A wire pin is inserted into the wax pattern.

Procedure Applied to Modern Practice in Industry

In the use of the method in industry, some divergence from the jewellers' art is only to be expected. In the first case a scientific study is made of the component to be manufactured, and shrinkages and distortions determined for the investment and patterns.

It is usual, if the component is of a complex nature, to make a master pattern in metal, a replica of the desired component, but oversize to allow for shrinkages.

From this master pattern injection dies of soft alloy are made, and into these dies the wax is injected to form wax patterns.

The wax patterns are then painted with investment and metal mould cases placed around the patterns; the investment is poured in and allowed to set, after which mould burn-out is undertaken and the wax volatilised, leaving the cavities within the investment mould. The mould is placed on a

centrifugal casting machine or trunnion arc furnace, during which operation the casting material is run into the mould. An air hammer is used to break away the investment and the castings are separated and shot blasted.

The finished article is a replica of the master pattern except for the calculated shrinkages.

The Investment and its Characteristics

The latest technical dictionary only refers to investment in the science of zoology and explains that it refers to the outer parts of organs; in colloquial speech investment means the act of covering or surrounding, and in the "lost wax" method the investment is the material surrounding the wax pattern and finally the actual casting.

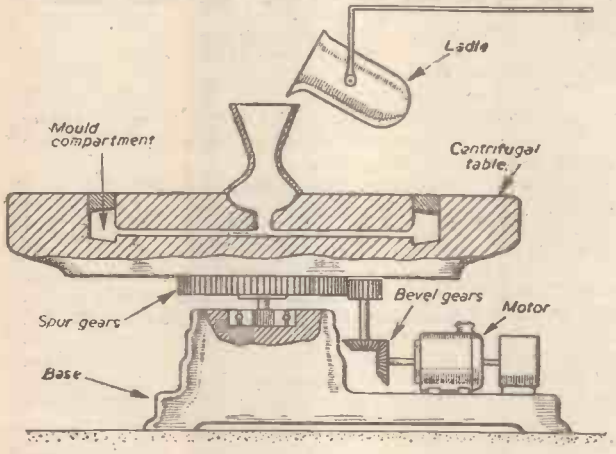


Fig. 2.—Diagrammatic sketch of a centrifugal casting machine.

One of the most common investments is plaster of paris and powdered silica mixed with water, the silica being the refractory part of the mixture and the plaster of paris the binding agent. It should be carefully noted that investment has what is termed a setting expansion, and this is an inherent feature and not to be associated with the expansion occasioned by heat during the evacuation of the wax during mould burnout. Since this expansion drastically affects the cavity volume it must be controlled within fine limits; to this end the characteristic of the investment in use must be available. Many investments are the subjects of letters patent, and the patent gives a clear exposition of the physical characteristics. Manufacturers of the investments can, however, always supply setting expansion curves, thermal expansion curves and shrinkage curves over a wide temperature range. (For some typical investments see the Appendix.)

It is essential that the investment contains no ingredients that will chemically react with the casting alloy, since this may cause a generation of gas or oxidisation which would disrupt the casting's finish. To ensure a good external finish for the final casting the fineness of the average particles of the investment should be of 500 mesh, which makes the investment finer than good quality sand.

Composition of the "Wax" and its Characteristics

The most used pattern material has been wax, but for extreme accuracy certain plastics such as polystyrene are being used. The wax has a paraffin base controlled by compounding with one or more of the following: beeswax, carnauba, damar and stearin. Waxes having melting points over 170 degs. Fahr. are called high-melting-point waxes. Much discussion could be made upon the use of high melting-point wax at high or low pressures of injection, and the same applies to the use of low melting-point waxes. At the present stage of the art it must be left to individual preference, decided by experience and experiment, to give the optimum results.

Wax patterns should be covered with investment as soon as possible, since wax is subject to plastic deformation under its own weight, and this can and may seriously distort the pattern.

Evacuation of the Wax

When the investment has set, the investment is heated in an electric furnace (usually slowly) to about 1,300 degs. Fahr. At this elevated temperature the wax will volatilise and the cavity will be left within the investment. The wax will be burnt away if the temperature is not controlled, and it is usual to reclaim the wax by melting it out before burning occurs. Refinement and analysis of the reclaimed wax is then necessary before it can be used again in the manufacture of a pattern.

Master Patterns

As explained previously the master pattern must allow for the various shrinkages and expansions. These are additive and subtractive, and an example will clarify the procedure.

Compensatory Arithmetic

Expansion :	Per Cent.
Setting expansion of investment	C_1
Thermal expansion of investment at 1,300 degs. Fahr. ..	C_2
Total :	$(C_1 + C_2)$
Shrinkage :	
Wax pattern shrinkage ..	S_1
Casting shrinkage of alloy, etc.	S_2
Total :	$(S_1 + S_2)$

Shrinkage − Expansion = $(S_1 + S_2) - (C_1 + C_2) = Z$.

Assume shrinkage > expansion. Then pattern must be made larger by Z per cent.

Methods of Casting

In dental practice a centrifugal casting machine is often employed, and the arm carrying the mould is powered by a torsion spring. For the manufacture of components on an industrial scale centrifugal machines are now made which are motor driven and equipped with other essential refinements. Fig. 2 gives a schematic idea of such a machine. The other machine in great favour is a trunnion arc furnace, which is inverted about the trunnions to allow the molten metal to be gravity fed (often assisted pneumatically) into the mould. Fig. 3 is a sectional view of such a furnace, and it should be self-explanatory.

Appendix

Typical Wax Formula :	Per Cent.
Paraffin	60
Carnauba, sometimes called Brazilian Wax	25
Ceresin; bleached Ozokerite ..	10
Beeswax	5
Wax for Precision Casting :	
Paraffin	10
Carnauba	40
Beeswax	10
Rosin	40
Investment Formulæ :	
(A)	
Calcined gypsum	80
Asbestos fibre	20
(U.S. Patent 2,201,037)	

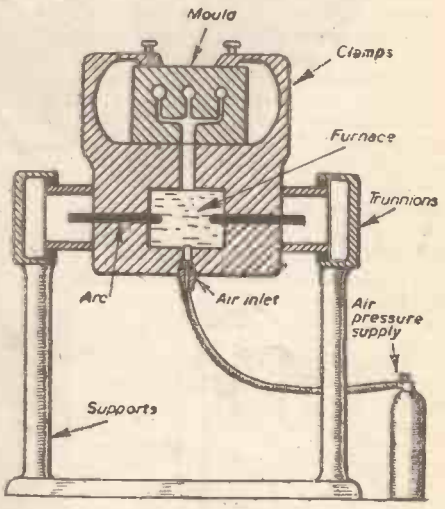
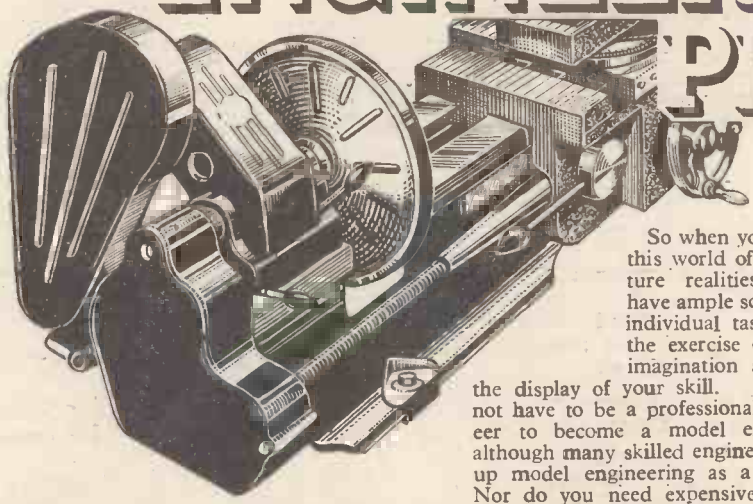


Fig. 3.—Diagrammatic sketch of a trunnion arc furnace.

(B)	
Plaster of paris..	60
Silica	25
Talc	15
(U.S. Patent 2,220,703)	
(C)	
Silica	90
Magnesia	6
Monobasic ammonium phosphate	3
Monobasic sodium phosphate..	1
Water	
(U.S. Patent 2,209,035)	

A New Series

MODEL ENGINEERING PRACTICE



by J. J. Camm

A VISIT to the Imperial Science Museum at South Kensington will reveal the value of model engineering in the development of some of our most important industries. Here you will see working models of steam engines, clocks, aeroplanes, looms, almost every conceivable type of machine tool, non-working models which demonstrate a principle; in fact, models of almost everything which is mechanical. It is difficult to define where real engineering begins and model engineering ends, for the two are complementary one to the other. Models are often used as a cheap form of demonstrating the practicability of an idea or as the prototype of something which it is intended to build full size, but which may be more cheaply experimented with in model form and modified after experiment.

What is a model? Some models are larger than full size, others are full size and some are to scale. Some are built for the purposes mentioned above and others sheerly for the joy of seeing something of one's own creation work and to provide an instructive and amusing hobby. Some models are scale models of existing apparatus, others are free-lance creations of the builder.

So when you enter this world of miniature realities you have ample scope for individual tastes, for the exercise of your imagination and for the display of your skill. You do not have to be a professional engineer to become a model engineer, although many skilled engineers take up model engineering as a hobby. Nor do you need expensive equipment. Tools may be acquired as they are found to be necessary.

It is difficult to subdivide the hobby of model engineering into sections. There are the model locomotive enthusiasts, there are those who prefer scale modelling, others who prefer model boat building, architectural modelling, free-lance modelling and those who prefer to create their own designs.

Fig. 1.—The late Percival Marshall and Mr. F. J. Camm discuss models over a cup of tea.

Model aeronautics is the favourite hobby with many. Several model-makers even make their own tools.

The Home Workshop

In this preliminary article, therefore, I want to talk about the home workshop and its equipment. Few houses to-day have spare rooms available which may be rigged up as a workshop. Where such a room, however, can be used it is a boon in that one does not have to collect up the tools and materials each night and unpack them again the following night. It is inconvenient unless some room or attic or shed is available to start model-making in earnest.

A garden shed, weather-proof, well lit inside, and with adequate windows, is the solution found by most model engineers. It prevents complaints from the other occupants of the house who may wish to listen to the radio and object to the sound of a lathe or the use of a hammer and chisel while the programme is being listened to, and it provides a den segregated from the house which the model-maker can regard as his own *sanctum sanctorum*.

The construction of a shed is not outside the scope of the veriest amateur. A word of warning, however; if the shed is of your own design it may be necessary to obtain the sanction of your local council before erection may be commenced, and they may require to pass the plans. In general, such buildings may not extend beyond the building line, and one can understand the reason for such restrictions. If they did not exist a quiet residential district might have its value destroyed by the erection of large numbers of ramshackle huts, hen coops, rabbit hutches and noisy workshops. A second

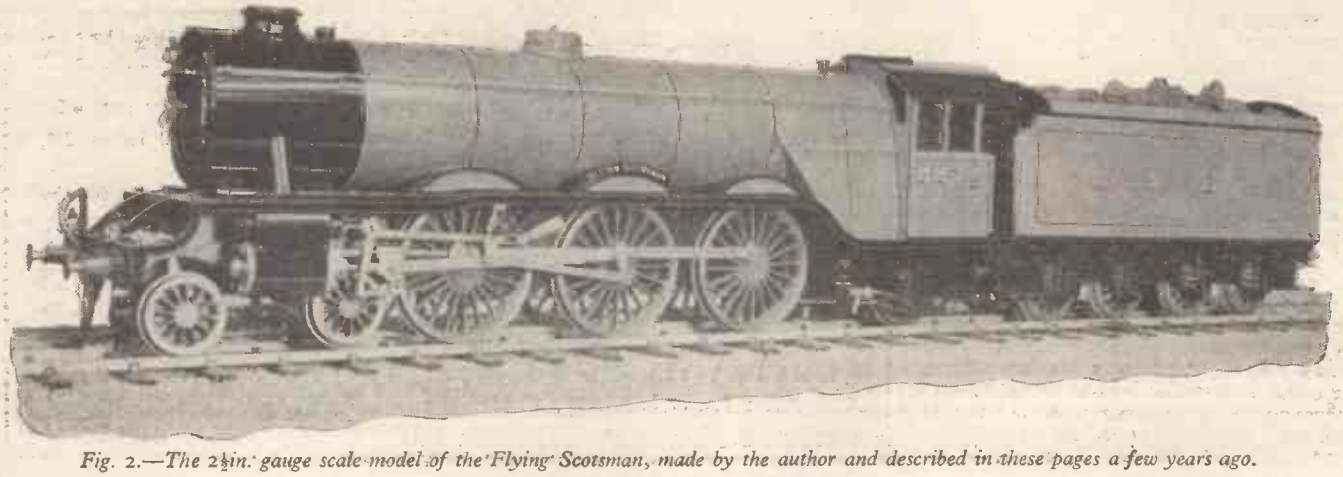


Fig. 2.—The 2½in. gauge scale model of the Flying Scotsman, made by the author and described in these pages a few years ago.

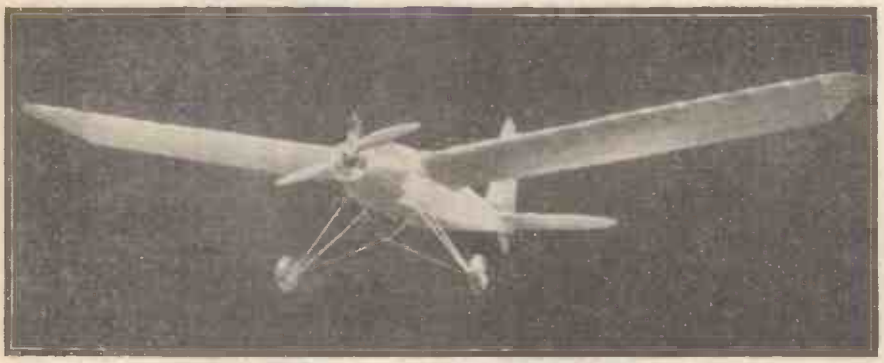


Fig. 3.—The author's petrol driven monoplane.

point is that if you intend to install a lathe, and this is really necessary, the advice of your electrical undertaking should first be sought. Whatever electrical apparatus is installed it should be suppressed, so that it does not cause interference with the radio.

The location of the workshop is, therefore, a matter which the prospective model engineer must settle for himself; and the equipment will to some extent depend upon the sphere of model-making he proposes to undertake.

Wide Choice of Subjects

The illustrations to this article give an idea of some of my own essays in model-making. It will be seen that the range covers model aeroplanes, scale working model locomotives, road tractors, flash steam plants, electric clocks, model power boats, monocars, full-size gliders, watch-making, etc. Most of these have been described in this journal.

There are many excellent sectional workshops of varying sizes available on the market which can be erected in a few hours. Indeed, the makers undertake to erect on the site. This is probably the cheapest and most satisfactory way of providing oneself with a workshop, the other factors mentioned permitting. See that the workshop is floored, that it is draught-proof and weather-proof. A damp workshop will cause steel tools and steel parts rapidly to rust. If a lathe is to be installed it will need a fairly solid foundation, for accurate work cannot be undertaken on a lathe which chatters. For most purposes a 3½in. centre back-geared gap bed screw-cutting lathe will suit, and there are many such lathes of excellent quality on the market. A good example is the Myford, which can be obtained on a motorised stand with tray and tool cupboards and, if necessary, with pump for cutting coolants. All of the necessary accessories may be acquired from the makers of the lathe and this is a distinct advantage.

Small Hand Tools

Before buying small hand tools I advise the reader to obtain some tool catalogues so that he may make up a shopping list within his means, remembering that it is not necessary to buy a lot of tools which will not be immediately required. There are some tools which must be purchased at the outset; ½lb. and 1lb. engineer's ballpaned hammers, a pair of side-cutting pliers, a pair of end cutters, a centre punch, a hack saw, a pair of snips, an assortment of files in various cuts from the fine Swiss file upwards, a scriber, a universal square and protractor, a surface plate, a spirit level, a 12in. steel rule graduated in 64ths, a 6in. flexible rule graduated in 100ths, 1in. and 2in. outside micrometers and an internal micrometer, a set of spanners of the set-jaw type, an adjustable spanner of the Lucas Girder or King Dick pattern, a set of scrapers, a set of drills from 1/64th inch up to ⅜in., proceeding in 64ths, a set of taps and dies to suit the model engineering standards (Whitworth, B.A. and B.S.F.), inside and outside and

Fig. 4.—The author's flash steam plant. Its construction is described in his new handbook entitled "The Model Aeroplane Handbook."

odd-legged calipers, soldering and brazing equipment and brazing hearth, and various screwdrivers, including a set of watch-maker's screwdrivers, represent the minimum equipment with which to start. Needless to say, the very best which can be obtained are the cheapest in the long run.

Raw Materials

It is necessary to lay in store a certain amount of raw materials such as brass wire in various gauges, sheet brass and sheet mild steel and bar stock in various sections. Firms like Bassett-Lowke and Garners supply these, and their catalogues indicate the various sections available. Obviously the quantity and the nature of the stock will depend upon individual requirements.

The supply of heat for brazing and soldering is another problem which the model-maker must settle for himself. Gas is a great convenience, for it can be used for the dual purposes of heating the shop, and various processes such as soldering and brazing. In this respect make quite sure that the workshop is adequately ventilated, for gas fumes can be dangerous. The work bench and its vice need to be selected with care. It should be solid, contain a good drawer for files and other hand tools and be of the right height. If, when standing upright, the elbow will just touch the top of the vice, the height is correct. The vice should be one of the quick release, 4in. type.

Around the walls of the workshop, shelves should be placed to keep the floor space clear and a cupboard should, if possible, be provided for the storing of the more delicate tools, such as micrometers, surface gauges, squares, etc.

Wood screws, nuts and bolts and washers should be kept in a divided box with a division for nails.

A set of overalls is a necessity.

Scale Drawings Necessary

Much disappointment will be avoided if the first model is attempted slowly and progressively. So many take up model engineering without any concerted plan and tire of it when the model is half finished.

In this respect, having made up your mind as to the model to be constructed, it is important to start off with a scale drawing. If you are not a good draughtsman, and do not understand the principles of orthographic projection, it is wise at the first attempt to purchase a scale drawing of the style of model you desire to build.

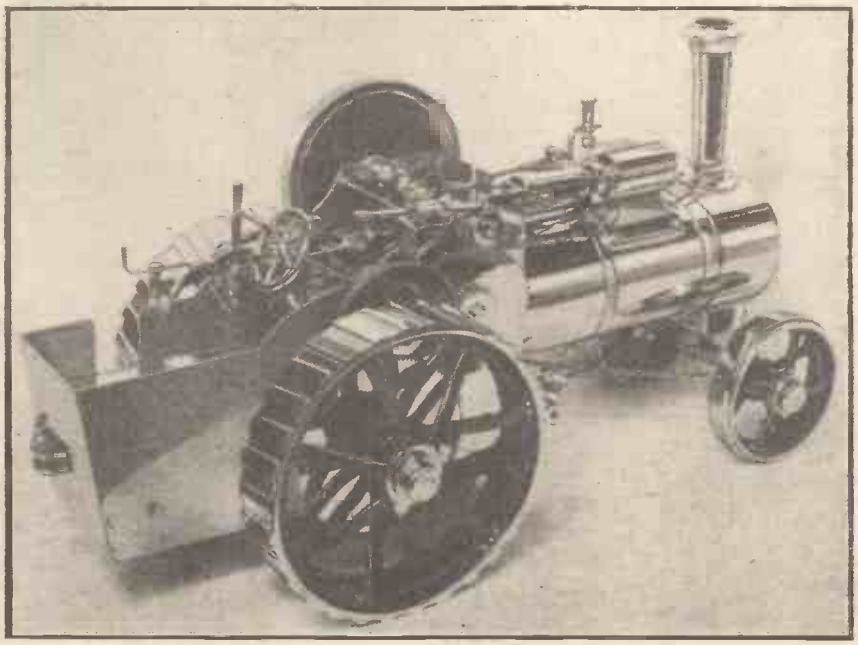


Fig. 5.—The author's working model of the Burrell Road Tractor has been seen by many thousands of our readers at model engineering exhibitions. Its construction was described in earlier issues of this journal.

Fig. 6.—A model boat. The author's "Model Boat Building" describes the construction of similar power and sailing boats.

The method of construction of similar boats and other models will be described as this series of articles develop.

The List of Parts

Having made or acquired the drawing, the next step is to make up a shopping list, down to the minutest detail, of the raw materials required. By this means as each stage of the work is completed you will be able to proceed with the next without annoying delays awaiting the supply of essential material.

Of course in every model there are parts which you may not be able to make yourself. Gears, for example, cannot be cut unless you have a gear-cutting machine or a gear-cutting attachment for your lathe. There are small parts, like platinum contact screws, nuts and bolts and washers, which it does not pay for the model-maker to make, although he has the equipment to do so.

Standard Screw Threads

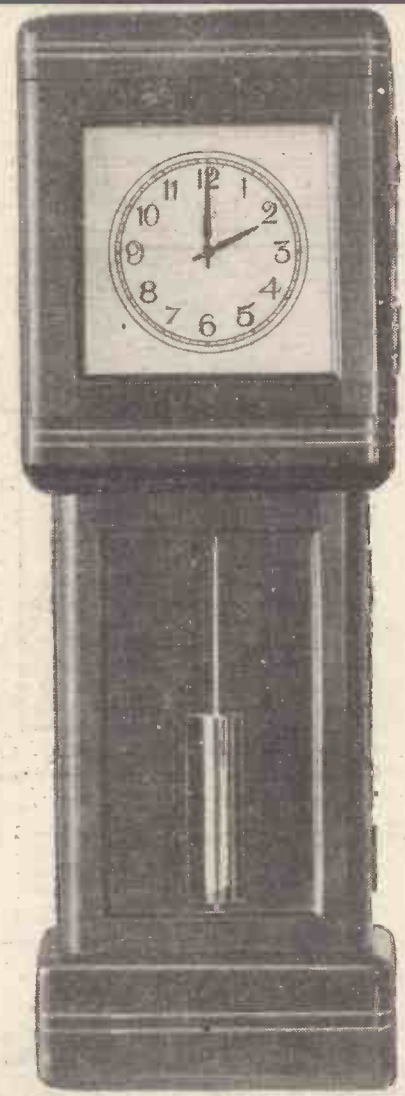
Fortunately, there are many firms catering for the special needs of the model-maker, and they supply fittings screwed to the agreed model engineering screw thread standards. Most, but not all, of the model engineers' screw threads are of the Whitworth form. The sizes range from 1/16th up to a ¼in. in sixty-fourths, and all of these have 40 threads to the in. The sizes then proceed to 5/16in. (32 threads to the in.), ⅜in. (32 threads to the in.), 7/16in. (26 threads to the in.) and ½in. (26 threads to the in.).

If you are building a model of your own design you should study the model-makers' catalogues, and make quite sure that your design does not call for fittings which are non-standard and will have to be specially made. The sizes of the bolts should be selected according to the standards listed.

Pipe unions in a wide variety of forms are available for steam pipes and similar purposes.

The First Stage

Having obtained the drawing and the materials, the next stage is to select the first part of the construction, and this, of course, will depend upon the type of model. With a model aeroplane it should be the fuselage, with a model boat the hull and with a model locomotive the frames. If it is to be a working model and you do not propose to make your own power unit this should first be obtained and incorporated in the design to avoid later complications. It is often advisable with one's first model to purchase the power unit, as this can be the most troublesome. Once the remaining structure is completed working results may be obtained immediately, and this is of great encouragement to the beginner and inspires him to more skilled efforts, leading up to the construction of his own power plants.



Scrap Spoiled Parts

In the early stages you will undoubtedly spoil certain parts. I cannot too strongly advise you to be ruthless about these and scrap them at once. Do not attempt to botch, for it will be an eyesore when the model is completed, and by starting over again you will exercise the greater care which makes for skill and experience. Do not attempt to make do, nor to rely upon emery cloth and a bright finish, or a coat of paint to hide up bad workmanship.

It will be some time before you acquire skill in the art of filing—the most skilled part of a fitter's job. To be able to file flat takes considerable practice, and in a later article I shall explain how to acquire skill in filing.

Even the drilling of holes requires ability.

(To be continued.)

Fig. 7.—The "Practical Mechanics" Master Battery Clock. Visitors to the model engineering exhibition saw this clock, built by Mr. F. J. Camm, in skeleton form on our Stand. Here you see it in its case. Several thousands of these clocks have been constructed by readers. Blueprints are available from the office of this journal.

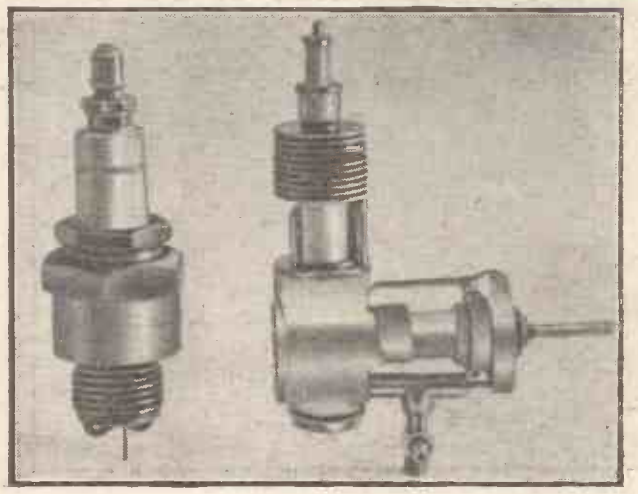


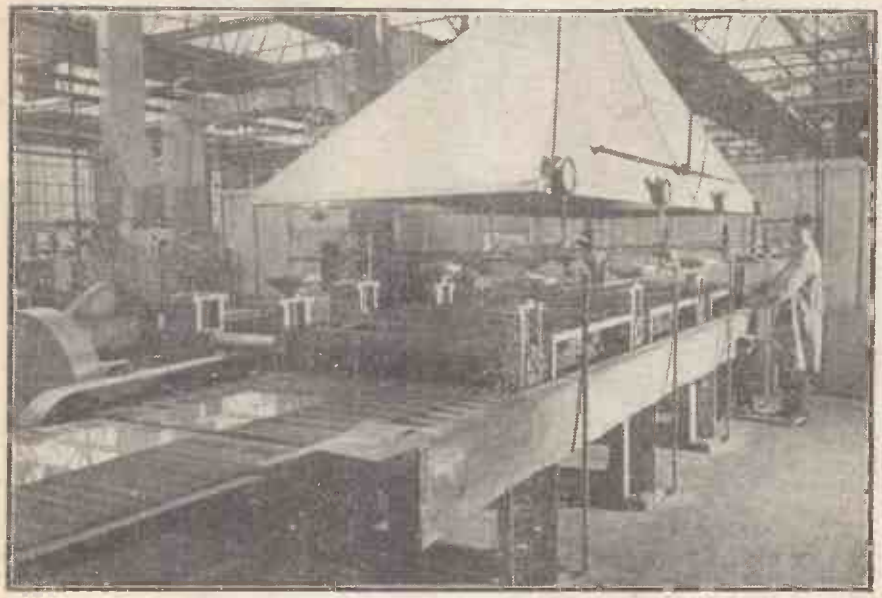
Fig. 8.—The 1 c.c. engine, blueprints for which are available.

Fig. 9.—Mr. F. J. Camm's famous monocar, for which we sell blueprints. This little monocar is capable of a speed of 60 miles an hour and has a petrol consumption of over 70 miles to the gallon. Many hundreds of these cars have been built.

The Production of Safety Glass

Various Stages in the Process carried out at the Triplex Works at Birmingham

By OUR SPECIAL CORRESPONDENT



By courtesy of Triplex Safety Glass Company.

Preliminary pressing of laminated safety glass.

I RECENTLY visited the Triplex works at King's Norton, Birmingham, and witnessed the various stages in the production of Triplex Safety Glass. There are two types of safety glass—laminated and toughened. The principles of the former were discovered accidently at the beginning of the present century; toughened safety glass was developed from a principle known three centuries ago.

Laminated safety glass is of sandwich construction, consisting of two sheets of glass with an interlaying material. There have been two outstanding developments of modern research in the safety glass field—the introduction of a plastic interlayer known as Vinal, and the evolution of curved safety glass.

Laminated Safety Glass

The first methods of manufacture necessitated the use of an adhesive, usually gelatine, and the three component parts were brought together whilst immersed in a liquid which slightly softened the celluloid. The finished glass had to be sealed around the edges with pitch, not only to prevent the ingress of moisture but to retain within the sandwich the slightly volatile assembly liquid.

Celluloid, however, was found to have disadvantages. It turned brown readily, became brittle and blistered. It was soon supplanted by cellulose acetate in sheet form, which did not possess these particular drawbacks, although the same manufacturing process was necessary.

As previously mentioned, research has now evolved a synthetic resin, polyvinyl butyral (Vinal), which overcomes the above disadvantages. Its tensile strength (about 3,000lb. per square inch) is almost as high as that of cellulose acetate; it can in addition be stretched 400 per cent. before breaking, giving to the interlayer a toughness and shock-resisting quality never before achieved. It adheres to glass by heat and pressure alone, and needs no sealing. The process has been developed in England by the Triplex Safety Glass Company, and is claimed to yield the safest safety glass ever made.

In the manufacture of laminated safety glass the Vinal interlayer is placed between the two glass components and preliminary adhesion obtained by heating and passing the loose sandwich between rubber-covered nipper rolls. Final lamination is carried out by heat and pressure in an autoclave.

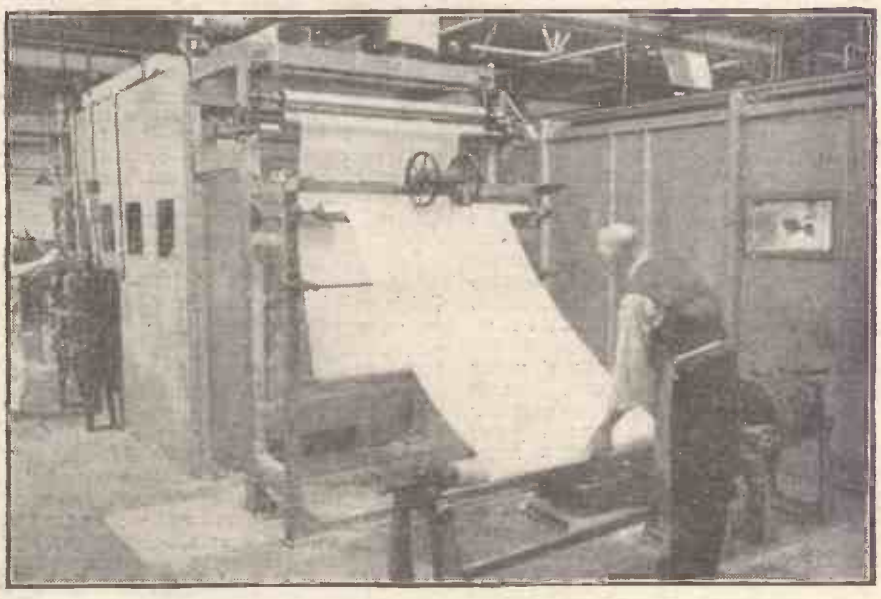
There are, of course, two types of laminated safety glass—laminated plate and laminated sheet. Plate glass is so manufactured that its two sides are parallel. It thus gives rise to no visual inaccuracy. In sheet glass, however, there tend to be slight waves, which can cause distortion. It is, of course, desirable that plate glass should be used for car windscreens, while back and side window glasses can suitably be made from sheet-glass. One can identify sheet-glass by looking through it at an angle and moving the head up and down or sideways. If the object at which one is looking is at all distorted, one may safely assume that the window contains sheet glass.

Toughened Safety Glass

Toughened safety glass is produced on a completely different principle. If molten glass be poured into water it forms pear-shaped droplets with long tails, and these do not crack as might be expected. The pear-shaped part of the drop is immensely strong and may be hammered on an anvil without fracture, but if the tail of the droplet is broken the whole thing shatters to a fine powder. By applying this theory to flat glass it was found that sheets of glass could be "toughened" for car windscreens and windows. Sheets of glass are heated till they are just beginning to soften throughout. At the requisite temperature they are withdrawn and subjected to draughts of cold air at considerable pressure. The outside of the glass hardens and contracts quickly, but as glass is a poor conductor of heat the inside hardens far less quickly. The effect of this when the glass is wholly cooled is to produce a state of compression on the surface of the glass and, in equilibrium with that, a tension inside the glass. Glass can only be broken by a tension stress acting on the surface and therefore toughened glass is mechanically stronger than ordinary glass because applied loads have first to neutralise the surface compression before fracture can take place.

Safety Properties

You can hit a sheet of toughened glass with a hammer and it will not break. It is possible for two or three people to stand on a sheet suspended between two chairs. If, however, the glass receives a blow severe enough to break it, it disintegrates into particles, but with blunted edges so small that they will not cause cuts or abrasions. Thus it is that toughened glass in a car windscreen will withstand a heavy blow without breaking. If it is subjected to so intense a strain that it does break, it should do so without causing any harmful effects to the occupants of the car.



By courtesy of Triplex Safety Glass Company.

Laminated glass—conditioning of Vinal interlayer.

Curved Glass

For many years motor-car manufacturers in particular have been aware of the advantages that the widespread use of curved safety glass would bring, but hitherto its production has not been a commercial proposition. Wartime experience in aircraft, however, stimulated developments already in hand, and there are now available techniques and production plant by which safety glass may be made in curved form and in adequate quantities. There are two distinct types of curved panels—single curvature and double curvature. The terms are best explained by comparing the properties of a piece of stiff paper with those of a sheet of soft rubber. The stiff paper will only bend and, without creasing, can only curve one way; but the rubber will stretch as well as bend and so can follow a surface curved in two directions.

Curved safety glass can be made in both the laminated and toughened forms, and many different methods of production are necessary according to the curvature requirements. At present laminated glass is less suitable for work with double-curvature, but heat-treated glass can have either single or double curvature although, with the latter, it is necessary to use only very light force to make the glass "stretch" to the required amount, and the degree of double-curvature is preferably that which the glass naturally adopts for itself under the process used. Any degree of double-curvature other than that may mean markings from the mould with some distortion of vision.

Testing the Glass

All glass which comes into the Triplex factory is carefully tested before being converted into safety glass. The glass is closely examined for flaws and imperfections. There is a small group of girls who between them examine many thousands of pieces of glass each week. Their job is not to look *through* glass as most people do, but to look *at* it. Mirrors and lights are so placed as to show up every mark and fault which may be in the glass.

The finished glass must reach certain standards laid down by the British Standards Institution. The Triplex Safety Glass Company require a normal car windscreen to withstand the impact of a 1.68lb. steel ball dropped from a height of six feet, which is a more severe test than that required by the Institution. In practice, it is often found that sheets of Triplex toughened glass will withstand a blow from a ball dropped from two or three times this height.

Clearly it would not be practicable to test every single sheet of glass by this method. Therefore, a loaded hammer head falls on to each sheet of toughened glass as it passes along the conveyor belt. This hammer test is the equivalent of the 1.68lb. steel ball dropping upon the glass from a height of 4½ft. In addition to this hammer test, specimen sheets are taken out and subjected to the ball-drop test itself. When hammer tested, the glass is viewed through a polariscope, which by means of polarised light shows up any flaw in the finished glass. This finished glass is then trade-marked, and checked again for scratches.

In other tests, toughened safety glass has been twisted twelve degrees in each direction one hundred thousand times without the slightest damage. Without being in any way impaired, it has withstood molten metal being poured on one side, and icy water on the other.

Laminated safety glass must be able to pass boiling, humidity and discoloration tests. There is also a ball-drop test. Pieces of the glass, selected at random, are tested regularly. The glass, inevitably, is fractured by the impact of the ball, but while it may star it must not splinter. Laminated glass will, without splintering, withstand the impact of a half-pound ball dropped from as high as twenty feet.

By courtesy of Triplex Safety Glass Company.

Glass cutting by hand.

Industrial Plant in Glass

Another important branch of the Triplex concern is the manufacture of chemical equipment carried out by their subsidiary Quickfit & Quartz, Ltd. Here I witnessed technicians busily at work producing "Quickfit" interchangeable laboratory glassware. This equipment is suitable for use with corrosive chlorine compounds, all acids including concentrated nitric, sulphuric and hydrochloric acids, the only exceptions being hydrofluoric and hot concentrated phosphoric acids. Glass may be used successfully with dilute alkalis but is unsuitable for hot strong caustic solutions. "Quickfit" all-glass pipe line is simple to install since all parts are fabricated in the factory to close limits. An important point to note is that glass columns, condensers and pipes may be very conveniently used in conjunction with stainless steel, enamelled iron or steel vessels.

It should also be noted that the transparency of glass equipment enables plant control to be effected visually, as in the laboratory, whilst contents and internal processes may always be visually observed.

Glass units are very light, being only a fraction of the weight of their metal equivalents. Dimensions are accurate and flange jointing faces are ground flat to ensure 100 per cent. leak-proof joints. The coefficient of thermal expansion of the Chance's Hysil Glass used in Quickfit & Quartz equipment is the extremely low figure of 30×10^{-7}, one third that of copper.

Bullet-proof Glass

Most of the bullet-proof glass used in British tanks and aircraft during the war was made at the King's Norton and Willesden works of the Triplex Safety Glass Company, Ltd. It was made from a combination of laminated and toughened safety glass varying from 7- to 17-ply and as much as 7in. thick. In these blocks a toughened layer is placed near the front to withstand the impact of shrapnel or bullets; layers of laminated glass are behind this, and then there is a further layer of toughened glass to help hold together the layers shattered by bullet impact.

Safety glass has an especial value in solving problems connected with aircraft. Laminated safety glass windows, for example, can be made to stand up to very high pressure—a fact of great importance in high-altitude flying and pressurised-cabin aeroplanes. Even if the glass breaks, the Vinal interlayer is strong enough to stand up to the pressure. Aircraft frequently come into collision with birds, and even a small bird at a relative velocity of a hundred miles per hour will break any normal type of glass, laminated or toughened. Interesting experiments have recently been carried out, using a compressed air gun capable of ejecting bird carcases at velocities up to 450 miles per hour. The glass shatters, but the Vinal interlayer bulges into a sac, thus retaining the carcase.

Anti-slip Tests of Rubber

IT is well known that the slippery state of pavements, corridors, floors in buildings, etc., contribute to many accidents, as do haste and carelessness on the part of pedestrians. In the United States experiments have been carried out to provide data for the production of safer surfaces, and the *Journal of Research* of the U.S. National Bureau of Standards recently reported the results. The effects of different types of footwear were considered and the tests made on surfaces which were actually in use, the design of the instrument used being based on the assumption that slipping is most like to occur as the edge of the heel meets the ground. A 1½in. square test piece was made to drag one edge, by means of a pendulum, along the surface being tested, the angle of the edge being adjustable to simulate the characteristics of different people's walk, which had previously been studied by slow-motion pictures.

It was found, as might be expected, that rubber heels gave higher anti-slip properties than leather ones. Some surfaces were, when wet, dangerous for both leather and rubber heels. Good anti-slip properties under wet conditions were found for surfaces where rough particles projected through the film of water, thus preventing its action as a lubricant and eliminating any tendency for slipping.

Converting ex-Aircraft Generators to A.C. Motors

A Simple Method of Reducing Speed and Increasing Torque

By H. H. WARD

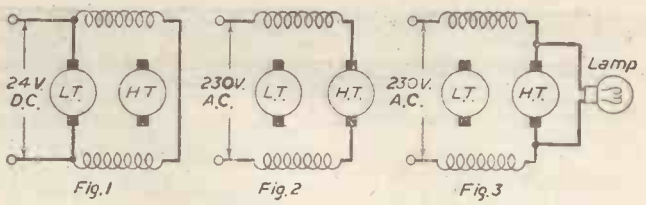


Fig. 1 Fig. 2 Fig. 3

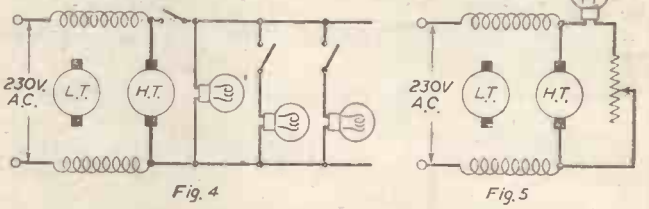


Fig. 4 Fig. 5

Wiring diagrams for ex-aircraft generators, showing methods of passing more current through the field coils for the purpose of increasing torque

MANY dealers in the disposal of ex-Government stock have on offer, at low prices, motor generators taken from aircraft radio equipment. These were built to take their supply from batteries giving voltages in the order of 24 volts DC, and to give out various DC voltages from 270 to 1,000 volts. For this purpose the machines have two, or sometimes three, commutators, one to provide a passage for the actuating current, and the others for the collection of the current generated. It is important to note that there are *only one pair of field coils* and that these are (a) common to all windings, and (b) they are designed for low voltage work, and consist of relatively few turns of heavy wire. Fig. 1 shows how these machines could have been wired in service, although it is possible that control resistances may have been fitted in some cases.

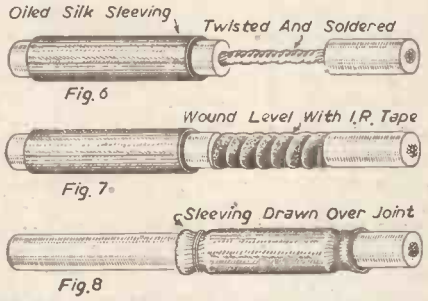
High Speed on No Load

As most of the machines have both field and armature of laminated construction, the possibility of converting these DC machines to AC motors was obvious, and so dealers advertise that the machines either have been, or can be, so converted to run on the 200-240 volt AC mains. Whilst it is true to say that they run when converted, they usually do so at uncomfortably high speeds and with a typical "series" characteristic, or, in other words, they "run away" to a high speed on no load and when loaded slow down and down as the load increases and finally stop. This occurs on series motors specially designed for AC work as anyone may prove by placing their hand over the nozzle of a vacuum cleaner so as to stop the flow of air. With no air to handle the load on the fan diminishes and the note of the motor rises sharply. This unpleasant habit of series motors is more than usually apparent when ex-aircraft generators "converted" as in Fig. 2 are used, the "conversion" consisting of placing the LT field coils (i.e., the only available field coils) in series with the lowest voltage of the H.T. windings. For simplicity the diagrams show only one H.T. commutator, but there may be a second one of about 1,000 volt output. Owing to the small number of turns in the field coils, and the fact that the amount of current which can pass through them is limited by the H.T. armature winding, there are not enough ampere-turns to give a satisfactory field strength. This weak field in turn gives rise to two difficulties:

(1) The armature fails to generate the necessary back E.M.F. and so goes on speeding up as the armature accepts more and more current.

(2) As the torque or turning power is produced by the reaction of the magnetic forces in the field and the armature, it is clear that if the field is weak there is nothing for the armature to "kick against" or react from, and therefore the torque is low.

The obvious remedy for this state of affairs is to pass more current through the fields so as to make up for the shortage of turns, as a magnet winding of few turns fed with a heavy current can produce the same result as a winding of many turns fed with a smaller current. To do this one must provide an alternative path other than the armature. In Fig. 3 this path can conveniently take the form of a lamp of main voltage, and of a suitable wattage. The exact wattage is best found by experiment, but some guidance may be had from the plate on the machine. For example, a machine in the writer's possession is rated at 24 volts 3.2 amps. for the low voltage end. As it was shunt connected it was estimated that it would be safe to put at least 1 ampere through the field, but experiment proved that it was not necessary to do so.



Method of making a properly insulated joint in connecting cables

Insulation Precautions

As 200-230 volts A.C. current can be lethal, every precaution should be taken to see that the machine frame is earthed, and that all connections involved in making the conversion are thoroughly insulated. In some cases where wires pass down the carcase in the space not occupied by field coils there is not much room for them, and when they have to be extended to the H.T. end the joints must not be bulky. Figs. 6 and 7 and 8 show a useful form of joint. A length of oiled sleeving or systoflex is chosen which will just slip over the insulation as in Fig. 6. The joint is then twisted and soldered and the insulation rebuilt to the original level preferably with raw rubber tape, or, failing this, with ½in. insulation tape split down the centre. The systoflex sleeving is then slipped back over the joint and secured as shown, and should overlap the joint by at least ½in. each end. A touch of talcum powder on the tape eases the job of sliding the sleeve over the rubber or tape.

Referring back to Fig. 3, all lampholders used should be of the plastic type with skirts or lamp cap protectors, and all switches should be of the insulated type. All these fittings should be mounted on hardwood boards with the wiring on the underside as in standard practice. *It cannot be too strongly emphasised that loose experimental "hook-ups" on this sort of work are highly dangerous.* Having made sure of one's safety and having assured oneself that there is no danger of flexible wires being caught by the shaft or armature, insert a 15-watt lamp in the holder shown in Fig. 3, and switch on. The speed should be slightly less than with the current in Fig. 2. In turn insert 25, 40, 60, 100 watt lamps and it is probable that at some point in this range the motor reaches its slowest speed and maximum torque and increasing the wattage of the lamp gives no other result. The lamp which just produces the result is obviously the one required.

Varying Speeds

If, for example, the lamp required is one of 60 watts, it is clear that four 15-watt lamps or one each 25- and 40-watt lamps in parallel will produce the same result. Fig. 4 shows an arrangement which will give a series of speeds. With the switch nearest to the H.T. commutator open the motor runs at top speed, but as the remaining switches are closed the speed falls by steps and the torque increases. Fig. 5 shows a fully variable arrangement the lamp being of the maximum wattage needed to obtain the lowest speed whilst the variable resistance should be capable of carrying a load equal to the wattage of the lamp, e.g., the resistance for a 100-watt lamp would need a resistance capable of carrying ½ amp.

THE WORLD OF MODELS

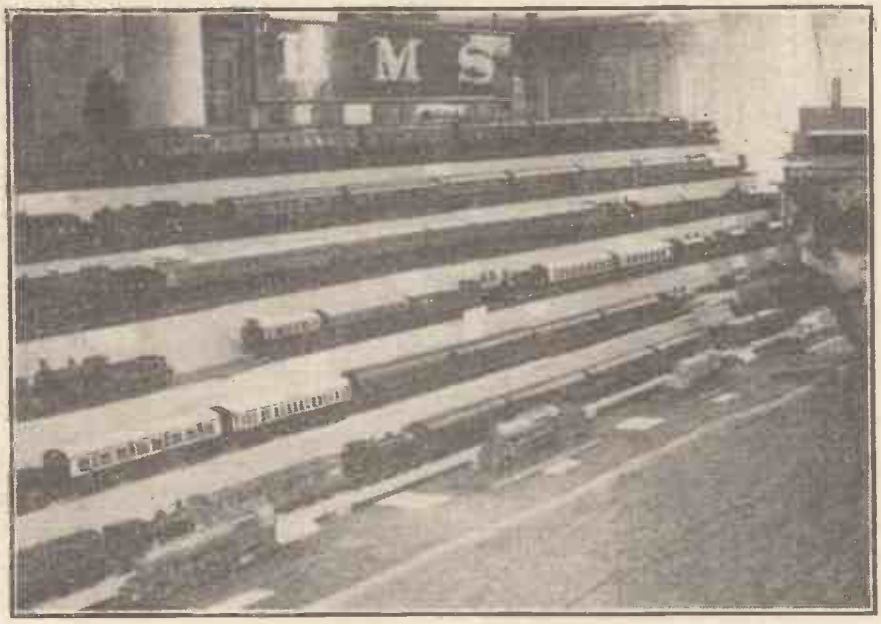


Fig. 1.—The Model Railway Club Exhibition : The excellent display of L.M.S. locomotives and rolling stock.

Model Railway Club Exhibition. Northampton Model Engineering Display

By "MOTILUS"

THE annual Model Railway Club Exhibition held at Central Hall, Westminster, is certainly one of the most popular events of its kind that occurs in London during the year. This year it opened on April 19 and was well attended right up to closing time on April 23. The exhibition was similarly arranged to last year's layout, with the addition of improved refreshment facilities, which were much appreciated.

As usual, a major attraction was the passenger-carrying track, erected and operated by members of the Society of Model and Experimental Engineers, and on which they ran a number of the Society's steam locomotives. It was installed at one side of the central portion of the Upper Hall, where crowds of youngsters gathered continually, waiting for rides.

The organisers are to be congratulated on the excellent grouping of the main railway model exhibits, which was most convenient for those interested mainly in locomotives and rolling stock of one particular railway section. The L.M.S. were leading with the greatest number of models (Fig. 1), but the Great Western had a more characteristic and comprehensive selection. The Great Western group was displayed in the Lower Hall, in a glass-fronted case, well floodlit from the top, and it included many models from the wonderful collection of Sir F. Leyland Barratt, the well-known G.W.R. enthusiast.

A fresh interest at the exhibition was the British Railways' stand on the lower floor. This displayed a gauge o layout incorporating goods yards, a large station and a long track run through rural scenery. A few lineside comments were overheard from onlookers, who were wondering how this layout could be realistically operated without any signals: did it forebode some kind of radar control not yet divulged by the Railway Executive!

Gauge 1 Locomotives

The Gauge 1 Association, a keen, enthusiastic body, made a good display of locomotives and rolling stock for this gauge, which is still very popular among those model railway owners who have sufficient room to operate a larger scale than gauge o. It is hoped that when the association have agreed on some range of standard measurements, in the same way that gauge o has been standardised, the manufacturers will be able to produce standing ranges of finished models, drawings, castings and parts to further interest in this most useful and attractive size for model railways. Mr. Victor Harrison, who is a gauge 1 enthusiast, still demonstrates on his own garden railway the wide possibilities of this size.

"oo" Gauge Layout

Mr. P. B. Denny, who is well known as a specialist in oo (18 mm.) gauge, and who had a working layout in the Club's exhibition last year, had again contributed an excellent scenic railway. This is a 2-rail layout, representing an imaginary Great Central single track branch line terminus, somewhere in Yorkshire, of about the date of 1912. This had been made as a companion model to the one entered in last year's exhibition, which showed a scene on the Buckingham branch line. The Great Central model is portable, folding up to measure about 4ft. by 1ft. 6in. Notwithstanding this, the model has a comprehensive scenic surround, including a road, houses, locomotive sheds, and many more attributes all in excellent detail.

Mr. Denny's accomplishments in oo gauge scale should encourage other model railway owners to endeavour to increase the interest of their scenic displays: as Mr. Denny's models show, these extra touches, when executed with care, improve the realism of any model railway. One model railway fan I have met, Mr. Ivor Peters, of Bath, has brought the construction of lineside buildings and equipment to a fine art, and has thus added considerably to the realism of his own layout, a quality that is often sought after, especially in indoor model railways.

The Model Railway Club has some affiliated French members, and they had contributed photographs and posters of French railways, making an attractive exhibit of their own in the Lower Hall. Nearby, the electrical section of the club had arranged a stand to display models of many interesting electrical devices for railway operation. A few trade stands were also in the Lower Hall, including a working layout of Trix trains, a fascinating sight that always attracts a crowd of spectators. It is now once more possible to obtain limited supplies of these popular pre-war oo gauge trains.

I would like to pay a tribute to my friend, Mr. G. P. Keen, chairman of the Model Railway Club, who has for so many years

Fig. 2.—A section of the Exhibition held by the Northampton Society of Model Engineers last April. In the foreground can be seen a model U.S. torpedo boat, made by Mr. A. M. Welter.

displayed unflagging interest in model railways and their equipment. Mr. Keen now probably has the finest collection of gauge o *real* scale models that are in existence the world over. I was therefore particularly pleased to see the special display of load-carrying wagons of K. lines and a model gantry dockyard railway, modelled by A. M. and G. P. Keen, all to the 7 mm. scale.

From a model railway point of view, this exhibition was a most stimulating display. It was a tribute to the enthusiasm of those who put so much time and energy towards making the exhibition a success. The club are indeed lucky to have as their leader their chairman, Mr. G. P. Keen, A.M.I.Loco.E. For many years he has been the organiser responsible for this specialised exhibition to which so many look forward after the annual Easter holiday.

Northampton Model Engineering Exhibition

The Northampton Society of Model Engineers held their second post-war exhibition in the Northampton Town Mall in April this year. On the whole the display was more representative than the previous one, covering a better variety of models, and with some considerable improvements in the arrangements of the exhibits (Fig. 2). Like all model exhibitions nowadays it was very well attended.

Fig. 3.—Northampton Society of Model Engineers' Exhibition : Mr. Welter's Cup-winning model caravan, a model beautifully executed, with an admirably smooth finish.

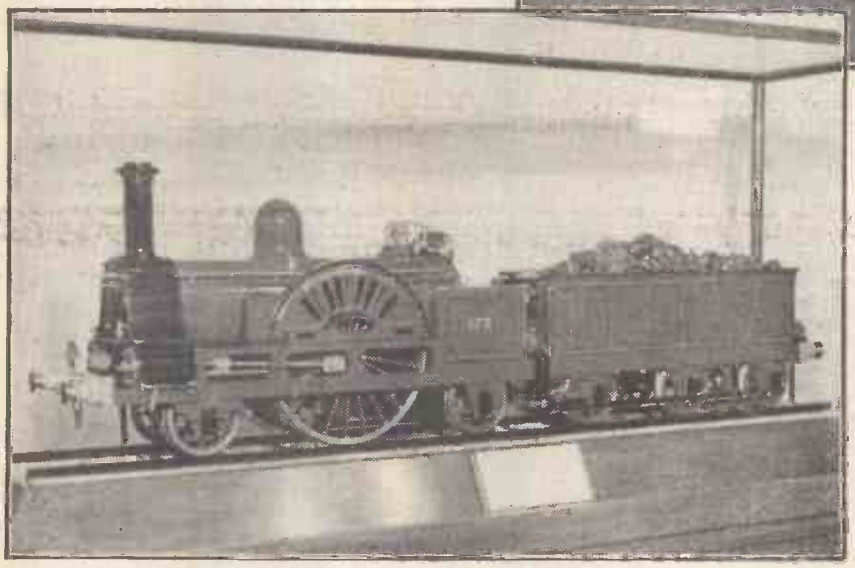


Fig. 4.—Northampton Society of Model Engineers' Exhibition : The working model of the Ex-L.N.W. "Cornwall" locomotive, built by Society member Mr. S. J. Ward, to a scale of 1¼in. to 1ft. A superb example of locomotive modelling.

Some outstanding new models among the exhibits are well worth mention, and those for which awards were made are particularly interesting. The Members' Cup, which is awarded for skilled workmanship, was given to Mr. A. M. Welter for his model caravan, built to his own design (Fig. 3). The model is well proportioned, beautifully finished and complete with interior decoration and furniture, all up to the usual high standard of Mr. Welter's work, which is always the subject of admiration from his fellow society members. The Bassett-Lowke Challenge Bowl, given for originality in choice of model or design, went to Mr. W. A. Wells, the society's secretary, for his model of a duck decoy. This is a model of an actual decoy being used by the Severn Wildfowl Trust in Gloucestershire; it is a most realistic representation of this unusual rural installation, set up for the study of wild bird life. All detail, including trees, shrubbery, the decoy screens and net, and model livestock had been faithfully carried out. The complete model was in a dustproof glass case, a most necessary precaution with a model of this kind.

A further award, the Strickland Cup, which is given for the best model among the work of those exhibiting for the first time, went this year to Mr. A. Coley for an exhibit in the locomotive section. This was a very good ½in. scale (2½in. gauge), 4-6-2 "Pacific" L.N.E.R. locomotive: a steam-driven model with Walschaert's valve gear. This model, along with several other working models, was operated during the exhibition by means of a supply of compressed air.

One exceptionally good locomotive model, admirably displayed in its glass case, was a working steam model of the old L.N.W. "Cornwall," to a scale of 1¼in. to 1ft. Fig. 4). This is an example of the excellent workmanship of Mr. S. J. Ward, who is well-known to all model engineering enthusiasts and especially those keen on locomotive modelling, whether ancient or modern. Without doubt, this beautiful model is one of the finest pieces of work ever shown in an amateur exhibition. Mr. Ward's collection of model locomotives, all to a similar scale of 1¼in. to 1ft., but representing many varying types, is becoming one of the finest in the country.

Aircraft, stationary engines and motor cars were all represented in the exhibition. In

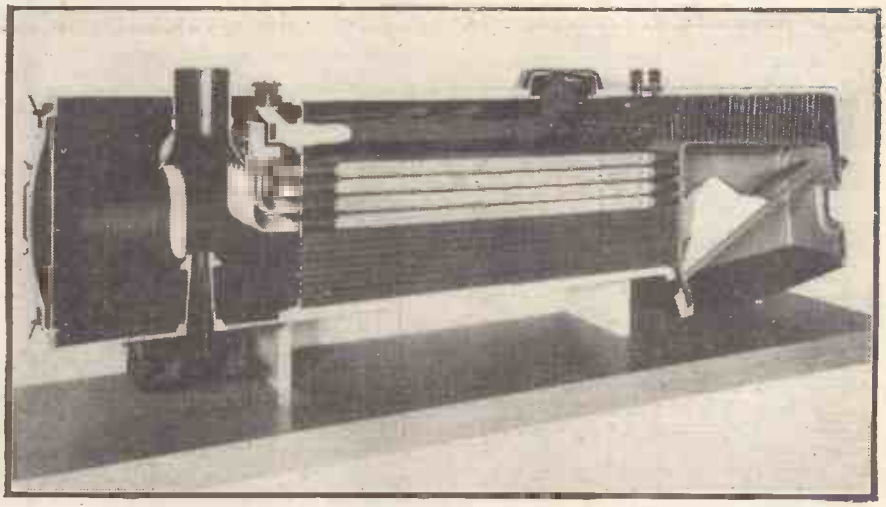


Fig. 5.—New model-making methods : sectional model of a locomotive boiler showing the special design and installation of the MeLeSco superheater.

the latter group there was a very good model G.P. "Alta" racing car, by Mr. F. Tooms, a neat, clean model in execution and finish, which also holds the amazing working record of a speed of 75 m.p.h. It was justly awarded a 1st class diploma.

Some varied examples of handcraft work, one or two trade stands, and a 00 gauge model railway layout were all to be found in this lively exhibition. Also, for the air-minded, the R.A.F.V.R. were showing a full-size aircraft jet engine. With such a catholic display there was something of interest for every visitor.

A Unique Sectional Model

All students of locomotive practice and performance acknowledge that superheated steam is indispensable for the economic and efficient operation of steam locomotives. The Superheater Co., Ltd., of Manchester, have just had a unique model constructed for them by Bassett-Lowke, Ltd., of Northampton, to show in section the design and working of their superheating system. The model is built to a scale of 2 2/5in. to 1ft. (or 1/5th full size), making a model of 6ft. in overall length. It shows a longitudinal half-section of a boiler (Fig. 5).

The interesting feature in the model is that the boiler shell and fire-box are made of multi-plywood and the superheater header is also carved in hard wood. Only the fire tubes and superheater elements are in gun-metal. This method of construction has many advantages, as hard wood lends itself to a better finish and also makes the complete model considerably lighter in weight for transport.

Being for general exhibition and demonstration purposes, the model shows clearly the special design of this superheater system. The superheater elements have a specially welded return end, which allows four 1½in. diameter tubes to pass through a 5in. fire box. The model is descriptively coloured, to indicate the principles of superheating. The line of saturated steam from the boiler dome, through the header and first element tube is coloured blue: then the colour changes to red as the steam passes through the final elements to the superheated chamber of the header and on to the cylinders. The steel grey of the boiler fire tubes is an effective background.

This model, with its innovation in the use of hard wood as building material to represent metal, serves its purpose admirably, showing as clearly as possible the operation of the MeLeSco superheater.

Trade Notes

New Mullard Accelerometer

THE accurate measurement and recording of acceleration by electronic methods is made possible by the DDR100 accelerometer tube recently announced by Mullard Electronic Products Ltd. This device is basically similar in construction to an all-glass valve of the loctal type, and has the advantage that it may be mounted in any position. This feature, coupled with the high output and excellent response of the tube at low and zero frequencies, enables it to be used with great advantage as a low mass pick-up for measuring and recording the acceleration and vibration of high velocity elements. One of the chief advantages resulting from the high output of the tube is that it makes possible the observation and recording of acceleration without the necessity of using a special high gain amplifier. This is a desirable feature in certain flight tests in aircraft, and among the numerous applications of the tube to aeronautical research is the measurement and recording of vibration on aircraft in flight. The tube should also prove of value in many fields of industrial research where the particular advantages of small size, light weight and high output are required. It may also be used quite successfully for displacement velocity measurement and recording.

The DDR100 accelerometer is a double diode with anodes elastically supported so that the anode impedance is varied when the tube is subjected to acceleration. In practice, the tube is rigidly clamped to the structure under test and the measurement is expressed in terms of a current change in a Wheatstone bridge circuit, of which the anode/cathode impedance of the accelerometer tube forms adjacent arms. The frequency range over which the response to a sinusoidal acceleration can be considered independent of frequency is 0 to 250 c/s. The resonant frequency of the tube is 1kc/s and the maximum acceleration range is 100g. The tube is designed for a heater voltage of 6.3V and a maximum anode voltage of 10V.

The output of the tube is sufficient for recording directly on a low impedance galvanometer or micrometer, but where necessary the bridge output may be fed into an amplifier and cathode ray oscilloscope, in which case the sensitivity will be 7.5mV/g.

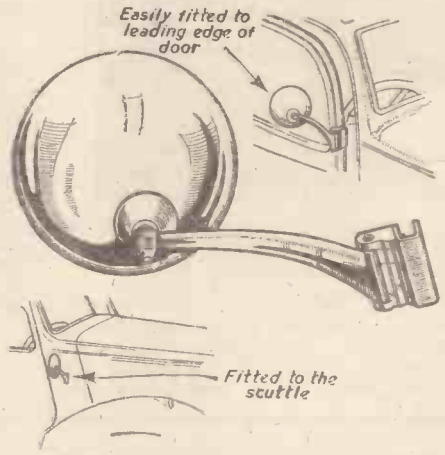
The maximum dimensions of the tube are as follows:

Overall height	78mm.
Seated height	63mm.
Overall diameter	30mm.

The list price of the tube is £12.

Chemical Apparatus

VICSONS LTD., of 138, Pinner Road, Harrow, Middlesex, have recently issued a very comprehensive catalogue of chemical apparatus which is now available to the general public. Printed on art paper, the catalogue runs to 24 pages and includes numerous items for laboratory use in "Pyrex," soda glass and "Sillax" porcelain. There are also Bunsen burners, burette stands, desiccators, flasks of all kinds, funnels, glass tubing and rubber tubing, graduated measures, retort apparatus, tripod stands and various types of bottles. There are also listed precision laboratory balances by Stanton, Vicsons Ltd. and Eta, and various sets of weights. This well-produced catalogue, which is profusely illustrated, is available to readers for 2s. 6d., post free, from the address given. Trade customers are supplied with the catalogue free by post.



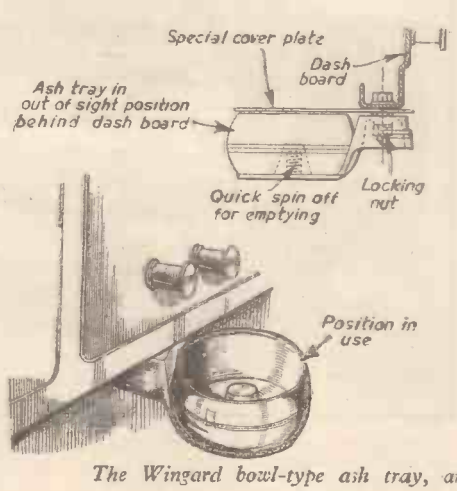
The Wingard universal extension mirror.

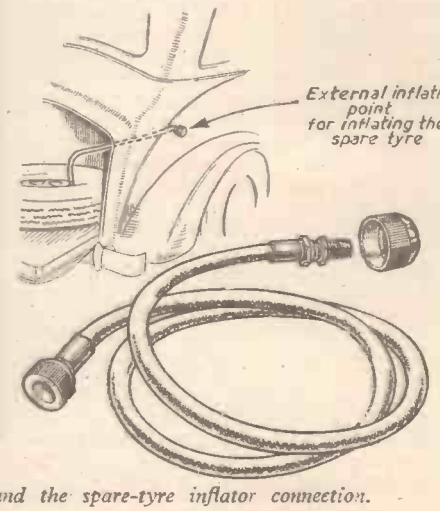
Wingard Motoring Accessories

THREE of the latest additions to the Wingard range of motoring accessories are a universal extension mirror, a spare tyre inflator connection and a bowl-type ash tray. The mirror, which is easily fitted to the leading edge of a car door, or to the side or front of the windscreen pillar, has a special adaptor which obviates the drilling of holes into the bodywork. A swivelling arm and offset ball joint give perfect adjustment in any position. When fitted to the scuttle in a "low level" position the mirror is easily adjusted for perfect rear vision.

The inflator connection, as shown in one of the accompanying sketches, provides an external inflation point for internally-stowed spares. Wherever the spare tyre may be carried, the new inflator connection provides a convenient point on the outside of the car to which the normal tyre-pump connection can be quickly fitted. One end of the Wingard connection is screened to the valve on the spare; the other end is fixed to any suitable point on the outside of the car body.

The new ash tray has a large re-entrant shaped bowl which prevents ash blowing out when doors or windows are opened. By means of a single-screw fitting, the ash tray is easily fixed to any horizontal edge—car dash, card table, office desk, etc. The bowl is arranged to spin off quickly and makes emptying a simple operation. Further particulars of these accessories can be obtained from Wingard (M.A.), Ltd., Chichester, Sussex.





The Wingard bowl-type ash tray, and the spare-tyre inflator connection.

Letters from Readers

Etching Glass

SIR,—On page 253 of the May, 1949, issue of PRACTICAL MECHANICS I came across your advice regarding the etching of glass by (a) sandblasting and (b) hydrofluoric acid.

Readers may be interested in a method which I found described in an old book called *Experimental Science*, by George M. Hopkins, published by Munn & Co., New York, in 1902. On page 152 of that book there is an illustration which has apparently been taken from the *Scientific American*—it is an old wood-cut.

The method suggested is a good one and I have actually used it successfully. I quote from the book.

"The requisites for carrying out the process in its simplest form are: A pound of coarse emery, a pound of lead shot, a wooden box 10 or 12 inches long (a cigar box will answer), some pieces of glass or metal and some paper patterns or stencils. The box is provided with a clip at the back and a sliding clamp at the front for holding the plate to be engraved, and it may with advantage be furnished with a clamping device of some sort at the upper end. The lid of the box must be provided with a packing strip of thick cloth or felt, to prevent the loss of emery.

"The glass or metal to be engraved is cleaned thoroughly and to secure the best effects it should be polished. A paper stencil of the desired form is fastened to the glass or metal plate by means of mucilage of good quality. The pattern should be made of thick writing paper, and care should be taken to see that every part of the paper is thoroughly attached to the plate. Any gum around the edges of the paper should be removed by means of a moist sponge. The exposed parts of the plate must be perfectly clean and free from streaks, otherwise there will be undesirable markings on the finished work. For coarse stencils the shot should be large and the emery coarse, but for fine work moderately fine shot and finer emery are required.

"After the plates to be engraved are placed in the box, the shot and the emery are poured in, the box is closed and the lid fastened, when the box is shaken violently endwise, causing the shot and emery to strike the plates at opposite ends of the box in alternation. The shot, in the operation of driving the particles of emery against the plates, become charged with particles of emery."

The book goes on to describe further details at length. I have used a cardboard tube with a wooden bung at one end and the glass plate fastened at the other end by adhesive tape. Round jars can be engraved by shaping the end of the tube to take the jar.—J. HOME DICKSON (Teddington).

An Old Double-beam Engine

SIR,—I was interested in your reference to the Cornish Beam Engine in the May issue of PRACTICAL MECHANICS.

Regarding this type of engine, you may be interested to know that there is running in a Dundee jute mill a double-beam quadruple expansion engine which was installed sometime about 1870. It was designed and built by a Dundee firm of engineers and is still doing yeoman service.

I can't tell you much about it, but I understand that it develops 1,500 h.p.

The flywheel is built in four sections and with shaft and cranks weighs 50 tons.

It is a straight-tooth gear wheel driving a cast-in-one-piece gear wheel of about 5 to 1 ratio.

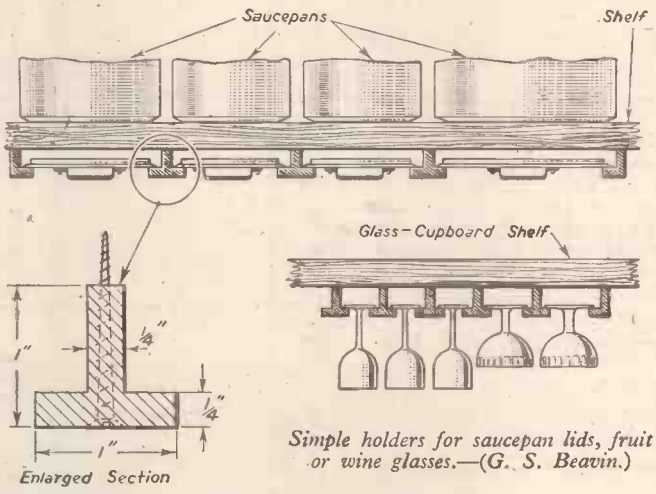
The valve gear is most unusual, being of the trip type, but appears to be of a very high standard and trouble-free.

This engine runs remarkably quiet considering its tremendous size and all-in weight, and in addition to driving a very large mill does its own condensing, pumping by rods from the beams.—C. I. BLYTH (St. Andrews).

Kitchen Saucepan-lid Holders

SIR,—The following fitment will only take the average handyman a short time to construct, and yet prove invaluable to the housewife.

From 1in. square timber (hardwood if possible), cut the T-piece as shown below. This section is then cut into lengths the width of a kitchen shelf; drill and countersink each end of the strips to take a screw for fixing, and directly under each saucepan



Simple holders for saucepan lids, fruit or wine glasses.—(G. S. Beavin.)

fix two runners the width of the saucepan lid. Continue the length of the shelf in a similar manner. At the end of each shelf, to make a neat appearance, cut off one arm of the T-section.

The lids are then accommodated in the slot directly under the corresponding saucepan.

A similar T-section can also be cut to carry fruit glasses and wine glasses on the underside of a shelf in the glass cupboard.—G. S. BEAVIN (Petts Wood).

Fog Dispersal

SIR,—One day we may see fog dispersed by a wave of suitable atomic radiation, but until then I favour the cat's-eyes, but to be really safe they should form a lane on the near side of the road. Where there is only one line in the centre you and the oncoming vehicle have to keep well out to see them. A line of, say, green ones on the kerb or roadside would be better, continued across side roads in a different pattern or spacing. At the worst you would only bump into someone going your way.

Regarding visible infra-red, it is possible, but I wouldn't like to drive by it on our roads. There is a big difference between, say, a tank plunging through enemy country and a private car on a road full of other cars.

Also, since the only rays received back would be infra-red, the image formed could only be a monochrome shadow and inclined objects would be fainter, as not so many rays would be reflected. It may be that the side of a long truck would not be seen at all.

Further, if the image was formed on a screen the driver would have to give it his full attention and learn to interpret the picture, such as with radar. If he wore a kind of binocular he could not look up at the road at all. There would be no indication of anything out of the beam or coming across the road at him.

The human eye has a wide field of view, and one is conscious of the whole surrounding area while watching the kerb or the cat's-eyes.

I can't see why fog need slow up railways with modern signalling so long as the driver knew the signal in time. With rail-guided vehicles there are many ways of warning the driver, by light signals between the rails, trip levers operating warning devices in his cabin and automatically applying the brakes, etc. Fog-signals, with their human element, seem a very old-fashioned method.

Ships, with their wider field of movement and lower frequency, could use infra-red or radar, meeting could be distinguished from overtaking by the other ship's beam, which brings another point regarding cars which seems to have been overlooked. The infra-red lamps of oncoming cars would probably blot out your screen much as headlamps dazzle.—E. W. SARGENT (High Wycombe)

Rear-light Improvement

SIR,—May I submit to you a modification which I carried out to the rear light of my cycle some time ago.

It consisted of a 3/16in. hole drilled in the bottom of the reflector; this throws a beam of light on the ground in the vicinity of the right-hand crank, so that a glance at the ground reveals whether the light is on or off.—H. HARGREAVES (Bolton).

Long Sight and Presbyopia

SIR,—In the interesting article, "Lens Calculations Made Easy," in the May issue, the paragraph headed "Spectacles for Long Sight" has been confused with presbyopia (old sight).

It is not possible to arrive at a proper correction for long sight by finding the nearest point of clear vision, as stated. Many other factors are involved in the calculation.

If the man had emmetropia (normal sight) the correct glasses for reading a book at 10in. would be $+3\frac{1}{3}$ dioptres (not $+2\frac{1}{2}$ dioptres) if his near point were 30in. This is because a person can only maintain half his focusing power (60in.) when reading, otherwise the print would quickly become blurred and illegible.

Power of the object = 40/10in. = +4 dioptres.

Power of the virtual image = −40/60in. = $-\frac{2}{3}$ dioptres.

Power of the lens (algebraic sum) = $+4 - \frac{2}{3} = +3\frac{1}{3}$ dioptres.

A long-sighted person would require this $+3\frac{1}{3}$ dioptres, *plus* his distance correction, for reading at 10in. if his corrected near point were 30in. Incidentally, his age would be about 60 years.—WILLIAM E. THOM, D. Opt., I.C.O. (Dublin).

Static Electricity

SIR,—I have a theory which I would like to have discussed by your readers.

I have never heard a *satisfactory* explanation of whence the enormous power comes from which is revealed in a flash of lightning. Nor can I agree with the various theories put forward to explain the electrical charge generated in a steam traction engine.

My theory is that, in the formation of a cloud, the latent heat of vapourisation can be, in some way, changed into electrical energy! If this is so it might be possible to construct some type of enclosed boiler and collect electricity from a condensing device above the boiling liquid. The possible developments, should this simple method of generating electricity prove practical, will be obvious to you.

All this is, of course, pure theory, and, unfortunately, I have neither the time nor the equipment to carry out experiments, but I thought perhaps some of your readers might be interested.—R. DOUGLAS (Manchester).

Purification of Acetylene Gas

SIR,—I noticed in the January issue of PRACTICAL MECHANICS a query by A. Dunn concerning the Purification of Acetylene Gas and I should like to offer the following notes on the subject:

Purification of Acetylene

Impurities.—Acetylene produced from commercial carbide contains the following: 1. Phosphuretted Hydrogen; 2. Sulphuretted Hydrogen; 3. Ammonia; 4. Water Vapour; 5. Lime Dust. Lime dust tends to clog pipe lines and may be removed together with the other impurities by a purifier.

Purifier.—This consists of a chamber filled with a chemical reagent, the gas entering the lower end and leaving from the upper end.

At the lower end the purifier contains a felt pad or layer of lump pumice which supports a layer of cleansing compound such as Puratol, Catalysol, Heratol or Klenzol, which removes gaseous impurities and arrests lime dust.

A layer of cotton wool is sometimes used to collect any finely divided solid matter which may be in suspension above the surface of the cleansing compound.

The materials mentioned above are usually supported on a perforated steel plate, beneath which a space is provided for the reception of any condensed vapour which may be separated from the gas.

Purifying Agent.—This deteriorates with use and a daily test for impurities in the gas must be made.

Test for Impurities.—A piece of white blotting paper upon which a 10 per cent. solution of silver nitrate has been placed is exposed to slightly open cock.

If spot turns black in a few seconds, it is a sign that purifier is completely exhausted. Should colour remain unchanged the gases are pure.

Regeneration of Cleanser.—Puratol is a regenerative cleanser, i.e., after becoming inoperative through use, it can be restored, in part by exposure to air.

This process can only be carried out about four times and the material regains about 75 per cent. of its properties each time.

One pound of fresh puratol will purify gas from 35lb. of carbide.

After first regeneration from 26lb. carbide; after second regeneration from 20lb. carbide; after third regeneration from 15lb. carbide; after fourth regeneration from 11lb. carbide.

Process.—Spread the material in layers about 2in. thick. Expose to air (but *not* to direct sun or heat).

Regeneration will be complete: First time after 24 hours; second time after 30 hours; third time after 36 hours; fourth time after 45 hours.

When exhausted, material is a yellowish grey. Colour will be restored after each process, but a lighter shade each time.—D. WOOLLEY (Portsmouth).

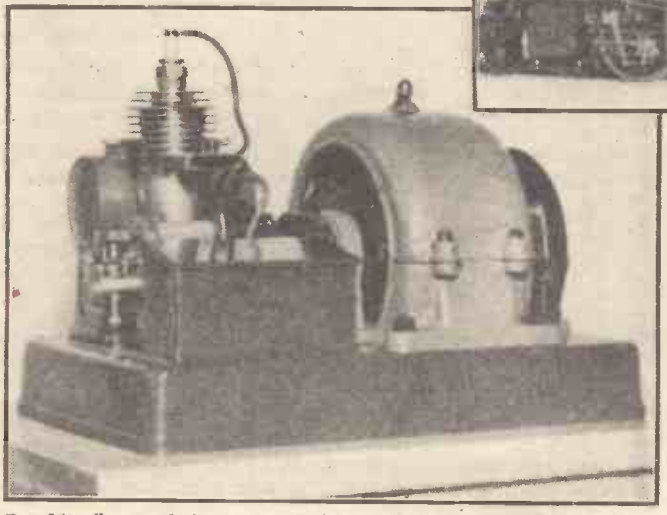
Tubular Door Chimes

SIR,—I am a regular reader of PRACTICAL MECHANICS and have just finished making your tubular door chimes with stainless steel tubes. I made the case of pink Perspex on a wooden framework, secured by chrome-plated dome-headed screws in a geometric pattern. Possibly this would be of interest to other readers.—A. WORMALD (Barnsley).

Club Notes

Proposed Model Engineering Society for Barnsley

A FEW people in Barnsley are trying to form a model engineering society, and I shall be glad if any interested readers of PRACTICAL MECHANICS will communicate with A. CHEAL, 11, Westville Road, Barnsley, Yorks.



(Left): Mr. S. Breedon's ¼in. scale L.M.S. 2-6-2 tank loco.

Dr. Lloyd's petrol-electric generating set and Mr. Lowe's cup-winning 1¼in. scale showman's road loco, exhibited at the Sheffield Model Society's Exhibition.

Sheffield and District Society of Model and Experimental Engineers

THE above society held its 6th Annual Exhibition on the 20th-23rd of April at the Junior Technical Schools.

As usual, the show was a huge success, with an attendance of upwards of 10,000 spread over the four days. The exhibition was opened by Col. W. R. Stevenson, senior warden of The Cutler's Company.

The passenger hauling track was as popular as ever, and the proceeds of this side-line were devoted to The Sheffield Newspaper's Fund for Holidays for Poor Children. The judges, who were E. T. Westbury of *The Model Engineer*, Lt. Com. J. H. Craine, and W. Young of Sheffield, acclaimed that the standard of workmanship was higher than ever before.

In all, there were about 200 exhibits of a varied nature, but not quite so many power boats as in other years, and fewer model cars.

All communications to: E. D. D. ADAMS, 8, Westwick Crescent, Greenhill, Sheffield, 8.

Book Received

Ship Modelling Hints and Tips. By Lt. Comdr. J. H. Craine ("Jason"). Published by Percival Marshall and Co., Ltd. 118 pages. Price 10s. 6d. net.

IN this book the author has endeavoured to indicate to the prospective model-maker the best methods of approach to the subject, the best methods of construction, and to guide him safely through the many pitfalls which may beset his path. Nothing is so disappointing to the ship-modeller as to find, when he has completed his model, that some parts are not to scale, or that everything is not just ship-shape. A careful study of this book will enable the reader to choose his subject, select the proper kinds of wood to be used, and to go about the construction of his model in a practical manner. There are numerous helpful illustrations throughout the book.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 80 (THE CYCLIST), 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.

Self-fluxing Solders : Solder Paint

CAN you please give me details of the composition, the method of manufacture and application of solder paint and of self-fluxing solders ?—D. Gerzon (Birmingham).

YOU can make self-fluxing solders by taking any tin-rich soldering alloy (say, tin 70 parts ; lead, 30 parts), heating it to near its melting-point and by crushing and grinding it to powder in that state. The powder is further ground when cold, passed through a fine mesh and mixed with about one-sixth of its weight of a mixture of equal parts of potassium nitrate and cream of tartar.

For use, the article to be soldered is heated and a little of the soldering compound is rubbed over it. Alternately, the heated article can be dipped in the compound. At a sufficiently high temperature, the compound will melt on and attach itself to the heated surface. The surface is then wiped with a rag to remove the scum which forms. In this way, a tinned surface is prepared, which can be gently "sweated" to similary tinned surface or used with ordinary solder.

The whole operation, in general, is (and is intended to be) one of tinning rather than of soldering.

Solder "paints" usually contain a similar metallic powder to the above, which is incorporated into a medium consisting of Vaseline thinned with paraffin or white spirit. In this case, the Vaseline contains about one-fifteenth of its weight of zinc chloride.

Such "paints" are mainly experimental and, of course, are not used for heavy soldering work.

Synthetic Rubber Moulds : Artificial Marble

I AM interested in synthetic rubber moulds and shall be glad if you will inform me where I.C.I. "Neoprene" can be obtained, and how does one prepare it for casting ? Can you tell me of any other rubber preparations supposing that the "Neoprene" is unobtainable. The American magazines advertise liquid rubber preparations for the purpose of mould-making. Is this a similar product ?

Also, could you give me any formulas for making and casting artificial marble ?—Thomas Morgan (Swansea).

NEOPRENE can only be obtained from I.C.I., Ltd., London, S.W.1, or from its branches, but we doubt whether you will be able to obtain the material in small quantities. However, the I.C.I. people may be in a position to advise you of any stockists from which you might derive supplies.

Previous to the war, I.C.I., Ltd., issued a fair amount of literature dealing with the treatment of neoprene. We do not think that this literature is still available, although, no doubt, it may be consulted at your nearest Technical Reference Library. The point is, however, that the neoprene material, when fresh, can be moulded to any shape, and that it can be left to harden automatically. There is no suitable chemical treatment which you can conveniently give it.

The liquid rubber preparations which you mention are doubtless various preparations of rubber latex, stabilised by ammonia. Such material is marketed in this country by Revertex Sales Co., Ltd., Upper Thames Street, London, E.C.4, but supplies are, at present, only available for high priority uses, and we feel sure that you would have difficulty in getting any at the present time.

An artificial stone or "marble" can be made by slaking powdered calcined magnesite with a solution made by dissolving 40 parts of magnesium chloride in 60 parts of water. This sets dead hard in 30 hours, and since it expands very slight on setting, it gives very sharp casts.

If you cannot get the magnesite at the present time, the following preparation may be found suitable :—

Paraffin or Ceresine wax ..	50 parts (by weight).	
Resin (pale)	35 „	„
Sulphur	10 „	„
Carnauba wax	5 „	„

The carnauba wax may be omitted, if desired, or varied in amount. Its function is to harden the preparation. The formula above gives a moulding composition which is quite plastic when warm, but which is hard and unyielding when cold. In making the preparation, melt together the waxes, then stir in the resin and, finally, the sulphur. Do not overheat once the sulphur has been added.

Sound and Visual Tracks on Sound Films

ON sound films the sound is recorded ahead of the picture. Could you please give me the standard measurement for this difference in the following film sizes ?

(a) Standard 35 mm. cinema film.
(b) Sub-standard 16 mm. cine film.
(c) Sub-standard 9.5 mm. cine film.

Also, could you give me any idea how many frames or pictures per foot there are in the following sizes :—

(a) Sub-standard 16 mm. cine film.
(b) Sub-standard 9.5 cine film.

—H. Smith (Bolton).

IN order for the sound-sight synchronisation to be correct, the sound track must always be advanced in front of the visual track on a sound film. This is to allow for the difference in position of the sound and picture gates in the projector and also, for other technical reasons.

On the standard 35 mm. film the sound track is 19½ frames ahead of the picture record. In the 16 and 9.5 mm. film, it is 25 frames ahead of the picture record.

Standard 35 mm. film has 16 frames per foot. With 16 mm. and 9.5 mm. sub-standard film the number of frames per foot is almost the same, viz., 40 frames per foot for the 16 mm. film and 40.5 frames per foot for the 9.5 mm. film.

Casting Objects in Soft Metal

I AM interested in casting some small badges in solder. Could you please inform me as to the best material for the mould and also the best metal to use ? I have tried plaster of paris but it is too soft as it breaks whenever I remove the badge. There are some letters embossed on the badge, which do not come out clearly.—F. George (Grimsby).

Readers are asked to note that we have discontinued our electrical query service. Replies that appear in these pages from time to time are old ones, and are published as being of general interest. Will readers requiring information on other subjects please be as brief as possible with their enquiries.

THE trouble with the soft, solder-like metals is that they all very quickly become dull. Hence, their appearance as badges is thus spoiled. Zinc would be a better metal for your purpose. It melts about 430 deg. C. There is, also, aluminium, melting at 655 deg. C., which can be liquefied in a gas furnace. Then there are the various babbitt metals, which are soft and readily melted. Any of these would suit your purpose better than common solder.

Steel or iron moulds would be best for your purpose, provided that they were well lubricated with a soap paste. Alternatively, you could use plaster of paris moulds strengthened by adding about 15 per cent. of powdered asbestos to the plaster mix. Again, there is the well-known magnesite moulding mix. This comprises powdered calcined magnesite slaked with a liquid containing 40 parts of magnesium chloride dissolved in 60 parts of water (parts by weight). This sets dead hard in 30 hours and is much more enduring than a plaster of paris mould. Unfortunately, at the present time magnesite materials are difficult to obtain, but for magnesite and magnesium chloride you might try Messrs. Reynolds and Branson, Ltd., Manufacturing Chemists, Leeds.

Spraying Distemper

I AM interested in the spraying of distemper and am wondering if you could supply me with any information on the subject.

I possess a spraying unit, and am acquainted with spraying enough to avoid loops, runs, sags, etc.

My trouble is that after "thinning down" to the viscosity necessary for spraying, the distemper runs as water from the walls.

Perhaps you could advise me as to a quick drying agent or some method to overcome this difficulty ?—L. A. Wade (Lowestoft).

THE presence of water is necessary in a distemper for it governs the action which results in the formation of an insoluble medium around the pigment particles. Without water, you could not have a true distemper. Hence, there is no "thinning" agent which could be used to cause the quick drying of the medium.

The only way in which you can experiment is in the direction of using the largest possible jet for spraying. Also, you might make some trials in spraying the medium through a wire mesh. This would take out the coarser particles of material which often serve as nuclei for the condensation and accumulation of water drops, and it would give you a more uniform but a thinner and a finer surface. We do not guarantee the method, but we recommend it for your trial.

You will also find it a help if the wall surface is slightly rough, since this will go some way towards preventing the marking of the surface in consequence of the unequal distribution of the medium over the wall.

Core Sands

CAN you recommend a good mixture for core sand, using very sharp or sea sand, molasses and sperm or linseed oil ?

The mixture I am using, whilst giving fairly good results, does not seem to be quite right. I require a mixture that will suit a variety of cores.—J. E. Legg (Axminster).

THERE is no special formula for core sand. Each core-maker usually has his own favourite one, and a sand which satisfies one operator may be condemned by another.

In times gone by, much good work was done with a core sand prepared by mixing sand, fine loam and horse manure, the mixture then being baked in an oven.

Many present-day core sands are made on a resin basis, the following being a typical formula :

Sand	96 parts (by weight)	
Resin powder	4 „	„

The above mixture is sprayed with molasses and thereafter baked in an oven at 325 deg. F.

Other core sand have "core oils" incorporated with them.

A suitable core oil may be made by dissolving 40 parts of resin in 30 parts of raw linseed oil. Five parts of dry soap shavings are added. The mixture is heated to 145 deg. C. (293 deg. F.) until homogeneous. If desired, it may be thinned down with paraffin.

The above is mixed with sand and loam until a stiff mass is obtained, which, on baking will become hard.

Raw linseed oil is always to be preferred to sperm oil, and it is usually less expensive. Also, pit sand is preferable to sea sand, since the grains of the former (not being sea-rounded) are sharper, and the interlocking of the grains is better.

Quick-drying Ink

I AM experimenting with a large-reservoir drawing pen, using a steel ball tip instead of a nib, but am having great difficulty in finding a suitable ink. The type of ink required must be fairly "gummy," as otherwise the ink runs too freely and should preferably be a quick-drying ink.

You recently gave a formula for an ink for use with a pen which would appear to be of a similar nature, but when I tried this I found that it also ran a little too freely, although it dried very quickly.

I shall be very glad if you can give me any information on this subject.—N. Panott (Nottingham).

THERE is no published formula for the precise type of ink which you require, but we think that if you make up an ink on the following lines you will, with a little experiment, be able to produce the type which you require.

Make up the following "ink medium":

Diacetone alcohol	.. ..	10 parts (by vol.)
Ethyl acetate	.. ..	30 " "
Acetone	.. ..	30 " "
Cellusolve (i.e., ethylene glycol monoethyl ether)	.. ..	30 " "

Two parts of the above mixture added to 3 parts of ordinary writing ink will make a very quick-drying ink. If the resultant ink is too pale, add a little more dye. If too thin in consistency, add a few drops of a strong solution of gum arabic.

The above liquids can be obtained from any wholesale chemical merchant, or from General Metallurgical and Chemical, Ltd., 120, Moorgate, London, E.C.2.

Making Putty: Greenhouse Glass

I SHALL be making large greenhouses of steel and would like to know if there is any method of fixing glass other than putty; if not, how I can make or obtain putty for steel frames? Also, can you give me the name and address of suppliers of greenhouse glass?—A. W. Ward (Mildenhall).

YOU will require putty for glazing your steel frames, and this material is best bought, since it is not easy to make. However, if you are willing to take the trouble, you can make it by mixing together 3 parts raw linseed oil and 1 part boiled linseed oil. The mixture is worked into ordinary whiting until a tough, doughy mass is obtained.

You should be able to purchase putty from your local ironmongery shop, or from a builder's merchant, or decorators' stores.

Sheet glass for greenhouse and hothouse purposes is usually obtainable from builders' supplies stores. Alternatively, you can purchase it from glass manufacturers or merchants, but there is still a restriction remaining on its supply. Try the following firms: Messrs. Butterworth Brothers, Ltd., Newton Heath Glass Works, Manchester; Messrs. Josiah Lane and Sons, Ltd., Eve Hill Works, Park Road, Dudley; Messrs. Pilkington Bros., Ltd., St. Helens; Messrs. John Taylor and Son, Ltd., 334-348, St. James' Road, Old Kent Road, London, S.E.1.

Quality Test for Lubricating Oils

CAN you tell me if there is any definite method of checking lubricating oil for its quality as a lubricant?

Also, do the inhibited oils show any great advantage over the non-treated varieties?

Failing a simple test, can you advise me of any firms who could give an accurate check, and the approximate fee?—F. Parbery (Instow).

THERE is no simple, single test which can be used to assess the lubricating qualities of an oil. An oil's qualities are judged as the result of several tests. You will find these detailed in the annual handbook issued by the Institute of Petroleum Technology, London, S.W.1.

There is, also, a useful handbook on the subject which used to be published at 2s. 6d. net, although we think it is now out of print. It is entitled: "Lubricating Oil Tests," by J. E. Southcombe, and was first published in 1932. You might be able to obtain a second-hand copy from Messrs. W. and G. Foyle, Ltd., Charing Cross Road, London, W.C.; Messrs. Wm. Heffer and Co., Ltd., Petty Cury, Cambridge; or Messrs. Wm. Bryce, Ltd., 54, Lothian Street, Edinburgh.

Inhibited oils have the great advantage of being non-sludging, and their tendency to oxidise is much reduced.

There are no commercial firms which would undertake private analyses of oils. You would have to call in the service of a private technical consultant, whose fee would be anything from two guineas upwards, according to the type and number of tests which he was required to make. A list of such consultants can be obtained from the Secretary, The Royal Institute of Chemistry, 30, Russell Square, London, W.C.1, or from the Institute of Petroleum Technologists.

Heat-resisting Lacquer

WOULD you please inform me what is the type of paint used on the frames of electric fires, as this is evidently non-inflammable; also, what is the formula for making a bronze paint for similar work? From whom can the paints be purchased?—F. J. Cooper (Fleet).

MODERN electric fires are lacquered with a silica-base paint, the formula of which is maintained more or less secret by the various manufacturers. There is no formula for such a paint from which you could work at home.

If you want to follow the subject up for yourself, your best plan will be to write for particulars of ethyl silicate to Messrs. Albright and Wilson, Ltd., 49, Park Lane, London, W.1, which firm issues a booklet on this material. Unless you are an expert chemist, the preparation of a silica-base lacquer from ethyl silicate might prove to be beyond your skill and experience.

Bakelite, Ltd., 18, Grosvenor Gardens, London, S.W.1, may be able to suggest one of their heat-resisting resin varnishes which you can work up into a pigmented lacquer. This would be simpler than any ethyl silicate preparation and, also, less expensive. But since formulæ for such paints have not been published, you will have to do your own experimenting.

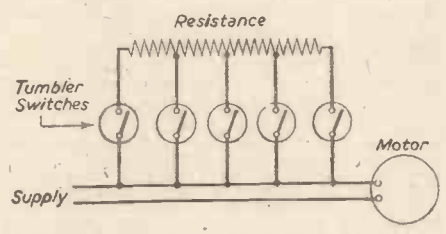
Starter for Small Motor

I HAVE a 3½in. lathe and wish to drive it with a ¼ h.p. electric motor, 230 v. single phase.

There is only a lighting circuit in my house, and it is certain that the starting load will destroy a 5-amp fuse.

Is there any method of introducing a starter which will obviate the excessive starting load and enable the motor to be run from the existing wiring?—R. Main (Southsea).

PROVIDED the motor can be started up unloaded there is no reason why you should not use a graduated series resistance starter to start the machine without melting a fuse rated at 5 amps. A simple way of constructing such a starter would be to use a 1,000



A simple starter for a small motor (R. Main).

watt 230 volt electric fire element, taking connections from the element at both ends and from three intermediate points, by means of suitable clips, to contact studs on a tapping switch. Alternatively, you could use tumbler switches to short circuit the sections of starting resistance as indicated in the diagram.

Diatomaceous Earth

I AM interested in the pre-treatment of wood waste prior to mixing with cement to form a light-weight concrete.

I have produced a good building board but am anxious to improve on it. I should like to know of any books on this subject.

I understand that diatomaceous earth has been used in the mixing of concretes. What is a diatom, or diatomaceous earth? Is there any in this country and where, or is there any substitute?—W. Bennie (Herne Bay).

THERE are no books dealing exclusively with the pre-treatment of wood. The following volume, however, refers indirectly to it, although it is now somewhat out of date: E. Hubbard: The Utilisation of Wood Waste (1920). (Pre-war published price, 5s.)

For the most recent literature on the subject, you will have to consult the patent files for the last 15 years at your nearest patent library.

A diatom is a microscopic organism, one of the order of unicellular algæ known as the *diatomaceæ*. It is practically invisible to the naked eye. These tiny plant-like structures have silica skeletons, and diatomaceous earth is, primarily, a material which is composed of innumerable fossil diatoms. The diatomaceous earth consists for the most part of silica in a peculiarly porous state. For this reason it is much employed as a non-combustible filling medium, an absorbent material, and for similar purposes. It has, as you say, been used in certain experimental concrete mixes to give lightness to the concrete.

Diatomaceous earth comes from the Scandinavian countries, not from Britain. It is quite cheap, and may be obtained from any firm of laboratory suppliers as, for example, Messrs. Griffith and Tatlock, Ltd., Kemble Street, Kingsway, London, W.C.2, or from Messrs. Vicsons, Ltd., 148, Pinner Road, Harrow, Middlesex.

Silica flour, with or without wood flour, has been used as a substitute for diatomaceous earth, but owing to the peculiar porous properties of the latter, there is no real matching substitute for it.

Magnesite Cement

CAN you suggest any substance the addition of which will hasten the setting of magnesium oxychloride cement? I made the latter with heavy magnesium oxide and a saturated solution of magnesium chloride, in quantities of approximately 3-5 grams, the materials being of B.P. purity.

Also, is any information available on the volume changes which take place during the setting of this cement, and can the volumetric changes be minimised by the addition of any other substance?—G. Thomas (Lincoln).

THERE is nothing which will hasten the setting of the magnesia mix to which you refer except, of course, a raised temperature. If you want quick setting, use as high a temperature as possible, together with a minimum amount of the magnesium chloride solution.

A similar medium can be made by slaking zinc oxide with a saturated solution of zinc chloride.

A magnesite cement containing 10 per cent. of zinc oxide which is slaked with magnesium chloride solution (saturated) containing 10 per cent. of zinc chloride, is said to have a quicker setting time than the plain magnesite mixture, but we very much doubt whether there is any substantial difference between the two.

The volume-changes of the cement depend on the amount and the physical nature of the inert materials used in the cement. If you employ only magnesite there is a very slight degree of expansion on setting, although, for practical purposes, this is almost unmeasurable. By using very light materials as inert fillers (such as whiting, talc, etc.) the volume change can be made a little greater than normal. The minimum volume change takes place with a plain magnesium oxide mixture, and there is no agency which will lower this change any further.

Smoke-producing Chemicals

I shall be grateful for any information you can give me upon the subject of "smoke making" by injecting fluid or fluids into the exhaust system of an aeroplane engine.

I have the aircraft already fitted up for the purpose, but I am unable to hit upon the correct mixture to use. The storage tank in the aircraft is aluminium and the pipes are copper, the exhaust system being made of steel.

I have tried using oil but the smoke so produced is not thick enough, and it is usually rather dirty.

I understand that a solution of antimony trichloride can be used, but I am not sure what the antimony trichloride should be dissolved in to produce the required results.

I should like to stress the fact that I am using an aluminium tank, as one fluid I tried acted upon aluminium in no uncertain manner.—J. Wallens (Norbury).

ANTIMONY trichloride is not much used nowadays for smoke-production, since it tends to be unstable and corrosive. The fluids used for this purpose are anhydrous tin tetrachloride and/or anhydrous titanium tetrachloride. These are clear liquids which, when forcibly sprayed in air, combine with the moisture therein to form the hydrated chlorides with the creation of white clouds of considerable density. These fluids can be stored in ordinary metallic containers, and they can be injected directly into the engine exhaust, although it is common practice to spray them directly into the air.

Another smoke-producer is red phosphorus, which is burnt in a forced draught. This, however, introduces some fire hazard, and this system of smoke production is not recommended.

Tin and titanium tetrachlorides are rather costly liquids, but they may usually be obtained through a firm of laboratory suppliers particularly if only small amounts are required.

You might possibly be able to get additional information on the use of tin tetrachloride as a smoke producer from the Tin Research Laboratory, Fraser Road, Greenford, Middlesex.

Marking Inks for Steel

CAN you inform me of an "ink" which will mark polished steel in a similar manner to the markings on flexible steel rules?

Photographers' hypo leaves the desired type of stain, but I am not able to control a solution of it in water, glue or flour paste solutions as it blobs when applied with a pen.

I know the method of etching with wax, etc., and require an "ink" which can be applied with a pen and which is either washed off after it has attacked and stained the steel, or will not chip, or rub off when dried.—P. Jarvis (Tenterden).

THE "blobbing" of your hypo marking ink is, we think, due to the greasiness of the metal surface. Give the surface a degreasing treatment with a caustic soda solution previous to the inking, and you should not be troubled with blobbing, particularly if you dissolve about 3 per cent. of gum arabic in the hypo solution.

The following are alternative marking inks for steel:

(a) Any dye dissolved in glacial acetic acid.

(b) A fairly strong solution of ferric chloride.

(c) A solution of copper sulphate in water to which has been added sufficient ammonia to redissolve the precipitate which first forms, and to give a deep blue solution.

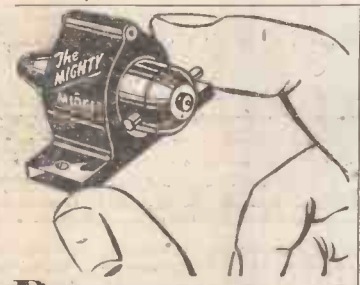
If the above solutions do not flow well from a pen, add a little surgical spirit to them (say, 2 per cent.), and dissolve in the solution about 3 per cent. of gum arabic or gelatine—preferably the former.

Waterproofing Brickwork

I HAVE a brick-built grain pit on my farm through which field drainage water is seeping. Can you please tell me if there is any waterproof cement or other preparation with which I can skim over the brick face inside the pit to render it waterproof?—B. Lancaster (Lattenbury).

THE most effective way of waterproofing your grain pit is to have a ½in. asphalt lining placed over the brick face on the *outer side* of the pit. A local asphalter should be able to do this for you at a charge of about 12s. per square yard, this not including the cost of any necessary excavating. Failing this, give the area a dressing of thick tar or of a proprietary plastic material, such as "Texaco," which is manufactured and supplied by Messrs. Baxendale and Co., Ltd., Manchester.

It is important to note that all treatments should be applied to the outer brick surface, not to the interior brick surface. This because a waterproof layer applied to the inside of the bricks might be forced away from the bricks by the pressure of the percolating water, whereas if the dressing is applied to the external surface of the brickwork, any pressure can only result in the waterproofing medium being forced more and more in contact with the brickwork.



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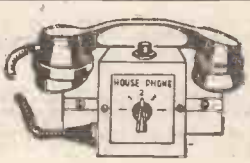

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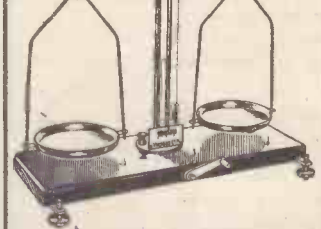

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Editor: F. J. CAMM

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Comments of the Month

By F. J. C.

Facts About Our Roads

GREAT Britain has nineteen motor vehicles to every mile of road and it therefore has the most crowded highways in the world. The United States, which is only seventh in the International List, has twelve vehicles to every mile. If all the 3,500,000 vehicles in Great Britain were to appear on the roads at the same time there would be only ninety yards between each. There are approximately 180,000 miles of roads in England, Scotland and Wales. Of these, over 46,000 miles are restricted, or roughly one mile in every four and a half.

Out of every pound earned in Britain 1s. 6d. is spent on running cars, lorries and buses. This works out at £648,000,000 from a national income of £8,500,000,000, or £13 for every man, woman and child in the country.

We hear so much talk of speed on the roads these days, but remember in the old days, those days which some of our cycling legislators [*sic!*] would like to see return, a trotting horse covered eight miles in the hour. To-day, travelling, say, between Euston and Trafalgar Square, or Ludgate Circus and Commercial Road, a 20 h.p. car averages seven miles per hour during business hours. This is according to statistics compiled by the Ministry of Transport and by Scotland Yard. In fact a few years ago a cyclist demonstrated in a test against a car that he was the faster vehicle in the streets of London.

In 1946 motor vehicles in Britain ran 18,000,000,000 miles or approximately 700,000 times the distance round the earth. No less than 900,000,000 hours were occupied in this enormous composite journey.

It is important to remember that road transport is the third largest industry in the country, agriculture and building being the largest. It employs 1,300,000 people.

Whilst the Ministry of Transport is busy creating even more stopping places and unwanted pedestrian crossings it is worth reflecting that if every motor vehicle is forced to make one stop per day at a traffic signal the value of the time and operating costs wasted amounts to £1,000,000 a year.

During a recent test on a scientifically designed motor-way a six-cylinder car was driven 100 miles. Four gear changes were made and the brakes applied three times. On an ordinary main road while covering the same distance gears had to be changed 102 times and brakes applied 491 times. On a road carrying 6,000 vehicles a year, by no means an unusual number, a minute's delay per vehicle per day costs £5,000 a year. This seems to be a sound argument in favour of using a bicycle in cities and busy towns. We give these statistics because they prove that speed *per se* cannot be the cause of accidents as is so often alleged. In fact, if anything, official statistics show that accidents are greatest in numbers where speed is low. It must follow that the more times a vehicle is compelled to stop the greater is the risk of accidents.

Diamond Jubilee Year

ALTHOUGH Dunlop patented his tyre in 1888, it was not until 1889 that it was marketed commercially, so this year sees the Diamond Jubilee of that important

John Boyd Dunlop.

event. It was the Du Cros's who saw the enormous possibilities in Dunlop's invention. The sole survivor of that famous family is Sir Arthur Du Cros and he has recorded the history of pneumatic tyre development in his book "Wheels of Fortune." He was

John Boyd Dunlop (Junr.) on the first pneumatic tyred tricycle.

honoured at a dinner given by the Roadfarers' Club on June 21st at the Savoy.

It was in February, 1888, that young Johnnie Dunlop rode his tricycle late at night to test the very first pair of pneumatic tyres made by his father.

It was a very small company which launched the original pneumatic tyre, but to-day the company bearing the name of the inventor has a capital of £60,000,000 and employs 80,000 people.

There was much opposition to the pneumatic tyre when it first made its appearance, and it was not until William Hume, the captain of the Belfast Cruisers Cycling Club, won the first races at the Queen's College sports, Belfast, that the cycling world gradually came round to pneumatic tyres.

It was Harvey Du Cros, a famous Irish sportsman, who joined Dunlop and arranged the finance for development. The first bicycle specially built to test the tyres was ridden over 3,000 miles.

The Pneumatic Tyre Company, the precursor of the Dunlop Company, stated in its prospectus that the tyre was "indispensable for ladies and persons with delicate nerves."

In 1889 and 1890, Arthur Du Cros, now Sir Arthur, scored some spectacular race victories with the new tyre and I suppose it was due to him more than to any other of the day that racing cyclists as well as touring cyclists gradually dropped the heavy solids.

The rapid success of the pneumatic tyre can be gauged from the fact that in 1896, only seven years after the formation of the company and the year in which the four miles an hour speed limit and the man with the red flag were abolished, the Dunlop Company was floated with a capital of £5,000,000. In 1916 the company had developed to such an extent that it was compelled to purchase a 400 acre site near Birmingham upon which the town of Fort Dunlop was built.

Hole and Corner Time Trials

WE cannot understand why the R.T.T.C. still insist upon the absurd secrecy rule unless it is that racing cyclists still like to think, like schoolboys, that they are members of a secret society. For, in spite of the rule, the police are well aware of all of the courses and the dates of the more important events. Indeed, it is customary for well organised clubs to inform the police of pending events and the police in most cases co-operate. The existence of the rule is probably due to the retention in executive positions of those old men whose minds are still back in the 'eighties and who have not readjusted their minds to modern conditions. Perhaps there is a little county pugnacity about the matter. They want to impose their will on others. Certainly there is no reason to-day for the stupid rule which may have been necessary towards the end of the last century when cycles were the fastest vehicles on the road.

Paragrams.

"World's Oldest Club" Celebrates

PETERBOROUGH CYCLING CLUB, whose claim to be the oldest cycling club in the world still active has never been contradicted, celebrated its 75th birthday on May 1st, with a gathering in Peterborough market-place, an official photograph and a run to Holbeach for tea with the club's oldest member, Mr. E. C. Thompson, who became secretary of the club in 1912, which position he held for a number of years, and a life member since 1924. Genuine antiques, as well as the last word in cycles, appeared in the market-place and also took part in the 55-mile run. Mr. A. C. Mundy, cycle agent, of Taverners Road, Peterborough, and the club's vice-chairman, rode 40 miles on an 80-year-old penny-farthing from his collection of old cycles. He was relieved twice on the run—and was he relieved! Another member rode a Singer tricycle, some 70 years old, with a small wheel in front and two large wheels, one on either side of the rider, at the rear. Also in the procession were an 1883 Whippet with solid tyres and an 1892 Dursley-Pedersen which, if it looked rather queer, was decidedly more comfortable than some of the old machines. The weather was perfect for the run, and a happy birthday was had by all.

Put Him in a Box!

AT least one cyclist has solved the problem of what to do with the dog when the open air calls. He has made a wooden box and attached it to a carrier behind the saddle and there the dog sits, enjoying the ride and not causing any annoyance to other road users.

Grantham-London at 72

A LIFETIME ambition has been realised by 72-year-old Mr. Arthur Edward Horne, of 46, Dudley Road, Grantham, who has just cycled to London from Grantham and most of the way back again on his 30-year-old machine. He started his 110 miles ride at 5.30 a.m. and reached London at 8.50 p.m., after a break of two hours on the road. Three days later he set off on the return journey, but only rode back as far as Huntingdon, as he had promised his wife not to cycle the full distance, and finished the trip by train. Mr. Horne says that if he feels as fit next year as he does this, he will do the journey both ways on his cycle and not trouble British Railways at all. In spite of advancing years, Mr. Horne has done several long-distance trips lately and hopes to do many more.

Following Wind Wanted

RIDING a tandem two Sheffield men plan to cycle the 870 or so miles from Land's End to John o' Groats in August. The rider in the front will be 62-years-old Gordon Shaw, with 83-years-old George Jowett behind him. Another youngster, 63 - years - old Tom White, of Manchester, is thinking of accompanying them on his cycle. They have chosen to ride from south to north because they say that in August there is usually a prevailing south-westerly breeze, and if all goes well they think they ought to be able to manage eight miles an hour and cover about 50 miles a day.

Paid For Cycling

EMPLOYEES of Nuneaton Borough Council, it is recommended by the General Works Committee, should be paid two shillings a week for using their own bicycles on corporation business. It is to be hoped that none of the employees are members of the Plumbers' Union, which refuses to let plumbers cycle with their tools in case they should fall off!

Bridge Building

WORK has started on the excavations for the foundations of a new bridge between Adwick and Carcroft, Yorks, to replace the bridge which was damaged by the 1947 floods. There is heavy traffic over the bridge, including more than 130 double-decker buses a day, and in order to prevent hold-ups the work will be done half at a time and a temporary wooden bridge will be brought into use.

Hard Words, Colonel!

SPEAKING at the quarterly meeting of the North Midland Accident Federation, held at the Town Hall, Grimsby, Col. H. Rawlings, Chief Constable of Derby, took rather a poor view of the average cyclist. He said that the recent Pedestrian Crossing Week had enabled the police to watch road behaviour in a way not otherwise possible. The behaviour of pedestrians was a great disappointment, but, he said, the worst offenders were cyclists, who just did not take care, while errand boys were one of the greatest menaces on the road.

No Kerb—Died

MEMBERS of Brigg (Lincs) Road-safety Committee are very concerned at the recent death of a cyclist who mounted the pavement near the market place and crashed into a wall. They say that the cyclist would never have been killed had the pavement not been almost level with the roadway at that spot, and they are asking the Lindsey County Council to have a proper kerb laid down at once.

Pedal Your Own Canoe

AN Indiana youth has built himself a light boat powered by the remains of an old bicycle. The bicycle frame is mounted upside down in the centre of the boat and the pedal drive is to two 2ft. paddle wheels. Mudguards are fitted over each paddle wheel to stop the boat from being swamped by its own wash. The boat is a single-seater and its owner claims that a journey of 45 miles a day—he doesn't go in for such awkward things as knots—is possible without undue fatigue. The cost of the boat was round about £15 and "Lone Eagle" is its name.

Street Lamps That See

ELECTRIC street lamps are now being produced which turn themselves on as it begins to get dusk and switch off as soon as it is light enough next morning. Fitted in the top of each lamp is an electronic eye which watches the world through a peephole. The fading light of evening operates this electronic eye and on comes the light. In darker parts of the town where there are tall buildings the lamps would light up sooner than those in open spaces where the light was better. The idea is a considerable improvement on some of the present clock systems, which switch the street lamps on during daytime and off when it begins to get dark.

Black Mark!

THE words of wisdom of a correspondent to a newspaper, written some 25 years ago on the subject of the free-wheel as compared with the fixed wheel, have come to light again. This somewhat pessimistic gentleman writes: "When any individual wishes to concoct some species of mechanism which is totally useless and calculated to increase the death rate, he usually turns his attention to cycling. A genius of this description has invented 'free pedals,' as they are termed. That is, instead of being able to back pedal down hills the pedals remain stationary owing to the back hub ring having a kind of ratchet arrangement inside it. Of course, there are various advantages to be derived from this invention. For instance, you may with the greatest of ease deposit yourself into the back of a coal cart or any other vehicle which happens to pull up in front of you." Poor old Misery had evidently forgotten that the mighty brain of man had also evolved brakes for bicycles!

Red Flash Means Death!

ON April 14, Leicester City police first put into operation a device at the police headquarters to show, day and night, a green flashing light if there were no fatal road accidents in the city, or a red light if there was a fatality. For several weeks the green light flashed out cheerfully every five seconds through the 24 hours and then for the first time it changed to red, as a 13-year-old Leicester cyclist died from injuries received in collision with a bus. The red light remains for 48 hours after the accident, flashing its message of death and the need for care on the road, before turning to green once more.

Around the Wheelworld

By ICARUS

Rear Lights

I HAVE received two letters apropos my paragraph relating to rear lights in last month's issue. Mr. K. O. Arton wishes to K.O. me by the argument that "if a cyclist is run into from behind and he has no rear light he has only himself to blame. At times it is very difficult to see dark figures at night whether pedestrian or cyclist." Another reader, Mr. W. R. Summers, writes as follows:

"Sir,—So, Icarus, you would vote against rear lamps for cyclists? (May, 1949). So would I if cyclists rode only on cycle tracks or, in other circumstances, were not likely to be overtaken by other vehicles. In my view all vehicles on the road likely to be overtaken by other vehicles should carry lighted rear lamps after dark.

"You say that pedestrians should be compell to obey traffic lights. I agree. 'I am also of the opinion that a pedestrian is as much a vehicle as a cyclist.' I agree if the pedestrian is walking in the road and liable to be overtaken by oncoming traffic, and I maintain that pedestrians, in these circumstances, should obey the traffic rules and carry a rear lamp. A front lamp I would not insist on. Surely it is far more sensible for a slow-moving vehicle to carry a rear lamp in preference to a front lamp? I would much rather avoid being run into from the rear than worry about lighting the road in front of me.

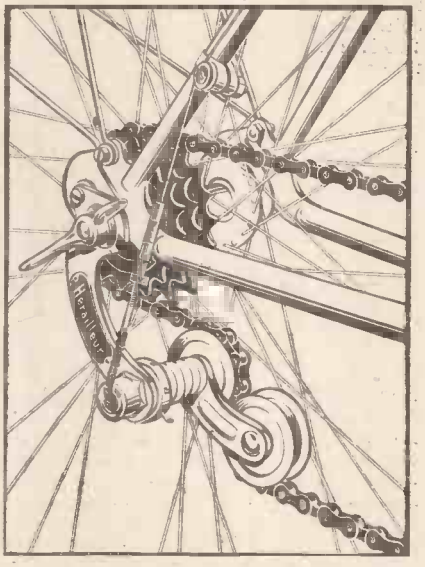
"'It is not the duty of the owner of any vehicle to warn those behind of his presence,' you say. Supposing that vehicle is stationary? It becomes then, in effect, say, a heap of stones by the roadside, or a barrier guarding a hole in the road. Would you leave these unlighted? Would you not rise in your wrath and denounce the careless county council which, perhaps engaged on road repairs, left these obstructions a potential danger to all using the road?

"I think motorists would agree with me when I say that a slow-moving vehicle with an unlighted rear lamp is more of a menace to the nerves than one with a proper lamp. When overtaking a red lamp the light can be watched with ease, but if the driver of the overtaking vehicle has to peer through the dark trying to establish the position of a shadowy form an unnecessary amount of his attention is drawn from the general business of driving and watching other traffic. 'These cyclists with no rear lamps!' says the driver. Why does one tend to get annoyed on occasions like this? Because of the unnecessary extra strain on the nerves. Surely more accidents are caused by drivers and others with bad tempers and frayed nerves than by the comparatively placid type? At least, that is one of my theories."

Ealing Cycling Club

ENTRY forms are now in circulation for the Ealing Road Race, 120 miles, open to independents and senior amateurs, also for the Feminin Grand Prix, 25 miles, open to ladies. Both events will be decided on Sunday, July 3rd, 1949, starting from Greenford, Middlesex. Invitations have been sent to the French, Scottish and Irish cycling federations.

Sir Arthur Du Cros, sole surviving member of the family which launched the pneumatic tyre. Sir Arthur won many important cycle races in the 'nineties. *(See article on previous page.)*



The new Hercules derailleur.

Mr. F. J. Camm timing a cycle race.

A special invitation has been sent to the French F.S.G.T. to send three of their best girl riders for the ladies' event. If accepted, this will be the first time that French girls will be seen in action on English roads in a cycle road race.

Councillor Watling

IN the recent Urban District Council elections for Kenilworth, Major H. R. Watling, director of the British Cycle and Motor Cycle Manufacturers' and Traders' Union, Ltd., was re-elected for the Castle Ward by 690 votes to 236.

New Derailleur

THE Hercules Cycle Co. announce that they are producing a new derailleur type chain gear which has been given the name of Herailleur. It is claimed to be the newest and fastest chain gear, with exclusive technical features such as configurated rollers mounted on ball bearings. Operated from the handlebar by a synchro switch it gives an automatic gear change of micrometer precision.

It is also claimed that the design is such that the possibility of "chain-jumping" is eliminated, and may increase cycle speeds by five miles per hour.

For the present, limited production makes it necessary to offer this gear as optional on the Kestrel Super club model only.

Damaged on the Railway

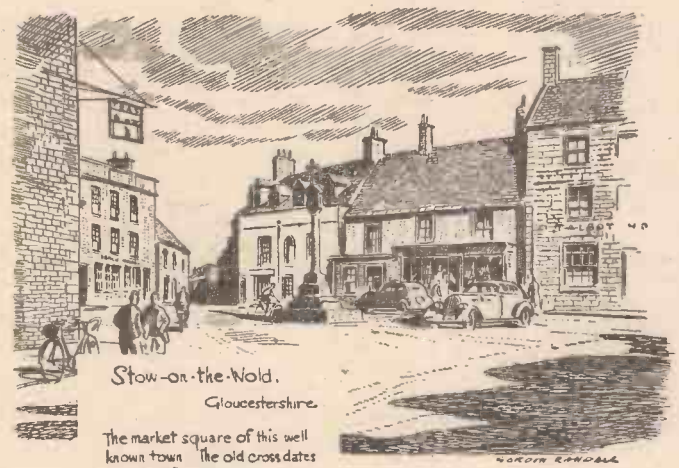
THE railways of this country are woefully negligent in their handling of bicycles. Even crated new machines arrive badly bent, scratched, and often with accessories missing. The other day a new bicycle arrived for me. Its containing crate was smashed and the front forks had been pushed back, rendering the machine unrideable. Second-hand machines are treated just as badly, and if you adopt the practice popular with many, of taking your bicycle by train, say, to the Lake District, and conducting your cycle tour from that point, the chances are that when you collect your machine it will be damaged in some way, or the pump or lamp will be missing.

Now, cycle charges are by no means modest; the railways, indeed, for many years have looked upon the bicycle as a serious competitor, and their charges, it would seem, therefore, have been punitive. Their whole attitude towards the transport of bicycles is that they would rather be without them.

The shortage of spare parts and the difficulty of getting the machine repaired promptly, as well as the need for economy, makes the problem more serious. Now that the railways are owned by the State, represented by a Government elected by a section of the community which is largely cyclist, I suggest that this matter needs investigation and the application of prompt remedy.

Wayside Thoughts

By F. J. URRY



Stow-on-the-Wold, Gloucestershire.

The market square of this well known town. The old cross dates from the 14th cent. Nearby in 1646 a battle was fought and many Royalist prisoners were held in the parish church for a long period. The town contains many lovely stone buildings.

A Good Example

HANS OHRT, the old cycling champion of U.S.A., is a character amid the wheeling circles of the States, and particularly in sunny California. He is one of the few world-famous figures in the sport of cycling who has kept his love of the game fresh and vigorous, and loves nothing better than the opportunity of stating his belief in the game and encouraging others to emulate his fitness. Pity there are not more such in the wheel world, who marry partners with a flair for the outdoor life and the comforting rhythm of pedalling, for as people grow to middle age and lose their quickness far too many are content to accept leisure as a rest rather than as an adventure and discovery. Here is an erstwhile champion content to accept gracefully the passage of time by using it for the active pleasure of roaming the delightful land in which he lives. To lag superfluous in competition is no doubt unwise, but when the perfect stylist of the sport says in effect, "Now I can enjoy cycling as apart from racing, and because I know how to ride it will be a superb pleasure," that is wisdom of a high order. It is what Hans Ohrt has done and is doing, which sets a fine example to every old racing man, far too many of whom fall out of the parade when the hectic days of their victories are over. I have been cycling most days for sixty years, and some of my friends seem to think I ought to grow tired of it, but the very opposite is the case, for now I find I can play this game as well as ever, even though the pace has slowed, and that very fact makes the way more lovely by being more observable. And there is another thing that counts enormously: as you grow older the seasons seem to be more beautiful, probably by reason of the fact that there are fewer of them to come to you, and certainly you have more time to assess their loveliness.

Go, and Take the Risk

IF any of you who glance at these notes have never been on a cycling holiday, may I encourage you to try one? Don't think of such a trip in the matter of miles, what you will do on a wet day or how you will fare along the road, but just go. Select the district you want to see, take your maps, persuade one or more good companions to join in, and forget the rest. It is so easy to worry yourselves with details that the whole job may well become a bore ere you start. I know there is a risk about this advice, but that is part of the adventure, and, personally, I have always found country people hospitable and ever ready to help if need be. But the risk is very slight now, and the joy of complete freedom from when and where your day will end is one of the great incidents in cycle touring. I am just now contemplating such a journey in the company of a couple of schoolboys, and I'm going to thoroughly enjoy it. We shall take a pocket primus, what provisions the home larder can provide, buy our bread and milk and eggs from friendly people and picnic in the most delectable spots, and if I mistake not those two lads will be in elemental exploration and take me along with them. It is a fine feeling of anticipation, and I know it will work, for how well I remember my first tour when I was twelve, a journey that opened my young eyes to the beauty of the land, and they have never been closed since. Indeed, the more touring I can squeeze into my limited leisure the richer life becomes, and never yet have I wanted to turn round and go home. There are lovely places to see, visions that are for you alone at the moment of passing, and the miles are the last item to count, for in very deed they are but the way to beauty, and mean nothing in themselves.

The Windy Way

IT blew! The saplings were certainly plied double, and I saw quite a lot of riders in trouble, or at any rate seriously at work to combat the draught. Nor do I pretend I found the going easy for the wind was staggering and came at you in fierce gusts. As soon as I could I turned into the little lanes, where the close hedges and the winding ways gave some substance of shelter, so that I made a steady eight or nine miles an hour with a remarkable degree of comfort. But a lot of the ease was acquired by the use of the second gear of a four-change hub, a gear in the region of 52in. which I could twiddle without swinging my weight from pedal to pedal in the effort to obtain speed. It was the kind of morning when I was glad to be on my own and dictate my own speed without the mental knowledge of the inconvenience in holding a more vigorous companion to my simple amble, for I like to ride at such times well within my powers in order to enjoy the scamper home when the time comes to return. That is always worth keeping in mind on such a day. Usually my gears are not put to work without necessity; indeed, during my daily journeys I rarely touch the change trigger to disturb the easy beat of my very modest normal; but that morning the changes were a comfort, giving me moderation in speed without undue effort. The climatic conditions suited the gears to perfection and the little experience was a supreme example of their value to an ancient rider. For once, the story of change gears as depicted was correct in every detail, and I was quite happy about it. I was nearly a couple of hours in making fifteen miles without a dismount, and then I joined a few friends who had started half an hour later, who were blown and warm by pushing away that gale, and we drank and made merry. They went on, I had to return, and what a glorious wind-wafted hour that was for the old thing, for I turned over a 75in. gear faster than at any time during this year. The old Adam of speed dies hard in us still.

You Must Realise——

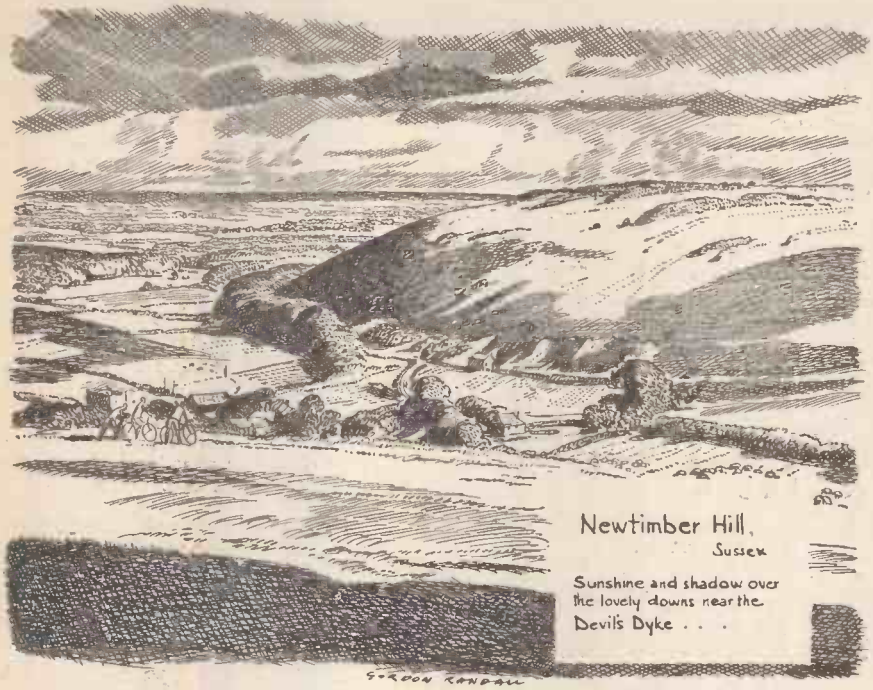
CLUB life has grown difficult in these days of high prices and changed values; difficult to make ends meet and keep up a healthy activity. Yet club members in the bulk seem to object to paying the piper; they do not like any kind of talk with a suggestion of increase of subscription as its subject. Why? Perhaps the answer is that most clubs are to-day giving their adherents greater value in return for subscription than ever was the case before, and because all of us concerned actively with club life are prepared to pay more than our whack for such preservation, and hate to think in terms of doubling the subscription; and the younger generation are being rather spoiled by the generosity of the older. That is how I read the matter at the moment; but like most other fellows who have studied the subject, and the balance sheets, the matter cannot rest on such rather slim foundations, for the older folk will die off in the course of time, and their present support may not be replaced. If club life is worth while, then it is worth paying for, and wholeheartedly I am in favour of this delightful phase of the cycling game, and so I think are most of the old boys. I have never been of the opinion that a club concerned with the sport and pastime of cycling should develop into an institution for building up big reserves, for that is too frequently a reason for quarrel, but I am in favour of keeping a club within its income and not putting on the shoulders of honorary officials the burden of carrying financial responsibility as well as organisation.

Not Much Trouble

JUST over a year ago I changed all my war assortment of tyres for new open-side covers—and went on my way rejoicing. At the beginning of March I had my first puncture for nearly a year, and so immune had my tyres been that I didn't believe it, so without examination I changed the valve rubber, inflated and started for home. The ominous bump occurred within a mile on the way, and like a fool I let the machine run on to a sheltered alcove where I could attend to the trouble away from the traffic pressure and the inquisitive small urchins of the district. There it was, the trouble, a nice fat hobnail right in the middle of the tread. Off came the cover with the aid of my little steel tool (a 4in. length of tempered saw blade shaped to a blunt screwdriver at one end), and, of course, my persistence in letting the tyre bump over the sets had given the nail leave to perforate the bed of the tube. It was a good job I looked for this damage or a further detachment would have been needed. The whole job occupied me just 12 minutes and I did not hurry. I timed the operation because so many people seem to think the trouble of a puncture is a serious handicap to the use of light tyres. When you have to search for the damage time is occupied, but when the enemy object advertises itself, as in this case, the matter is simple. Usually, I reckon on an average of three punctures a year, mainly collected on my daily town journeys where the mixture of glass and nails is more deadly than the thorns of the countryside.

CYCLORAMA

By H. W. ELEY



Newtimber Hill, Sussex

Sunshine and shadow over the lovely downs near the Devil's Dyke . . .

Established in "1797"

SOME time ago I wrote of old-established cycle trade businesses, and had the temerity to ask readers who had connections with old firms or shops to write in and give some details. For a while, there was no response to my request, but the other day I was delighted to get a letter from Mr. T. E. Rose, of the firm of T. S. Rose and Sons, of Uxbridge. Here is an old business indeed! Mr. Rose states that the business was started in the year 1879 by his father. The original premises consisted of a small shop in Carrick's Yard, and the founder made and sold "Penny Farthings." It took a fortnight to make one machine, and the bikes sold for about £14. It is interesting to note that Mr. Rose's nearest competitor was at Shepherd's Bush! For fifty-three years the father of Mr. T. E. Rose carried on this fine old family business, which is now conducted by Mr. T. E. Rose, two brothers and a sister. In normal times they carry a stock of 150 cycles. What a family business romance! And how good to hear from this trader who can look back on such a proud record. Now, more letters, please!

Lush July

COME July, and we have the fullness of foliage on our trees, the lush grass in our meadows, and there is a riot of wild-flower life in every hedgerow and ditch. Little scarlet flowers grow bravely amid tangles of nettles; the trees meet overhead as I walk down my favourite lane, making a green canopy of shade which is welcome after walking many miles under the July sun. By the side of the stream which meanders through the lush meadows, red and white cattle stand, swishing their tails to ward off the myriad flies, and occasionally they step through the squelching mud by the edge of the water and cool themselves in the stream. It is a pleasing picture they make on this summer's day, and as I take my ease under a hedge, after my warm walk, and light my pipe, and contemplate all the green glories of this July pageant, I am glad that I am in England . . . and in her beauteous countryside. . . .

A Fleet Street Memory

THE other day, I had business in the "Street of Ink"—and as I walked past the old "Cheshire Cheese" I met an old journalistic friend of the years ago . . . a man who knew Fleet Street in the ancient days when hansom cabs rattled along, when horse-drawn buses were in vogue, and when the street was innocent of petrol fumes. And we fell to talking of those incredible boys who rode bicycles, carrying bundles of newspapers, and darted in amazing fashion between drays and buses, and seemed to bear a charmed life. They were a tradition, those boys; they avoided accidents with astonishing ease; they were perky and precocious, and their reading matter consisted of "blood and thunder" periodicals which recounted the astounding adventures of "Deadwood Dick" and a host of characters which have long since gone into oblivion. But those urchins could ride cycles! I almost slipped into modern jargon and said, "and *how*."

Good Cycle Advertising

I HAVE referred previously to the very outstanding advertising being issued by some of our cycle manufacturers, and I have been greatly impressed lately by the colour advertising of Hercules. In several periodicals, full pages in colour are appearing, and the art-work is excellent . . . and the "copy" convincing. Although I am now retired from the "advertising game" I find that my heart is still very much in the business, and I like to see these evidences of the virility and progressiveness of firms in our good old industry. I fancy that the hand of my old friend MacLachlan, the Hercules advertising chief, is behind their fine efforts.

In Tulip Land

HAVE you ever cycled in Lincolnshire? It's a large county . . . second only to Yorkshire in size . . . and I know that some riders complain that it is too flat for interest. But this "flatness" bogy is silly . . . there is good undulating country in Lincolnshire, and I recall some good and interesting riding around Louth many years ago. But I wanted to talk of the Lincolnshire bulb-fields, for this spring I saw them, and revelled in their colourful beauty. Holland has "nothing on" our own Lincolnshire with regard to the beauty of bulb fields, and I suggest that a note is made, when thinking of next year's touring, to take a trip to Lincolnshire . . . to Spalding and vicinity. Those acres of flowers are a delight to the eye, and they represent tremendous work, and a lucrative business. As I gazed, fascinated, at those acres of flowers, I thought of the infinite variety of the English scene: here was Holland in England . . . and only just previously I had been riding in the Welsh border country, and finding new beauty and charm in the villages around Shropshire and Hereford.

A Catalogue . . . and a Memory

THE pages of time were turned back for me the other day when I was browsing among some old files and papers . . . during one of those spasmodic "clearing out" crazes which I fancy come to all of us at times. A catalogue of "Mead" bicycles! Unfortunately, no date appeared on the publication, but I fancy that it must have been issued round about 1909 or 1910, for then it was, I think, that the Americans made a bid for the English cycle market . . . made a bid, and failed to capture the market which was so strongly held in those far-off days by Swift, Rover, Humber and Rudge-Whitworth. I remember the "Mead"—but I forget the sales and distributing arrangements. Possibly these remarks about a bike which most of us have long since forgotten, will strike a chord in the mind of some "old-timer," and I may get another interesting letter. I hope so.

Nature Note

NOW is the time for the keen naturalist to take his walks abroad, for in the countryside there are all manner of interesting animals to be seen, and although in the realm of bird-life there is an absence of song after the choruses of spring, the furry creatures of field and hedge-bank are active and fascinating in their ways. Not often have I seen a badger . . . for you may live in the heart of the true country for many years and fail to catch a glimpse of friend "Brock"; but a week ago I was fortunate, and in the gathering dusk of a perfect summer's day I caught sight of a badger near to a marl pit. A fine big fellow, but very shy . . . and he soon sensed a human presence, and slipped away. And after that I saw a family of weasels slipping over a lane, to their home in the hedge-bank. Lithe . . . wily . . . intensely cruel—with the larger stoat, an animal that puts dread into the hearts of other creatures. My friend the hedgehog is with me, and runs with astonishing speed over my lawn when he spots the saucer of milk I put out for him. Yes! the world of wild life is vibrant and ardent on these July days and nights. . . .

Longborough Glos
Evening shadows fall across the green of this picturesque Cotswold village situated on the hillside below Sezincot (Moreton-in-the Marsh, 3 miles).

GORDON RANDALL

My Point of View

By "WAYFARER"

Towels

IT will be interesting to see how long it takes caterers to realise that, with the end of clothes rationing, they are now in a position to provide overnight visitors with towels, instead of compelling us to carry our own. I imagine that this aspect of rationing will take some little time to sink in—unless we cyclists adopt a firm stand.

Defects

I FILLED an idle half-hour recently by examining a lot of bicycles which had been dumped around the perimeter of a football ground in the country. Without actually counting up, I reckon that about nine-tenths of the valve dust-caps were missing, and that the same proportion of the tyres were under-inflated. To my way of thinking, flabby tyres are uncomfortable, as well as being more prone to gather up foreign bodies. Further, the best way of wearing out a tyre is to under-inflate it. It seems useless, however, to preach to the type of cyclist who uses his machine merely as a hack, and who flings it indiscriminately into the hedgerow what time he watches a football or cricket match. With regard to dust-caps, I always feel that a bicycle has an incomplete appearance without these trifling fitments, whilst it does not help to secure immunity from tyre troubles by omitting to protect the valves in the manner indicated.

Threatened Men

THE Minister of Transport stated in the House of Commons recently that the recommendations of the Committee on Road Safety concerning the compulsory fitting of cycles with two efficient brakes and a bell were under consideration. As *cyclists* already see to it that their machines are provided with these necessities (with the variation of one brake in the case of a bicycle with a fixed gear), the threatened legislation, when it comes, will have little impact on us. The people who will be affected are the so-called "cyclists" who ride anything and anyhow, being completely indifferent as to the condition of their steeds. I hope, by the way, that there will be no opposition on the part of organised cycling to the suggested regulation or law. The compulsory fitting of two efficient brakes and a bell will be no hardship: it may—or may not—contribute something to the reduction of road accidents, the prime cause of which must be sought elsewhere.

I realise, by the way, that there are a few *cyclists* who refuse to carry bells. Their attitude is incomprehensible, and it always appears to me that, in the event of their being involved in an accident, their position is liable to be prejudiced because of the refusal to fit a bell. I know, of course, that one can just as readily give warning of approach by word of mouth—which is quite legal—but the police and the magistrates look with disfavour on those cyclists who do not carry bells.

Topsy-turvy

TO my essentially simple mind it seems a bit odd that the Raleigh Company's extraordinary achievement of exporting 1,000,000 bicycles since the war should be written up in *The Times* by "Our Motoring Correspondent." What in the world cycling has to do with a motoring journalist eludes me, but I live in hopes of seeing the same august newspaper's Saturday religious article being contributed by "Our Racing Correspondent" and the Football Notes by "Our Music Critic." I am all for variety and novelty!

By the same token it is slightly odd that "Our motoring Correspondent" should have been delegated to write something about the draft convention on road transport which is to be considered by the World Road Conference next August. Hence the headline: "Single-file for Cyclists"—as though that were the most important item in the draft convention! Perhaps it is: indeed, I have encountered motorists who object to even single-file riding for cyclists.

Interesting Fiction

THE fairy tale about the death of cycling—the sustained and long drawn out demise, I might fitly say—has not been so much on the lips of the pundits as was the case a few years ago, when the coming of the motor-car killed a glorious pastime, the pressure of traffic on each and every road throughout the Kingdom having extracted all the pleasure (if any) to be derived from the process of pushing yourself about the country, with certain physical exhaustion as your reward at the day's ending. Besides, what individual in his right mind would continue to use up his energy when he could obtain greater lumps of travel with the aid of several horses in effortless ease?

The answer to this contemptible fairy tale is to be found in the continuous growth of the cycling vogue, despite the unreasonable conduct of a minority of selfish motorists and despite, too, the alleged overcrowding of our roads. The answer is to be found in the expansion of clubs—in the hordes of cyclists to be seen emerging from populous places at week-ends—in the tremendous popularity of touring. The answer is also to be found in a little news item about last Easter Monday, when the steamer service between Portsmouth and Ryde had to be augmented "for the first time in 100 years" by a special vessel for cyclists, which carried 633 bicycles. If this all spells "death," let's have more of it!

Space

A MOUNTAINEERING fan who writes for one of the daily newspapers I read contributed a recent article in which he stated that he had journeyed on foot from Portmadoc to Llanelly, a distance of 168 miles. "Every day's travel," he wrote, "renewed for me the miracle which most visitors from abroad observe but which natives of the British Isles seem often to ignore: the miracle that, over-populated as our country is, we possess great spaces of unspoilt hills which have no equal in the world for beauty."

It is the matter of space rather than of loveliness on which I would dwell for a moment. Ours, I suppose, is one of the most thickly populated countries in the world, and one often gains the impression that there isn't room to put up another house anywhere. That impression is very quickly destroyed with the aid of the bicycle. Let the handiest of all road vehicles take you to one of the only moderately high places in these islands—to the Cotswolds or the Malverns or the Clee Hills—from which you can see spread before your eyes leagues of loveliness with hardly a dwelling in sight. Here is space, and it may be written down as one of the advantages of our pastime that it bestows upon us a new orientation of the conditions in which we live. Even those moderately high places mentioned show us the spaciousness of our land and suggest that, despite the abomination of ribbon development and the growth of cities, there is still ample room available for all of us—room to stretch ourselves and to breathe. The bicycle does add to our knowledge and improve our education.

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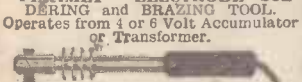

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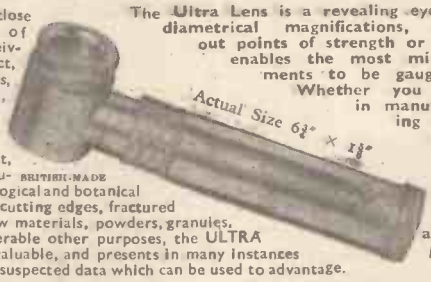

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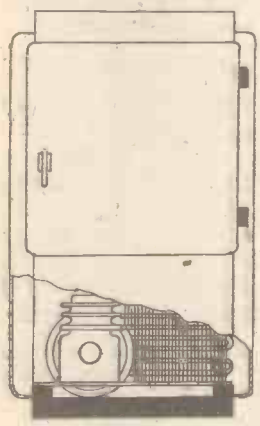

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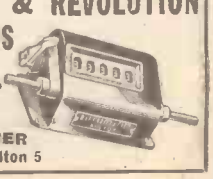

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