Palin

GAS–TURBINE DEVELOPMENT

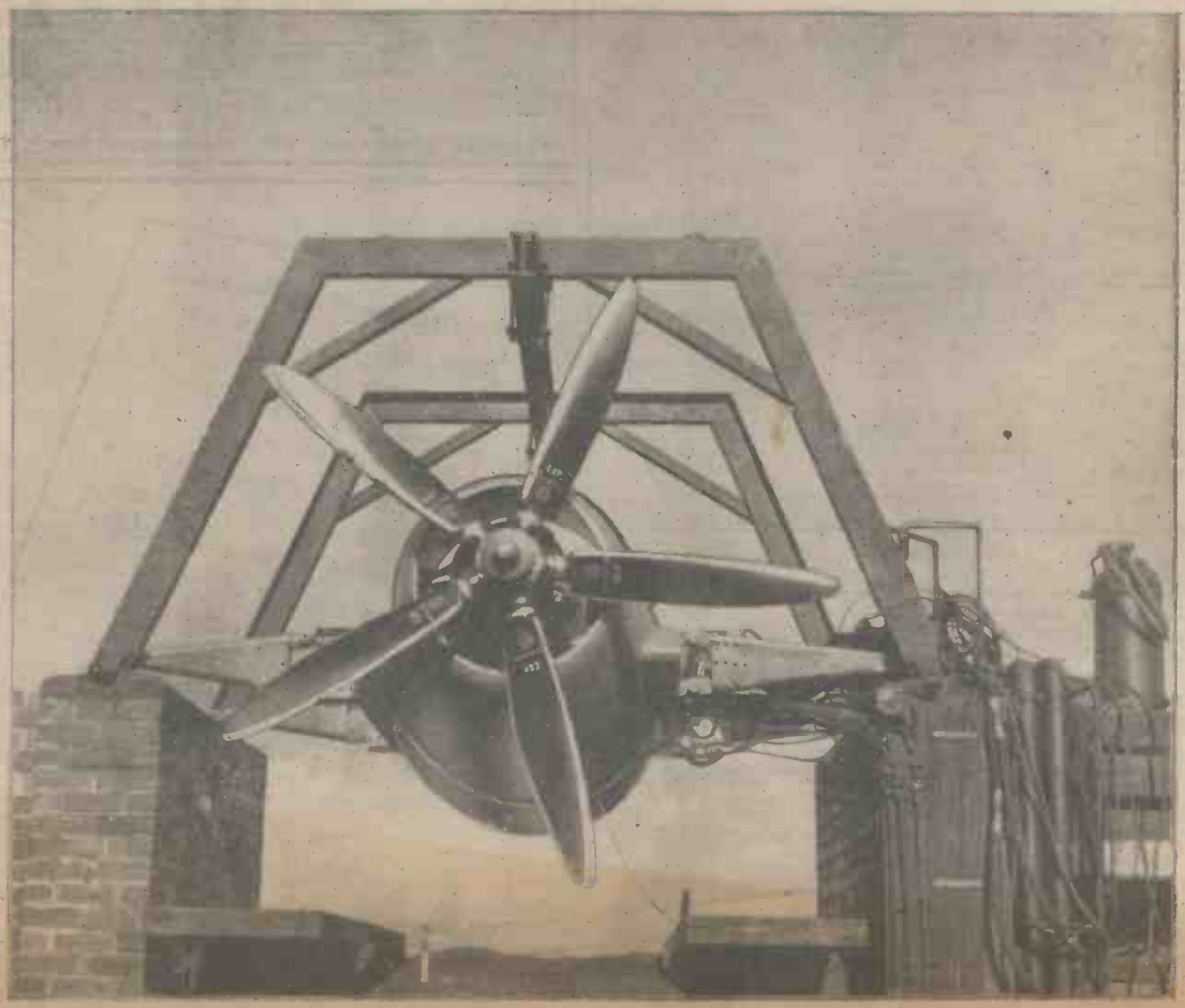
NEWNES

# PRACTICAL MECHANICS

9D.

EDITOR: F. J. CAMM

MAY 1946



# Join the Well-paid Ranks of the I.C.S.

# TRAINED MEN

**THERE IS ALWAYS A GOOD POSITION FOR THE MAN WITH A SPECIALIZED TRAINING, BUT THERE'S NO WORTH-WHILE PLACE FOR THE UNTRAINED**

*Ambitious men everywhere have succeeded through I.C.S. Home Study Courses. So also can you. We offer you the benefit of our 55 years' matchless experience as the creative pioneers of postal instruction. Since our establishment in 1891, more than 1,000,000 British men and women have enrolled for I.C.S. Courses.*


The man with an I.C.S. Training in any one of the subjects listed below knows it thoroughly, completely, practically. And he knows how to apply it in his everyday work.

Accountancy
Advertising
Aeronautical Engineering
Aero Engine Fitting
Aero Fitting and Rigging
Aeroplane Designing
Air-Conditioning
Aircraft Eng. Licence
Architecture
Architectural Drawing
Boilermaking
Book-keeping
Building Construction
Building Specifications
Business Training
Business Management
Carpentry
Chemical Engineering
Chemistry, Inorganic and Organic
Civil Engineering
Clerk of Works
Colliery Examiner's
Colliery Overman's
Commercial Art
Concrete Engineering
Cotton Manufacturing
Diesel Engines
Draughtsmanship (State which branch)
Drawing Office Practice
Electrical Engineering
Electric Power, Lighting, Transmission, Traction
Eng. Shop Practice
Fire Engineering
Fuel Technology
Garage Management
Gas-Power Engineering
Heating and Ventilation
Hydraulic Engineering
Hydro-Electric
Joinery
Journalism
Machine Designing
Machine-Tool Work
Marine Engineers
Mechanical Drawing
Mechanical Engineering
Mine Surveying
Mining Electrical
Motor Engineering
Motor Mechanic
Motor Vehicle Elec.
Municipal Eng.
Plastics
Plumbing
Quantity Surveying
Radio Engineering
Radio Service Eng.
Ry. Equip. & Running
Refrigeration
Salesmanship
Sanitary & Domestic Eng.
Scientific Management
Sheet-Metal Work
Steam Engineering
Structural Steelwork
Surveying (State which branch)
Telegraph Engineering
Telephone Engineering
Textile Designing
Welding, Gas & Elec.
Woodworking Drawing
Works Engineering
Works Management

And most of the Technical, Professional, and Matric. Exams.

Special terms for members of H.M. Forces and discharged disabled members of H.M. Armed Forces.

*If you need technical training, our advice on any matter concerning your work and your career is yours for the asking—free and without obligation. Let us send you full information regarding the subject in which you are specially interested. DON'T DELAY. Make ACTION your watchword.*

**The successful man DOES to-day what the failure INTENDS doing to-morrow. Write to us TO-DAY**

.....Use this Coupon.....

**INTERNATIONAL CORRESPONDENCE SCHOOLS LTD.**
**Dept. 95, International Buildings, Kingsway, London, W.C.2.**
(Use penny stamp on unsealed envelope)

Please send me particulars of your courses in.....
.....
Name..... Age.....
(USE BLOCK LETTERS)
Address .....
.....

**Addresses for Overseas Readers**

Australia : 140, Elizabeth Street, Sydney.
Egypt : 40, Sharia Malika Farida, Cairo.
India : Lakshmi Bldgs., Sir Pherozsha Mehta Rd., Fort, Bombay.
New Zealand : 182, Wakefield Street, Wellington.
South Africa : 45, Shortmarket Street, Cape Town.

ICS

**THE "FLUXITE QUINS" AT WORK**

*This old vacuum's now good as new,*
*Trust FLUXITE to see the job through,*
*Just hark how it hums, and what power, my old chums!*
*"It's not sucking, it's BLOWING!" cried OO.*

For all SOLDERING work—you need FLUXITE—the paste flux—with which even dirty metals are soldered and "tinned." For the jointing of lead—without solder; and the "running" of white metal bearings—without "tinning" the bearing. It is suitable for ALL METALS—excepting ALUMINIUM—and can be used with safety on ELECTRICAL and other sensitive apparatus.

***With Fluxite joints can be "wiped" successfully that are impossible by any other method.***

Used for over 30 years in Government works and by leading engineers and manufacturers. Of all Ironmongers—in tins, 8d., 1/4d. and 2/8. Ask to see the FLUXITE POCKET BLOW LAMP, price 2/6d.

● TO CYCLISTS! Your wheels will NOT keep round and true unless the spokes are tied with fine wire at the crossings AND SOLDERED. This makes a much stronger wheel. It's simple—with FLUXITE—but IMPORTANT.

THE "FLUXITE" GUN puts "FLUXITE" where you want it by a simple pressure. Price 11/6 or filled 2/6.

ALL MECHANICS *WILL* HAVE

# FLUXITE

**IT SIMPLIFIES *ALL* SOLDERING**

*Write for Book on the ART OF "SOFT" SOLDERING and for Leaflets on CASE-HARDENING STEEL and TEMPERING TOOLS with FLUXITE. Also on "WIPED JOINTS." Price 1d. Each.*

**FLUXITE LTD., Dept. P.M., Bermondsey Street, S.E.1**

**Film Shortage—The Facts**

Photographic dealers often have to say 'No Films' because they are only receiving a fraction of their pre-war supply. We are sorry, but we cannot let them have more because of labour shortage and the obligation to export part of our output. Better times are coming however, and Ilford Selo Films, embodying the scientific advances of six years, will then be in full supply.

ILFORD SELO FILMS

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



# PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XIII MAY, 1946 No. 152

FAIR COMMENT—BY THE EDITOR

## The London Airport

THE London Airport, formerly known by the name of Heathrow, has been officially opened but is still subject to further development. The name Heathrow is extremely difficult to pronounce in many foreign languages and that is why its name was changed. The area now under development lies south of the Bath Road. Subject to the obtaining of the necessary powers from Parliament, it is intended to acquire additional land for the further development of the airport. It is not possible to indicate to-day what the proposed ultimate boundaries are.

It should be understood that development of the additional area north of the Bath Road will not begin until 1950. Naturally householders wish to know where they stand. The area south of the Bath Road now under development will have six runways consisting of three parallel pairs arranged around a terminal building.

The first three runways, construction of which was started by the R.A.F., will all be completed by the summer of this year. They are 9,000, 6,000 and 6,000ft. respectively. The main runway can be extended to 15,000ft. if the need should arise. These three runways are all 300ft. wide, and have been constructed with a view to taking the heaviest aircraft now designed, including the Brabazon I. A control building, apron and hutments constructed by the R.A.F. will be modified to provide temporary traffic handling and other facilities. They lie between runway No. 1 and the Bath Road. These will be superseded at a later date by permanent buildings in the central area.

Access to this will be provided by a tunnel under the runways. Adequate space must be allowed for the terminal area. For this reason, and also to give an improved layout, runway No. 3 will ultimately go out of use as a runway, although all but a small portion of it will be used for apron, taxi-ways and other purposes, for which concrete of similar bearing strength is required.

This airport will be the first piece of England on which thousands of foreign visitors will land. For this reason, importance is attached to the design of the terminal buildings. These terminal buildings ought to be among the finest modern buildings in the country for these purposes.

It is estimated that when the airport is fully developed it will be capable of handling a maximum of 160 aircraft movements per hour in good weather and 120 aircraft movements per hour in bad weather (an aircraft movement is counted as one take-off or one landing).

It has been stated that a tangential runway pattern such as has been adopted at Idlewild, the new airport for New York, and elsewhere, would give better results than the parallel pattern adopted for London. A tangential system, which normally consists of 12 runways equally spaced around a central area and which permits the use of up to six runways simultaneously, was fully considered for the London airport. But, although, in countries blessed with continuously good weather, the tangential system offers greater capacity, it is less satisfactory than the parallel runway system for countries where such favourable conditions do not prevail. The chief disadvantages of the tangential pattern are the danger of collision between aircraft landing and taking off simultaneously; a slowing up of all traffic in bad weather due to the time occupied by aircraft taxi-ing along the runways in use; a dislocation of traffic and a consequent slowing of the movement rate where the airport is used by aircraft which require more than the standard runway length of 6,000ft. for landing or take-off.

It is worth noting that the tangential system for Idlewild was adopted only after considerable debate. The Civil Aeronautics Administration think that on balance the tangential pattern is preferable for Idlewild, the chief reason being apparently that it could handle the maximum amount of traffic in a given time. On the other hand, the Airline Pilots Association expressed the opinion that the parallel runway system would mean more emphasis on traffic control. The pilots thought that the parallel runway system would be safer in bad weather.

### Ironfounding

THE bottleneck in the building and industrial reconversion plans caused by the lack of iron castings has focused attention upon the ironfounding industry, a trade which has its beginnings in antiquity many thousands of years ago and is a fundamental factor in our industrial structure to-day.

In spite of the development of other materials, notably steel, since 1855, the demand for iron castings rapidly and intensively increased from the time of the Industrial Revolution. During the years immediately preceding the war the output of iron castings amounted to approximately 3 million tons per annum and it is estimated that the post-war demand will reach 3.5 million tons.

Cast iron has a large number of applications for which it is unsurpassed. It is a basic engineering material, is extensively used in power production, machine tool, chemical, building and other industries, and enters into a wide variety of articles in everyday domestic use. Manufacture is spread over 1,750 establishments in all parts of the country and the industry employs over 100,000 people, many of whom possess to a high degree the craftsmanship in founding which has always been a feature of the industry in this country.

The industry is, in fact, so widespread, and affects so many other industries, that it has only in recent years become conscious of itself as a separate industry using its own technique. It has at once the advantages and the handicaps of a tradition. Until the first European war, ironfounding was pursued very largely on a craft basis in individual foundries. Between the wars it passed through three major changes which have materially altered its character and outlook. First, within the industry, a process of grouping took place as a result of which a number of foundries associated themselves into larger units in order to obtain the advantages of rationalised production and to enable schemes to be planned beyond the capacity of a single foundry. Secondly, methods of continuous or mass production, which had proved so successful in the engineering industry, were developed and applied. Thirdly, by the application of science, something like a metallurgical revolution was accomplished. This has resulted in the provision of a means for the much closer control of foundry operations, leading to greater uniformity, homogeneity and soundness of the product, as well as to the development of much improved standards of quality. In parallel with this, a policy of specification in quality and standardisation of dimensions has been pursued through the British Standards Institution. There are now standards of quality from 9 to 24 tons per sq. in. tensile strength, and material may be commercially obtained to 35/45 tons per sq. in.

Among the developments which have taken place may be mentioned the production of cast irons with special properties for particular applications, non-magnetic, corrosion-resisting (including the highly acid-resisting silicon iron), heat-resisting, abrasion and wear-resisting; cast irons of high strength and toughness for such purposes as engine camshafts and crankshafts; new applications of centrifugal castings; the development of die-cast irons; the further development of chilled rolls and malleable cast irons, all of which enlarge the scope and increase the importance of the industry. During the war period the material has been successfully applied in a wide range of munitions components, grenades, fuse bodies, smoke and H.E. bombs, practice shot, shell, tank track links, tank bogie wheels, mines, etc. Iron castings have also been used in place of other materials in short supply or urgently needed for other purposes.

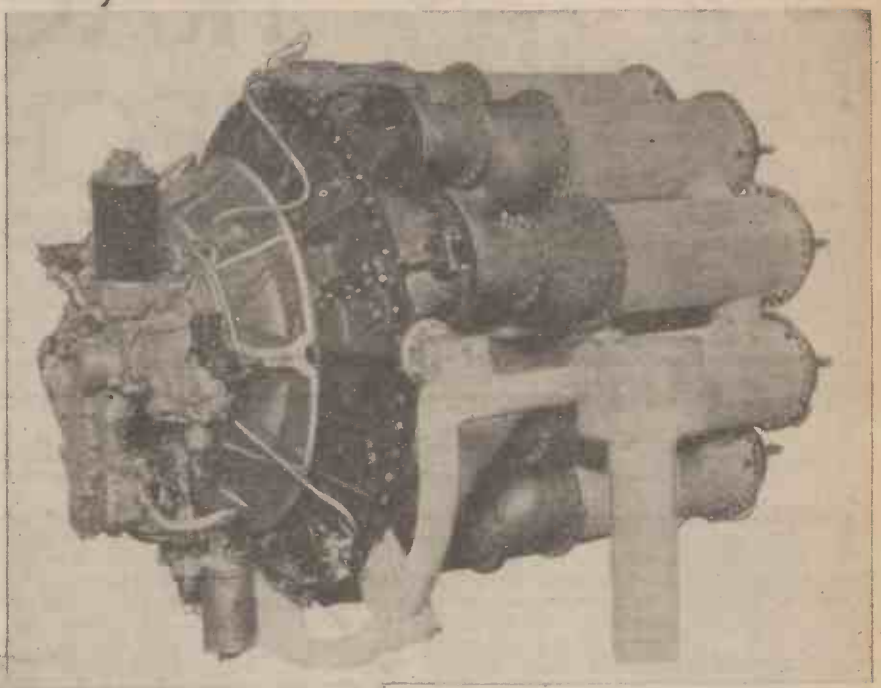
# Development of the Gas Turbine

## Technical Details of the Rolls-Royce "Welland," the "Derwent" and the "Trent," the first gas turbine with airscrew to fly

IN the story of British achievement in the field of gas turbine research, Rolls-Royce have played a very prominent part in developing to its present standard of efficiency the jet-propulsion engine based on Air Commodore Whittle's design. Rolls-Royce interest in gas turbines as a prime mover for aircraft dates from 1938, when Dr. Griffiths joined the company for the purpose of designing a contra-flow gas turbine engine.

### Rolls-Royce Research

A scheme for an internal-combustion turbine was agreed upon early in 1940, and by September of that year a bearing test rig, an aerofoil cascade test rig and a test combustion chamber had been put in hand in the shops. By 1941 these rigs were providing the answers to many complex problems which hitherto had hindered progress. Prior to this, Rolls-Royce manufacturing facilities were made available to both Power Jets and the Rover company, the machining of supercharger casings and wheel cases for the first sets of the W.2.B being undertaken at Rolls-Royce, as well as the manufacture of turbine blades and oil pump assemblies.



*The Rolls-Royce "Welland" jet-propulsion engine.*

*A British gas-turbine with airscrew. The Rolls-Royce "Trent" on hangar test at a Rolls-Royce factory.*

During 1941 a Rolls-Royce "Vulture" engine was modified and used at Derby for testing gas turbine compressors. This rig was running before the end of the year, and was first used to test a Power Jet's supercharger. In the same year a step-up gearbox capable of transmitting 2,000 h.p. and running up to speeds of 17,000 r.p.m. was designed. This particular test rig has been in operation since 1941 and until 1944 it was the only test plant in the world capable of testing the type of compressor used on jet-propulsion engines.

At that time there were no accepted standards of efficiency for the compressors used on jet-propulsion engines, and the Rolls-Royce centrifugal supercharger was used as a "yard-stick" whereby the efficiency of the jet supercharger or compressor could be measured.

### The First of the "River" Class

Since applying all their facilities to gas turbine development, Rolls-Royce, in the short space of three years, completed the development of the "Welland" engine, the first jet-propulsion engine to go into quantity production, and to go into service with the R.A.F. In the same period Rolls-Royce have designed, developed and produced the "Derwent," the "Trent" and the "Nene" jet-propulsion engines, including the "Derwent V," which enabled the Gloster "Meteor" to establish a new world speed record of 606 m.p.h.

The "Welland" was the first Rolls-Royce version of the Whittle jet-propulsion engine and had 10 reverse flow combustion chambers. It was 43in. in diameter and gave a thrust of 1,700lb. for a weight of 850lb. It passed its 100-hour type test in April, 1943, and deliveries to the R.A.F. commenced in May, 1944. The E.28, a Gloster single-engined jet-propulsion aircraft, and both the prototype and first production marks of the famous "Meteor" were fitted with "Welland" engines. The "Welland" was designed in collaboration with Power Jets, Ltd., and was ready for test towards the end of 1942. On test the only mechanical troubles which arose were connected with the sheet metal work of the combustion chambers.

### Jet Engines in Action

It is interesting to record that the "Welland" engines first went into action when the twin-engined Gloster "Meteor" was used to shoot down flying bombs in 1944. It was remarkably successful in its first service operations, and shot down more "F.B's" per flying hour than any other aircraft. It is also worthy of note that it was able to overtake the "F.B's" with a commendable margin of thrust still unused.

Following upon the "Welland," Rolls-Royce designed a new jet engine of the same overall diameter and with a similar compressor to the "Welland" but with straight-through combustion chambers and with a design thrust of 2,000lb. This was the first of the "Derwent" class of engine, and was followed by the "Derwent II," "III" and "IV." The "II" and the "IV" gave a 10 per cent. increase in thrust in both cases, the "III" being an experimental engine to provide suction on the wing surfaces for boundary layer removal.

### The Record-breaking Engine

Early in 1944 the M.A.P. issued a specification for a jet engine for installation in a single-seater interceptor fighter which was to have a minimum thrust of 4,000lb., a maximum overall diameter of 55in., and a maximum

weight of 2,200lb. With the background of experience gained by Rolls-Royce in developing the "Welland" and the "Derwent," the design of an engine to this specification did not present any insuperable problems. A design for an engine having a thrust of 4,200lb. and capable of development to 5,000lb. was soon in hand, the weight to be approximately 1,600lb. with an overall diameter of 49in. Speed in development was again the order of the day, and within six months an engine conforming to these figures was on test. This engine was known as the RB-41, and was later designated the "Nene."

Its successful development prompted the suggestion that a scaled-down version, in size similar to the "Derwent," would considerably enhance the performance of the Gloster

*The Gloster Meteor jet-propelled aircraft.*

"Meteor." As the "Meteor" had shown that it was capable of absorbing thrust greatly in excess of the original estimates, an intensive design programme was immediately instituted by Rolls-Royce, and a new "Derwent" was designed, built and tested in just under six months. This was the origin of the "Derwent V." So certain were the Rolls-Royce engineers of the success of the engine that it was decided to put it into production straight from the drawing-board, without previous development on test. The first engine built successfully passed the M.A.P. 100-hours *official* Type Test at a rating of 3,000lb. thrust, and during July-September of 1945 Rolls-Royce were able by intensive development to increase this thrust to 4,000lb.

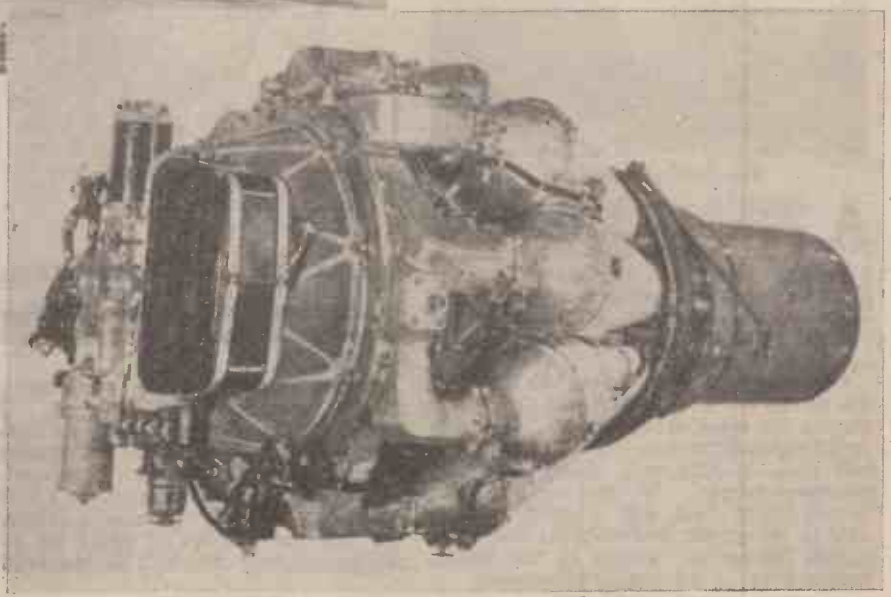
The power of the "Derwent" engine has thus been doubled without alteration to installation dimensions, and the speed of the Gloster "Meteor" was raised from 460 m.p.h. to 606 m.p.h.—a jump of 146 m.p.h.—a feat never before equalled in the history of aviation.

### General Description

Basically similar to the "Derwent I," the "V" incorporates an increased capacity centrifugal compressor mounted on the forward end of a shaft carrying an axial-flow turbine. This main shaft is carried on two roller bearings with a centre thrust bearing and is surrounded by nine combustion chambers, which are fed with compressed air from the impellor and fuel from a high pressure pump driven by the engine.

Fuel control to the burners differs from the "Derwent I." Whereas on the "Derwent I" the pump stroke normally remained fixed and the flow to the burners was varied by by-passing fuel in excess of engine demand, on the "Derwent V" the pump stroke and therefore the pump capacity, is varied by means of an aneroid to reduce the supply of fuel at altitude. The supply of fuel is also controlled by a throttle valve actuated by the pilot through a rack and pinion.

For starting up, a flame igniter assembly comprising a sparking plug and solenoid valve is employed. To obviate burning of the plug from the hot gases, it is not located directly in the combustion chamber, but between the outer casing and the flame tube, it being thus shrouded from the hot gases. When starting up the control switch for the solenoid operates for a given time, and fuel is sprayed directly on to the spark plug. A high pressure cock which cuts off the fuel supply is provided for stopping the engine. To improve the air flow the outlets from the blower casing which were previously curved elbows, are now right angled box section. The diffuser vane ring which was a built-up assembly on the "Derwent I" is now an aluminium casting machined all over, thus strengthening the diffuser and reducing fatigue at the tips of the vanes.



*The Rolls-Royce "Derwent V" jet-propulsion engine.*

Flame tubes are mounted concentrically within the combustion chambers, and combustion is completed before the gas enters the turbine vane ring at the rear. Balance pipes are provided between the combustion chambers to equalise the pressure and to allow the flames to ignite the fuel in adjoining flame tubes when starting up.

To obviate splitting and cracking of the welding due to the high temperatures at which the engine operates, the discharge nozzle box at the rear of the combustion chamber is a casting instead of being fabricated. Securing of the vanes inside the nozzle box is improved by employing a buttress type of holding which reduces the differential expansion of the vanes and casings. Combustion chambers, although reduced in number to nine, are of similar design to the "Derwent I," but have a greater cross sectional area to cope with the increased mass air flow from the blower.

### Cooling and Lubrication

Cooling of the air system, including the centre and rear bearings of the front face of the turbine disc, is provided by a small centrifugal fan mounted in front of the centre bearing. The cooling air enters through apertures at the centre of the engine, and passes out through a cooling air manifold to the exhaust outlet at the rear.

Lubrication is by a triple-gear type pressure pump to the various bearings, and the oil is then collected by two scavenge pumps and returned to the oil pump. As the plain type of bearing used on the "Derwent I" is dispensed with on the "Derwent V," no oil cooler is fitted. A filter is incorporated on the pressure side of the oil pump to ensure that no grit or foreign matter passes into the engine.

The engine's accessories, including fuel and oil pumps, generator and accessory gear box, are mounted on the wheelcase at the front of the engine, together with an electric starter motor. The whole engine is housed in a streamlined cowling, which has a large air intake in front, and a projecting jet-pipe or propelling nozzle at the rear.

### Jet Engine Development

Remarkable progress has been made in gas turbine work by Rolls-Royce, in improving the specific weight per lb. thrust. The "Welland" had a specific weight of .57 in 1943 and by 1945 the record-breaking "Derwent V" had reduced this figure to .36; and further improvement has apparently already been accomplished. Progress made with thrust per square foot of frontal area has been even more impressive. In a period of three years the thrust per square foot has been more than doubled, the "Derwent V" having reached 380lb. thrust per square foot of frontal area, as against 150lb. thrust of the "Welland." It is interesting to note that the fuel consumption per lb. thrust of the "Derwent I" was greater than that of the "Welland." This is followed, however, by a further remarkable improvement in the short space of a year, by the "Derwent II," continued with the "Derwent V," which has reached unity; in other words, 1lb. weight of fuel for a lb. thrust. From the projection of the curve considerable improvement on this can be expected during 1946, with an optimum figure of .9lb. per lb. thrust.

### First Gas Turbine with Airscrew to Fly

In the development of the gas turbine engine with airscrew, Rolls-Royce were the first in the Industry to produce an engine of

(*Continued on page* 278.)

# A Spanish-Hawaiian Guitar—1

## Constructional Details for Making One of these Popular Instruments

By "HOBBYIST"

*The finished instrument.*

A SPANISH guitar is often regarded as a rather difficult instrument to play. It can, however, be as easy to play as a ukulele. You see, it only differs from the latter in that it is larger in size—nearly 3ft. long—and has six strings. The 1st, 2nd, 3rd and 4th strings are tuned to a ukulele pitch, i.e., E, B, G and D.

One can, if desired, ignore the 5th and 6th strings and use the first four strings for playing the usual ukulele chords. There is no difference in the fingering. The tone, you will find, is delightful, being loud and extremely sweet. If you are a regular ukulele-player you will probably switch over to the guitar, preferring its loud, sustained, harmonious strains to the duller, weaker tones of the smaller instrument.

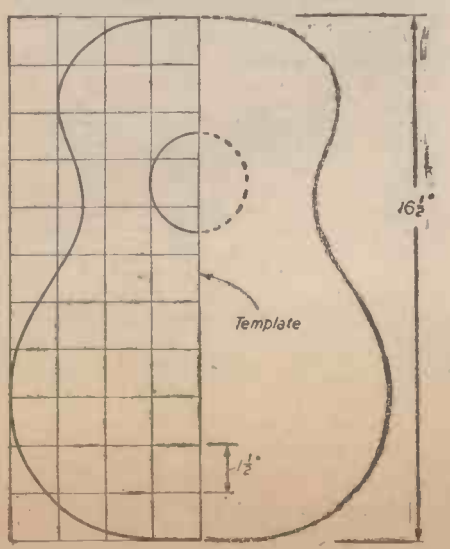



*Fig. 1.—Half shape of body plotted in 1½in. squares.*

But, you will not be content merely to play the usual "uke" chords all the time. You will probably want to learn the proper Spanish guitar chords which, in their simplest form, cover four of the six strings, which means that the 5th and 6th strings are invariably brought into use. These strings produce a wonderful bass effect, and the chords have to be heard to be fully appreciated. Many of these chords have "open" strings, which helps to simplify the fingering considerably.

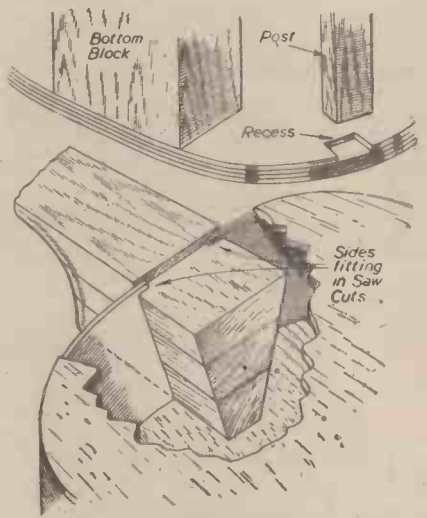



*Fig. 4.—Constructional details of body.*

Alternatively, you may wish to play melody, combined with harmony. This combination is, needless to add, *real* Spanish guitar playing. Much study and practice is necessary; in the hands of a professional artiste, such as Segovia, Llobet, De La Maza, Pujol, etc., solo guitar playing is unique.

If you are thinking of taking up guitar playing seriously you will be interested to know that there is an extensive repertoire of music published for the guitar in this country and on the continent. Amongst the many great musicians who have written special music for the guitar may be mentioned Berlioz, Beethoven, Bach, Gounod, Weber, Mozart and Paganini.

So much for the Spanish guitar.

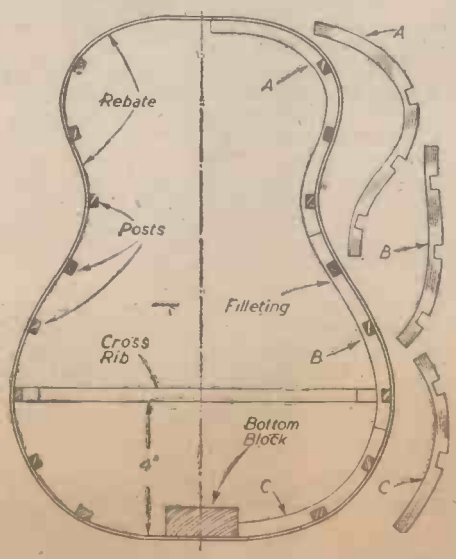



*Fig. 2.—Plan of bottom, showing posts and filleting.*

### The Hawaiian Guitar

A more modern instrument is the Hawaiian (steel) guitar. It is very easy to play. It was evolved by a native of the Hawaiian Islands in the Pacific nearly 60 years ago.

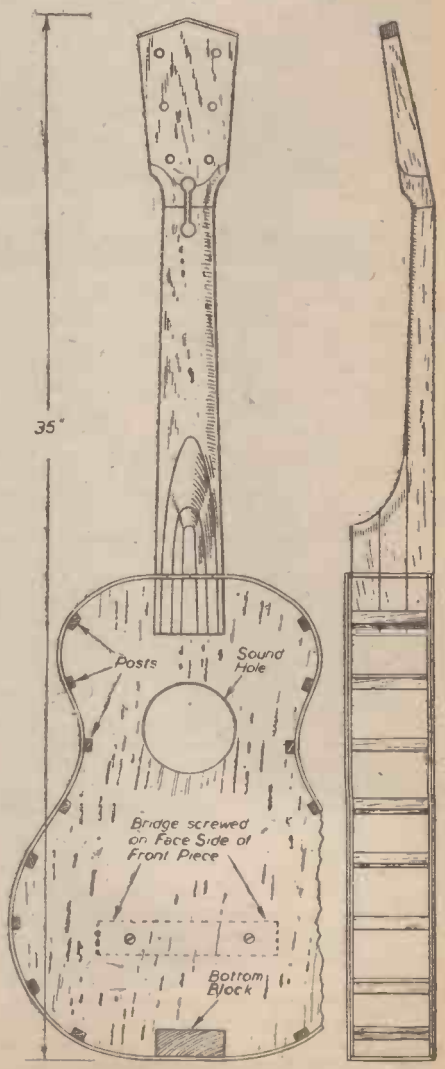



*Fig. 3.—Top plan of front, with back removed, and section through the body of the instrument.*

The Hawaiian guitar is a Spanish guitar with slight alterations. The true Spanish guitar is strung with gut and silk; a Hawaiian guitar has steel strings, and whereas the strings on the Spanish guitar are tuned to E, B, G, D, A and E, those on the Hawaiian guitar are tuned to E, C-sharp, A, E, A and E.

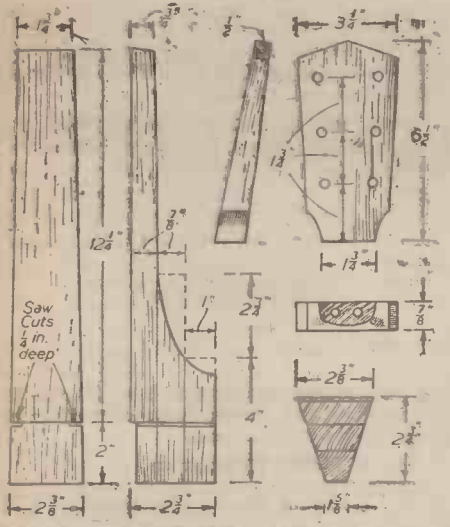



*Fig. 5.—Handle and head details, with end sections.*

Further, the steel strings are raised by a high nut to prevent them touching the finger-board frets when pressure is applied with the steel playing "comb," which, as you probably know, is a smooth-edged, flat bar of steel. The instrument is held across one's knees and the notes are produced by plucking the strings with the right hand and moving the steel comb along them with the left hand, using a gliding movement.

The notes thus produced have a weird, wailing, haunting effect, and by shaking the comb over prolonged notes a delightful "tremolo" is produced. One combines melody with harmony, of course, with frequent *vibrato* (oscillation of the steel bar) and, to prevent soreness on the right-hand fingers and give a louder tone it is usual to wear metal pricking thimbles on the first and second fingers, with a tortoiseshell zither ring for the thumb.

So much for the Hawaiian guitar.

### Two Instruments in One

The reader can have either type by making one or the other, at home, using odds and ends of wood. It is, however, better to make the Spanish guitar first, since the nut in this case must be a fixture at the top end of the finger-board. The nut used for converting the Spanish guitar into a Hawaiian type is bent from metal and fits over the fixed nut.

The photograph of the actual guitar made by the writer gives a good idea of its dimensions. The body is generally 18in. long by 12in. wide at the bottom and 9in. wide at the top; it is usual to cut the front and back body shapes from a soft pine, but the writer preferred to use ¼in. birch plywood (the plies of wood greatly facilitate rebating the edges for the side strips) and the scrap piece in his possession was only sufficient to make a back and front piece measuring 16½in. long by 12in. wide. The slight reduction in length has no effect on the tonal qualities of the instrument.

### Front and Back Pieces

A half shape of the body front is shown at Fig. 1, it being plotted in 1½in. squares. To ensure accuracy it is advisable to make a thin card template of the half shape. The template, cut to shape and placed on the wood, enables a half shape to be pencilled on directly. It is then only a matter of reversing the template and marking out the opposite half of the shape, as indicated by the dotted lines.

The 3in. diam. sound hole is only cut in the front piece, of course. The back piece is plain. The grain of the wood must run with the length in both cases.

Before proceeding further, it must be explained that there are two ways of providing a rebate for the side strips. One method, the simplest, perhaps, is to cut out shaped fillets of wood and adhere these on the interior sides of the back and front shapes to form a rebate 1/16in. inwards from the edges.

These fillets are shown at Fig. 2. They could be cut from ¼in. plywood in one complete length, but, by cutting them out as three separate pieces, like A, B and C, smaller plywood cuttings can be utilised. You will have to make templates of their shapes for marking out purposes; four of each of the three fillet shapes are required.

Have the filleting notched to accept posts cut from ⅛in. wide by ¼in. thick stripwood. Assuming the back body shape has been cut out, pencil a straight, central line down its length on the interior side.

Attach a bottom block (2⅛in. by 2½in. by ⅝in.) upon the bottom end, 1/16in. inwards, as shown, using glue and a few thin nails, such as gimp pins. Adhere the filleting shapes. These are glued down and held, temporarily, with gimp pins which, when the glue sets, are withdrawn. The filleting at the top end does not meet; there should

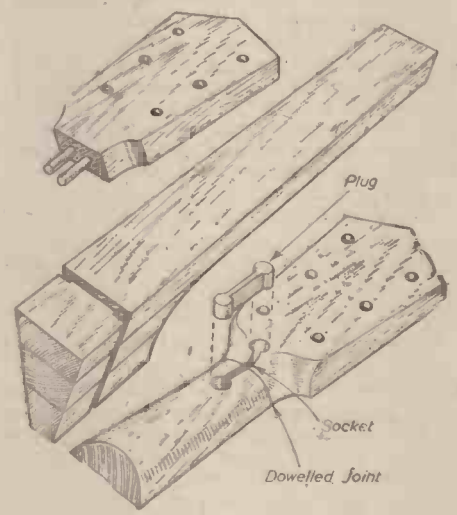



*Fig. 6.—Constructional details of the handle and head.*

be a ⅛in. space between the ends on the body back piece. The filleting on the interior side of the front piece has a 2½in. space at the top end. These spaces are necessary for the fitting of the handle shouldering.

### Rebated Edges

The filleting has a slight "dulling" effect upon the resonance of the wood. The writer preferred to cut an actual rebate around the edges of the back and front shapes using a tiny home-made cutting gauge and a penknife. He cut to the depth of two plies; it was tedious work, entailing plenty of care and patience, for it must be remembered that the plies used in making ¼in. three-plywood are less than 1/16in. thick. One could use 3/16in. plywood, but slight allowance must be made in sizes of certain parts, such as the lengths of the supporting posts, width of the side strips, etc.

### Cross Rib and Bridge

To strengthen the back body shape and keep it flat a cross rib is needed, this measuring ⅜in. wide by ⅛in. thick, with the ends tapering to ⅛in. thick. It is glued and pinned upon the interior side 4in. from the bottom end, as shown at Fig. 2.

To strengthen and flatten the front body shape the bridge should be made and attached on the face side of same, as suggested in Fig. 3, using glue and a couple of suitable screws. The screws give better security. The bridge, it must be stated, not only supports the strings, but is also used as an anchorage for them. It has, therefore, to take considerable strain and must be well affixed to the wood.

Details of the bridge are provided at Fig. 7. Shape it from a hardwood, such as birch, or similar close-grained wood. The wire rest is made from a piece of bicycle spoke wire and fitted on as shown. Drill six 1/16in. string holes through the bridge, same being ⅛in. or 9/16in. apart and about ¼in. up from the bottom side. The position of the bridge on the face side of the front body shape should be glass-papered prior to affixing the bridge to same in the manner described. Have the bridge attached absolutely central with the body shape or you may find, to your annoyance later on, that the strings are not in true alignment with the finger-board.

### The Posts

If you have attached notched fillets to the body front and back shapes, the sixteen posts required measure 2⅝in. long. If you have cut rebates on the edges, the posts will be the same length stated. But, if—like the writer—you prefer also to make recesses for the posts, as shown by the enlarged view at Fig. 4, the posts will be about ⅛in. longer.

By cutting ply-deep recesses for the posts, the recesses keep the posts accurately positioned and glue, plus a single gimp nail, suffices to hold them. If no recesses are cut for the posts, glue and a couple of gimp nails are advised.

Attach the posts to the body back piece first, then add the body front piece on top and see that the work goes together squarely. All that then remains is to make and fit the handle and fix on the side strips, and the most difficult part of the whole construction is overcome.

### Handle and Head

While the handle and head should be cut from a hardwood, a soft wood, like deal, can be used. The writer, having nothing else available except deal, *had* to use it. Being soft it simplified the cutting and shaping, but if you adopt it, 'ware large knots. These can give a lot of unnecessary bother.

The handle consists of three pieces of wood rub-jointed together, as shown by the side

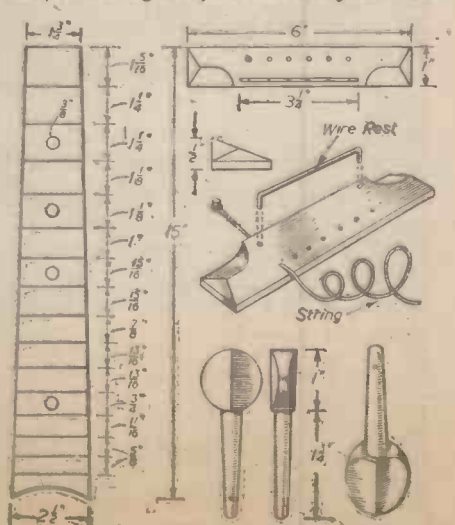



*Fig. 7.—Size and shape of finger-board, bridge and pegs.*

view at Fig. 5. The handle piece is 14¼in. long by 2⅛in. wide by ⅞in. The shouldering blocks are ⅞in. and 1in. thick respectively, one being 6¾in. by 2⅛in. and the other 4in. by 2⅛in.

When glued to the handle and set, taper the handle to 1¾in. at the top. The side edges are then bevelled to conform with the end section shown.

Saw cuts, ¼in. deep, are made with a tenon saw down each side, 2in. from the shoulder end. The position of these kerfs must be marked with a small set-square. The writer scribed them with the tip of a penknife and made a V-groove with the corner of a wood chisel as a guide for the teeth of the tenon saw.

Note that the shoulder is recessed ¼in. deep. This is to allow for the thickness of the front body shape. Note, too, that the head end is cut at a slight angle, i.e., sidewise. The head itself is also cut at a slight angle so that, when dowelled to the handle, it has a good tilt.

The head is cut from ⅞in. wood and planed to taper to ¼in. at the top end. It is then bored, with a ¼in. bit, for the six pegs. The joining end is bored for ¼in. or 3/16in. dowel stumps with corresponding holes in the end of the handle.

When the head has been dowelled on allow the glue to set, then proceed to carve the underside of the handle to shape. A sharp penknife, plus the use of a spokeshave and a rasp, will help with the shaping. Some idea of the shaping can be gathered from Fig. 6.

*(To be continued)*

# The Hydrofin

## Details of the New 70 m.p.h. "Seaplane" Boat

THE Hydrofin is similar to the aeroplane in that it uses a fin under water just as an aeroplane uses a wing in air. Given a positive angle of attack, you get a depression above and a pressure beneath the fin just as you get in air, with the important difference that water is 817 times heavier. Now since the coefficient of density is found in the formulæ for lift and drag, it follows that to obtain a given lift from water surface or speed or both can be small.

The particular advantage for a boat in lifting off the surface is the total suppression of all water resistance on the hull, and this resistance has the unfortunate habit of increasing as the square of the speed. That is why you travel at 60 m.p.h. in a train but only 10 m.p.h. on a ship.

Now that was what was behind the construction of Dr. Alexander Graham Bell's "Hydrodrome" of 1919, which travelled at 71 m.p.h., and in 1939 a small German craft reached 50 m.p.h. with a motor of only 10 h.p., which constitutes a record, but people are not impressed because this is not "pure speed" like jet propulsion or the V.2. You will find that it has other attractions, and as a means of maritime navigation it certainly is very fast indeed. Greater loads can be carried than are possible in air and the general construction is adaptable to very big sizes. Boat builders will say that large boats cannot be made to skim, but that is because weights proceed as the cube while surfaces proceed as the square of the linear dimensions. This craft does not "skim" on a planing bottom, it comes right out of the water on fins that can be made to any required size. In this respect the problem is the same as with aircraft.

### A Small Water Resistance

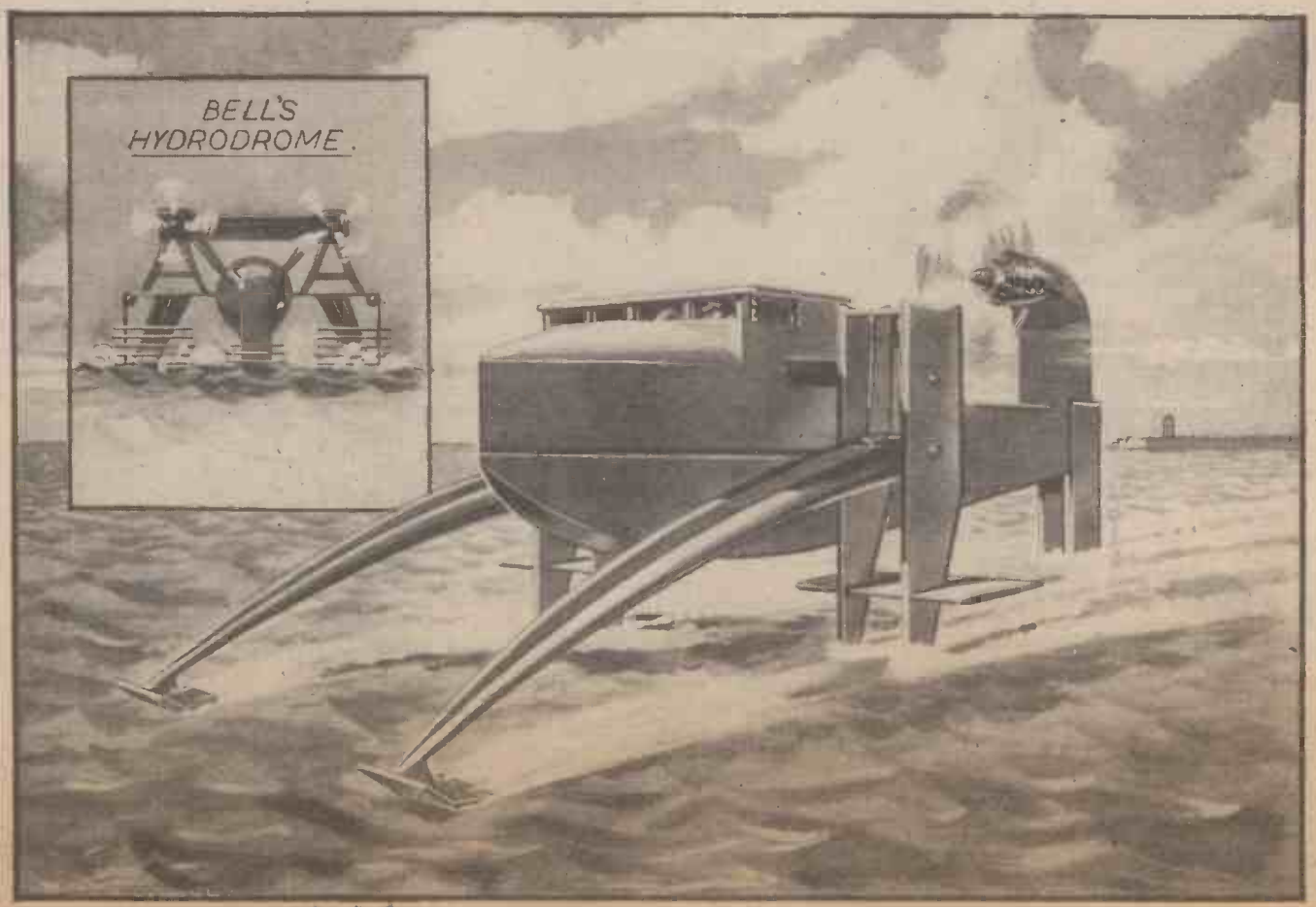
So little resistance is offered by the water to the knife-like fins that a Hydrofin will reach a speed of 70 miles an hour with low fuel consumption.

In an aeroplane it does not matter much to what height it rises so long as it gets off the ground. Here the fin must travel under the surface so as to get the lift from the upper side of the blade, but the higher the better in order to avoid parasite drag on the struts.

Clearly some automatic control for depth is required, and this is supplied by the "jockey skids," whose job is to predict waves and regulate the angle of attack of the fins according to their depth.

Mr. Hook, the inventor of the Hydrofin, has orders for several of these craft for export to South Africa and France. They will be 16ft. super-speed pleasure boats.

Next year he will build 10-ton coastal craft, to be followed by long-range freighters and passenger boats.




*Our artist's impression of a Hydrofin travelling at speed. Inset: Front view of Bell's twin-engined Hydrodrome.*

# Rocket Propulsion

## Japanese War Rockets : Rocket-firing Tanks : Airborne Rockets

By K. W. GATLAND

(Continued from Page 256, April issue).

ALTHOUGH the Japanese appear to have been in the process of developing jet-assisted take-off units, and at least one turbine-compressor jet fighter—the "Kikka"—there is little evidence of any similar work with rockets. The "Baka" suicide 'plane, some experimental copies of the German Me. 163, and a small variety of field weapons were the only rocket devices they produced.

In the years before the war very little of scientific affairs was allowed to leak out of Japan, and although it is known that some research with rockets had been conducted, it is not clear on what scale.

It is reasonably safe to say, however, that no liquid-fueled rockets were experimented with, either before or during the war, and although some of the larger pre-war powder rockets were controlled by radio, their means of propulsion was invariably little improvement on the pyrotechnic rocket.

The Japanese were slow in producing rocket weapons, and it was not until the closing months of the war that they came to be used on anything like a large scale.

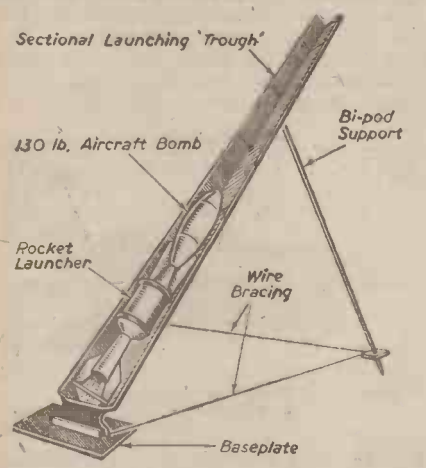



*Fig. 63.—The "model 10 rocket launcher" captured on Saipan.*

### Rocket Launcher Model 10

One of the first Japanese rocket weapons was captured at Saipan, and, oddly enough, it appears to have been the only specimen of its type ever used in action.

This was the "Model 10 Rocket Launcher," shown in Fig. 63. It comprised simply an elevated wooden trough of right-angle section, supported at three points—by two tubular legs at the front and a small steel base-plate at the rear.

This crude structure was intended for launching an ordinary 130lb. aircraft bomb, which was propelled from the trough by a specially designed launching rocket placed behind it.

The launching rocket had a "canister" nosing, which housed three sticks of smokeless propellant weighing 13lb. A long divergent exhaust nozzle emerged from the rocket chamber, and attached outside the mouth were three steel fins. A flat cap, fitted at the nose, was slotted to hold the fins of the bomb.

*Display of weapons showing how the "Bazooka" compares in size with the rifle-grenade launcher next to it. The Verey pistol and flare launcher are also in the exhibit.*

The rocket was fired by a percussion striker screwed into the base of the trough, which the launching crew operated remotely by means of a lanyard.

Although no degree of accuracy could be claimed for the Model 10 launcher, it was said to have been capable of projecting the 130lb. bomb for distances ranging from 770 yards at a minimum angle of 30 degrees to 1,300 yards at 50 degrees.

### A 20 cm. Rocket Projector

It appears that the Japanese favoured the "trough" to the tubular launcher, and this is borne out by the discovery of several light rocket projectors at Leyte. (Fig. 64.)

These resembled "production" equipment far more closely than the Model 10, although they were still remarkably crude when compared with similar Allied weapons.

The launching trough, which was in three sections, was formed of 3/16in. iron. It was supported by four tubular legs, two at the front and two at the rear, and could be adjusted to permit ranges from 450 metres at 60 degrees, the elevation being checked on a simple scale fixed to the side of the trough.

The projector fired a 20 cm. rocket that resembled a long shell, having an almost constant section. Its explosive was contained conventionally within a ballistic-shaped head, and seven sticks of smokeless propellant were housed at the rear in a motor body which screwed on to the back of the explosive compartment. As with the German rocket shells, stability was achieved through axial rotation, caused by the offset thrust of six nozzles set at 25 degrees to the rocket axis. The percussion cap, which initiated combustion, was screwed into the centre of the base-plate and, as in the previous rocket, was detonated by a lanyard.

There appears to have been no protection from blast, and it is assumed that the launching crew were well clear when firing took place.

### A 44.7 cm. Explosive Rocket

Large rocket shells were later discovered during the American drive on Manilla, and these were found to be to the same design as the 20 cm. projectile, though of 44.7 cm. calibre. The large rocket measured 5ft. 9in., of which over half comprised the explosive head. The propellant container was charged with 40 sticks of smokeless powder, and the complete projectile weighed approximately 1,800lb.

It was spin-stabilised, six offset holes again being responsible for the rotation.

### Improved "Jap" Rocket Equipment

There appears little doubt that, towards the close of the war, the Japanese were producing highly effective rocket shells, in many ways superior to contemporary German and Allied missiles. They, nevertheless, failed hopelessly in the manufacture of a satisfactory launcher.

The light and compact "Bazooka" was by far the most decisive rocket weapon of the Far Eastern conflict, despite its small size. This was very largely due to the conditions of the fighting, which demanded little more in the way of field ordnance than the mortar and the close-range rocket.

A tube-launcher was found later by

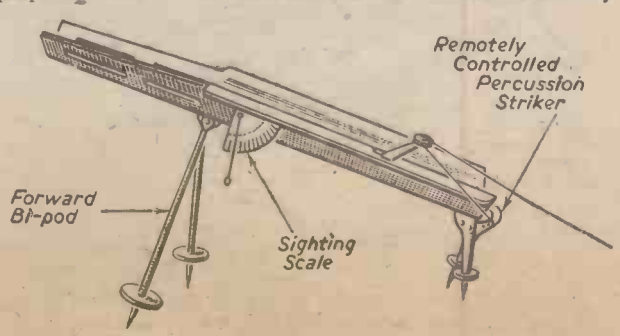



*Fig. 64.—Several "trough" launchers of this type were found by American forces on Leyte. They fired 20 cm. explosive rockets.*

American forces on Iwo Jima, and although somewhat cumbersome, it was an improvement.

The barrel, which had an overall length of 8ft., was assembled in two halves with a connecting collar, and was supported by two front legs and a rear base-plate. A simple catch was fitted at the rear of the open tube to prevent the projectile from slipping out of position once it had been inserted by the loader. The assembly was completed by a standard mortar sight.

The elevation scale indicated a minimum launching angle of 18 degrees, with a maximum of 65 degrees, and at full elevation the 20 cm. rocket had a range of 2,000 yards.

When stripped down into main components the tube-launcher—which, completely assembled, weighed 55olb.—could be transported by three mules.

### Rocket-firing Tanks

When D-Day eventually arrived in Europe rockets were used in their thousands, and there is no doubt that in the development of field rockets the Allies had far surpassed the Germans.

Soon after the initial landings had been established the first rocket-firing vehicles began to make their appearance; lorries and cars had multiple projectors, and similar apparatus was mounted on light gun-carriages.

Last, and most formidable of all, were undoubtedly the rocket-firing tanks. These were used in the final assault upon the Reich fortress, firing explosive rockets in quick succession from multiple launching tubes.

Another launching arrangement, employed on Sherman tanks, was the aircraft rail-type projector. Two launchers were fitted, one either side of the tank, which fired the same 60lb. explosive rockets that were used on the Typhoon and Beaufighter.

### Rocket-firing Aircraft

The first aircraft to fire rockets was the Russian Stormovik 1L2. Later, the two-seat Stormovik 1L3 and the Lagg 3, Mig-3 and Yak-1 single-seat fighters were similarly fitted.

It was these machines that figured prominently in the defeat of the Nazis at Stalingrad by their unremitting assaults upon tank columns. The rockets were housed under the wings on rail-type projectors and were fired electrically. They sped away at about 800 feet per second, and were proven capable of penetrating seven inches of armour plate.

A double-base propellant similar to cordite was used in airborne rockets, and this was generally in the form of several sticks inserted lengthwise into the propellant chamber. It was thus assured that a fairly constant area was exposed to combustion, with the result that initial velocities were high. The burning time was, at maximum, two seconds.

*A German anti-tank projector resembling the "Bazooka" captured south of Caumont, July, 1944.*

### Air-to-air Rockets

Although the Germans did not place great importance in the rocket-firing aircraft for attacks upon land and sea targets they, nevertheless, produced several unique airborne launchers for firing explosive rockets into Allied bomber formations.

In May and June, 1943, the first fighters to be so equipped made their début. They included such established types as the Focke-Wulf 190, JU 88, Me. 109 and Me. 110, all of which had been specially modified for the purpose.

As the Allied formations swept closer to the Reich during the summer months the rocket attacks grew ever more vigorous and a situation developed which must have caused the air strategists no little concern.

The new Luftwaffe tactics enabled the launching aircraft to attack from beyond the 1,000 yards range of the .50in. machine-guns which were the bombers' main defence against normal fighter interception. The close-knit formations, which provided each machine with an effective coverage of fire under normal circumstances, were easy prey for well-aimed rockets.

The Luftwaffe achieved its greatest success during the Schweinfurt raid of October 14th, when 60 heavy bombers of the 8th U.S. Air Force failed to return to base. The Nazi fighters circled around the formations at high speed, laying their aim without interference whilst well out of range of the bombers' protective fire.

Whatever their method of evasion, the bombers were equally prone to destruction. Breaking formation or spreading widely were no solutions because lone bombers fell easy victims to fast-flying machine-gun and cannon firing fighters. Their pilots had no alternative but to maintain formation, hoping all the time that the range was too great for accuracy.

The days of the rocket launching fighter, however, were numbered. In both Britain and America fighters were being produced which were capable of escorting bombers all the way to and from their targets. In a large number of cases existing machines were modified, and high performance fighters began to appear which embodied streamlined "overload" fuel tanks suspended from beneath their wings. This naturally added considerably to their endurance.

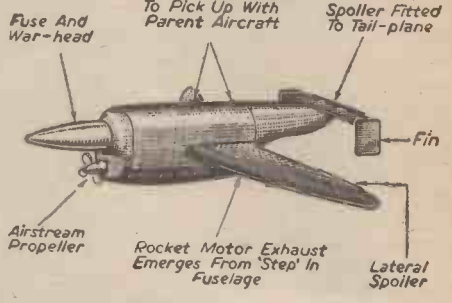



*Fig. 65.—The Henschel 298—an experimental air-to-air weapon produced towards the close of hostilities.*

The "overload" tanks were used before the internal tanks so that they were expended of fuel at as early a period in the flight as possible, whereupon they were jettisoned. Thus, as the formations approached the target area the escorts became fully combatant.

In later raids, it was the German fighters that took the greatest toll, and Allied bombers, ringed by numbers of protecting interceptors, returned to base almost unscathed.

### Further Details of the Rocket-firing Aircraft

The single engine fighters, such as the Focke-Wulf 190 and the Messerschmidt 109, had single projector tubes, one beneath each wing. They fired 2.5in. rocket shells. Four to six wing launchers were fitted to the twin engine aircraft, and these fired the larger 6in. and 8in. shells. In a few instances, it was noted that some bi-motor

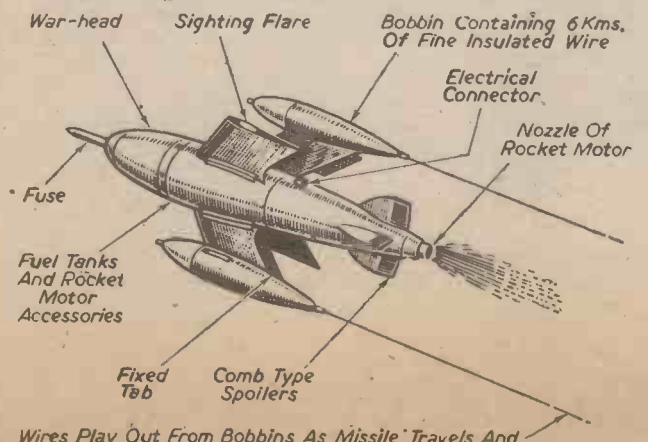



*Fig. 66.—Another German project for air-to-air interception—the X-4*

'planes had launchers mounted under the fuselage.

A number of the projectiles used on aircraft were the same or slightly modified versions of the explosive rockets used by the Wehrmacht. An example was the 6in. rocket shell used in the Nebelwerfer 41, (*Practical Mechanics*, April 1946, p. 255). This, it will be recalled, embodied the propellant in the rocket head, exhaust being made through a number of tangential nozzles in a conical centre-section. The after part of the projectile contained the explosive charge. The rocket had a length of 3ft. 6in., and weighed approximately 75lb. Its maximum range was in the region of 7,000 yards.

These rockets used a double base powder, similar to cordite, and in every case stability was caused by axial rotation.

The larger 8in. projectile was a development of the 21 cm. cannon shell, having a propellant container added behind the explosive charge. It had a range of approximately 9,000 yards, and weighed 200lb.

*Among the first British aircraft to be fitted for R.P. was this Hurricane Mk. II. C. Note the heavy "blast-plate" on the wing undersurface, and the two-rail launchers which were a feature of all early installations.*

At the close of hostilities in Europe at least two new air-to-air weapons were in course of production. These were large missiles, entirely different from the earlier "rocket shells."

One type, the He. 298, resembled a small aeroplane, and the other, the X-4, was a finned rocket projectile. Both were to have been controlled remotely from parent aircraft.

The Henschel 298 (Fig. 65), stable companion to the He. 293 anti-shipping rocket glider, had a liquid fueled motor, and was guided to its target by radio. Its development was commenced early in 1944.

In order for it to be aimed easily, the missile was released from its parent aircraft at a height slightly more or slightly less than the target formation. It had an effective range of 1½ miles, and was exploded by a proximity fuse.

The He. 298 appeared as a mid-wing monoplane. Its fuselage was narrow and deep, and there was a "step" approximately two-thirds from the nose, from which the exhaust emerged clear of the tail. The wings were tapered towards the tips and had slight sweepback. A wooden tail-plane was attached high at the rear of the fuselage, at the ends of which were fitted square-cut fins of non-aerofoil section, projecting downwards. Control spoilers were provided on the wing tips and tail-plane.

A thin, conical warhead protruded forward from the top of the fuselage nosing, and a small air-stream propeller was fitted below as power for the electrical services. Two lugs were disposed about the centre of gravity for attachment to the parent aeroplane.

The missile had a wing span of 4ft. 2¾in, and a tail span of 21in. Its length was 6ft. 7in., and the fuselage had a width of 7½in. and a maximum depth of 16in. The all-up weight was 210lb.

The He. 298, along with a selection of other aerial weapons, was included in a display of German aeronautical developments on view to technicians at the R.A.E., Farnborough, last autumn. "A large part of the exhibition was, earlier this year, removed to the Science Museum, South Kensington, to form the "Exhibition of German Aeronautical Developments."

The missile, shown in Fig. 65, was sketched at Farnborough, and observant readers who visited the Kensington exhibition will have noted that the tail-plane of the same exhibit appeared inverted, the horizontal stabiliser *below* the fuselage and the fins projecting *upwards* This was somewhat perplexing, and inquiries made at the exhibition brought no solution. As there is an obvious need for the tail to be high to clear the rocket exhaust, however, it is suggested that the missile shown there had been wrongly assembled.

Another air weapon in quantitive production at the time of the defeat was the X-4 (Fig. 66), perhaps the best example of an "aerial torpedo" that the war produced.

It embodied a well streamlined metal body, upon which were mounted four "wings" equally spaced around the circumference, about half-way along its length. A small cruciform tail-plane was attached at the rear. The nose of the missile contained a 110lb. warhead, which was detonated by a fuse in an 11in. extension, and the centre section housed a bi-fuel liquid propellant, which was fed to a single rocket motor at the extreme rear.

*A striking contrast in cleanness of design is the "zero-length" launching installation which is now a Service fitment on the latest Hawker Tempests. In this system there is no "rail": the rockets simply shoot off from the hook-retainers on which they are loaded.*

Perhaps the most unique point about the X-4 was that right up to the moment of detonation it was linked to the parent aircraft by two 0.22 mm. wires, which trailed out as the missile sped towards its target. The pilot of the controlling fighter was thus able to transmit electrical impulses direct to the missile: his signals worked electro-magnetic spoilers attached to each of the tail fins, permitting full longitudinal and lateral control.

Two bobbins, each capable of paying out fully six kms. of wire, were fitted to the tip of the lower port and upper starboard wings, and flares were attached to each of the remaining wings for sighting purposes.

The missile was carried by Focke-Wulf

*Demonstrating the "Bazooka." The loader inserts a rocket into the rear of the projector tube held by the kneeling sergeant.*

fighters on a modified version of the 70 kg. bomb rack. It had a top speed of 620 miles per hour.

**Allied Rocket-firing Aircraft**

In the summer of 1944 it was disclosed that four types of British aircraft had been modified to fire rockets. The Typhoon, Beaufighter, Hurricane and Swordfish were each fitted with eight launching rails, four beneath each wing, from which the same number of rockets were fired, either in pairs or as a complete salvo of eight. The launching aircraft experienced no recoil.

The projectile itself consisted of a heavy-gauge steel case, containing a charge of cordite sticks—it was stabilised by four small fins attached at the rear, and the warhead, which could be either high explosive or armour-piercing, was screwed on at the nose.

A number of American aircraft were later fitted for "R.P." (the Service abbreviation for "rocket-projectile"), among which the Thunderbolt, Lightning, Mustang, Tomahawk, Airocobra and Dauntless achieved outstanding success in the Far Eastern war theatre, notably in attacks upon Japanese shipping and troop concentrations.

The development of rocket launchers was carried out in Britain by the Projectile Department of the Ministry of Supply, and first tests were made with Hurricanes at the Aberdeen Proving Grounds, Scotland, during 1942.

In America the initial experiments were conducted at Wright Field, where, early in 1942, firing tests were made with a Curtis P.40, which had been fitted with two heavy-gauge steel projector tubes, one beneath each wing.

As might be expected, the early work was extremely hazardous, because of the ever-present danger of fire resulting from the rearward blast. This risk was minimised in early installations by the provision of a heavy steel "blast-plate" on the under-surface of the wing, local to the projectors. The precaution was dispensed with when improved, low-drag, launching rails and mountings were developed, which projected slightly deeper below the wing skin than previously. This was the British way.

The Americans overcame the difficulty by using tubular launchers extending to the trailing edge of the wing, which enclosed the blast and ejected it rearwards, clear of the structure.

The tubes, of which three were usually carried beneath each wing, were constructed of a special light-weight plastic, developed by technicians of the General Electric Company. They were 10ft. in length, having a bore of 4½in., with a wall thickness of ¼in. Each unit of three weighed 450lb.

Weighing 40lb. apiece, the rockets employed with this launching system had an overall length of 3ft., and were a sliding fit in the launching tubes. They were spin stabilised by the reaction of the airstream on six small offset fins attached at the rear, which were collapsed when the rockets were inside the launcher. This calibre rocket shell, known as the M8, was credited with an effective range of 4,000 yards.

More recently American aircraft have begun to appear which embody "zero length" launchers, similar to those fitted to recent Hawker Tempests.

The principal advantage of the rocket projectile over the conventional light bomb for terrain and marine attack is the greatly increased *impact velocity*. Whereas a normal bomb will strike the objective at approximately the same speed as the attacking aircraft, the rocket-accelerated "bomb," because of its inherent power, will arrive at the target at a considerably improved velocity, and thereby obtain a greater penetration.

Another point of significance is the reduced liability to error in sighting. The combined action of gravity and forward motion result in the normal type bomb falling with a curved trajectory, while the rocket-driven projectile is able to maintain a highly accurate flight path, coinciding very nearly with the line of sight. The pilot dives his aircraft directly at the target with the aid of a normal type gunsight, looses his missiles, pulls up and over the objective and is quickly out of range of local defence. Meanwhile the rockets have struck, and, if aimed true, have dealt destruction out of all proportion to the explosive weight. The war-head of the British projectile, for instance, was only 60lb.

The effectiveness of the R.P. has been demonstrated over a wide range of uses during the war, but its possibilities have by no means been exhausted. The complete absence of recoil means that the sole limiting factor to projectile size is the aircraft carrying load, and, in consequence, it is not unreasonable to assume that, if need be, rocket-projectiles bearing explosive charges rated in several hundreds, perhaps thousands, of pounds could be developed.

(*To be continued*)

## DEVELOPMENT OF THE GAS TURBINE

(*Continued from page 271.*)

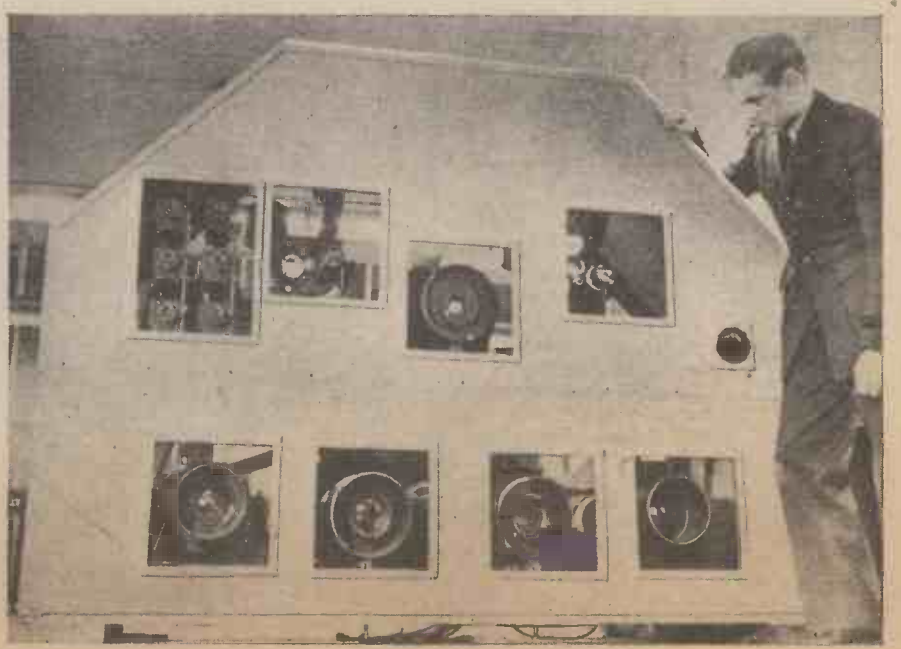
this type. As far back as May, 1944, the "Derwent" engine, subsequently known as the "Trent," was equipped with a spur reduction gear and tested for shaft horse-power. In March, 1945, it was hangar tested complete with airscrew, and in September, 1945, it was undergoing flight trials installed in the Gloster "Meteor."

The "Trent" was thus the first gas turbine engine with airscrew to be manufactured in the world, and the first to fly in any aeroplane. It may even at the present time be the only gas turbine-airscrew engine to have flown.

The Rolls-Royce "Trent" engine follows the general design of the "Derwent," with of course, the addition of the reduction gear through which the airscrew is driven. It is purely an experimental engine developed to gain experience with the jet/airscrew combination. The five-blade airscrew of small diameter will be noticed in the accompanying illustration, five blades being necessary to absorb the power. A smaller number of larger diameter blades could not be fitted on account of the low undercarriage of the Gloster "Meteor."

# Cameras for Recording Atomic Bomb Blast

*The accompanying illustration shows one of the camera units that will be used to photograph the blasts when atomic bombs are dropped on a "guinea-pig" fleet of warships at Bikini Atoll in the Pacific next month. The unit is made up of a number of cameras, all of which will be operated by remote control. The units will be set up on steel 100-foot towers ringing the warships, and controlled from a "magic box" by radio on a warship outside the danger zone. Cameras are left to right: (top), nest of six gun cameras; 35 mm. motion picture camera; F-56 8¼ inch Aerial camera; Mitchell 35 mm. motion picture camera. Bottom (left to right) row of cameras: F-56, 40-1 inch; F-56, 20-1 inch; F-56 20-1 inch and F-56 40-1 inch. The small circular opening at right is the "Magic Eye," which will operate all the cameras by the flash of the bomb itself should the radio remote control fail to work. The size of the unit can be gauged by comparison with the U.S. Lieutenant seen in the illustration.*



*Front view of one of the camera units.*

# Dowty Liquid Springing

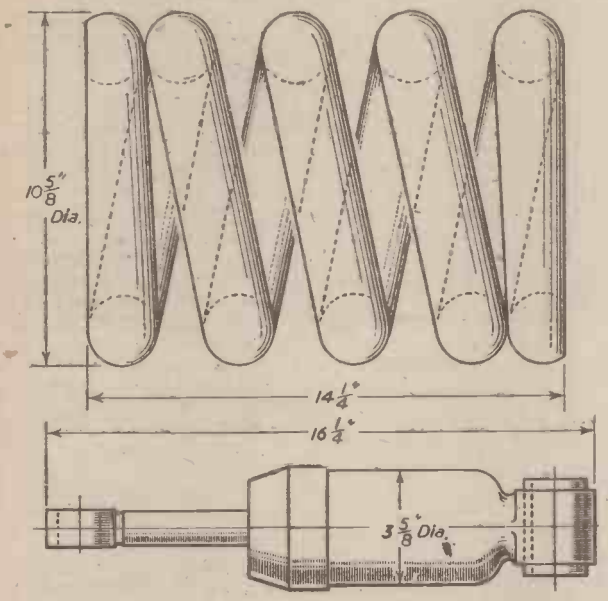
## Technical Details of a Far-reaching Invention

THE liquid spring is a revolutionary method of suspension, developed by Dowty Equipment, Limited, Britain's leading designers of aircraft undercarriages and hydraulic equipment.

In the past, many famous engineers tried to utilise liquid compression but all attempts were commercially unsuccessful. Now, Dowty technicians have perfected a liquid spring which operates at pressures up to 100,000lb. per sq. in. for the first time in engineering history.

Work was completed under wartime secrecy at the company's headquarters in Cheltenham, and since their introduction liquid springs have been fitted to many types of aircraft, the latest being the Bristol "Wayfarer," "Freighter" and Avro "Tudor." Many other military and civil types are fitted with this new suspension. Liquid springs, tested on motor vehicles, have shown an amazing improvement in suspension and road holding, judged by existing standards.

*The Avro Tudor air liner is fitted with Dowty liquid springing.*



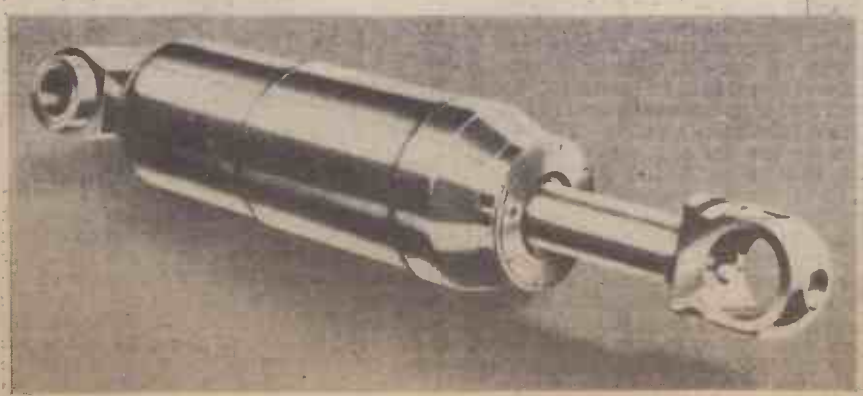

*A liquid spring compared with a steel coil spring. Both springs are designed to fully compress 20 tons.*

Owing to their immunity from fatigue, liquids provide the perfect springing medium. They remain unimpaired after prolonged service, whereas metal springs can deteriorate and are known to fracture in use. These advantages are an important safety factor especially for railway rolling stock, heavy motor and air transport.

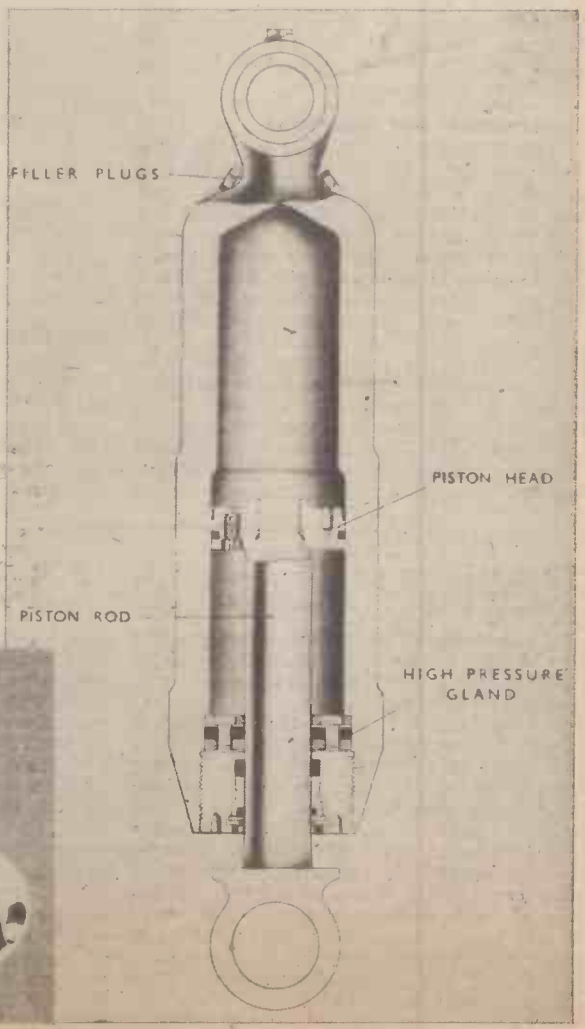
All indications point to the fact that more than a spring has been invented—the perfect method of suspension for heavy transport and machinery such as drop hammers, weaving looms, heavy vibrating marine engines, etc. They can be applied with advantage in all cases where springs and shock absorbers are necessary.

### Liquid Compressibility

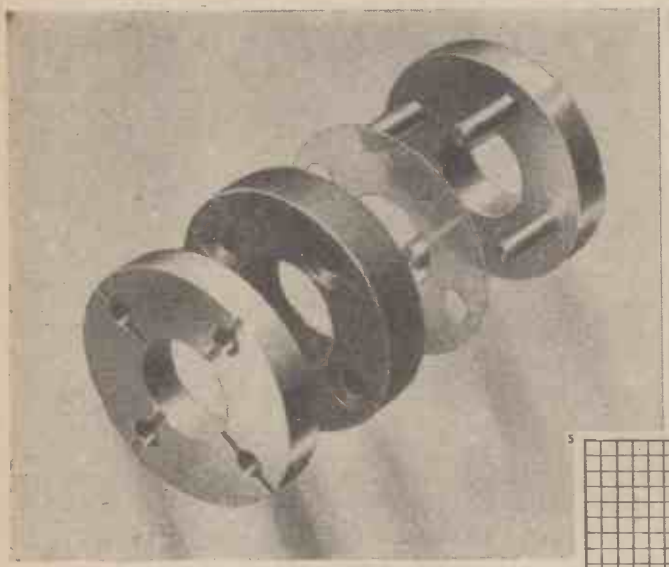
With the object of improving the shock absorbers of aircraft undercarriages, liquid compressibility became the subject of intensive research in the Dowty laboratories. All liquids were found to be compressible and under pressure they are resilient to an incredible degree compared to rubber or metal springs. The accompanying graph shows the compressibility of several different liquids



*A typical liquid spring used on the Halifax aircraft landing gear. The overall length is only 21in. Pressures of 50,000lb. per square inch are developed in this liquid spring when the aircraft lands.*




*Section of the liquid spring shown almost fully compressed.*



*An exploded view of the gland which withstands the high pressures developed in the liquid spring.*

plotted against the pressure developed.

Light mineral oils have proved the most suitable fluids for liquid springs, and continued research has led to the discovery of a fluid which can be compressed by no less than 20 per cent. of its original volume at 60,000lb. per sq. in. It is believed that fluids with still greater compressibilities will shortly be available.

### Construction and Operation

The Dowty Liquid Spring consists of a pressure-sealed cylinder filled with oil and containing a piston, which carries valve mechanism. Secured to the piston head is a rod which emerges through a high-pressure gland. A grease-filled recess in the gland-retaining nut lubricates the piston rod. When the rod is forced into the cylinder, the oil is compressed and simultaneously transferred from one side of the piston to the other. The valve in the piston head opens fully during compression but on recoil the valve closes so that movement is damped and excellent shock-absorbing qualities obtained. The high-tensile steel cylinder embodies two filler plugs to facilitate exclusion of air during filling. Occasional topping up can be carried out with an ordinary grease gun.

The liquid spring shown in the illustration was first used on the "Halifax" aircraft, one spring being fitted into each main undercarriage member. It measures 21in. between attachment centres and 4in. outside diameter. The ram is 7in. long × 1.4in. diameter and the whole unit weighs 40lb. The liquid spring used on the "Typhoon" tailwheel shock absorber is 8½in. long and 2in. outside diameter and weighs 5lb.

### The High-pressure Sealing Gland

The liquid spring has been made possible by the development of the high-efficiency gland which, when working under enormous pressures, permits smooth action of the piston rod. The gland is of the unsupported area type and is located between a step in the cylinder bore and a gland-retaining nut.

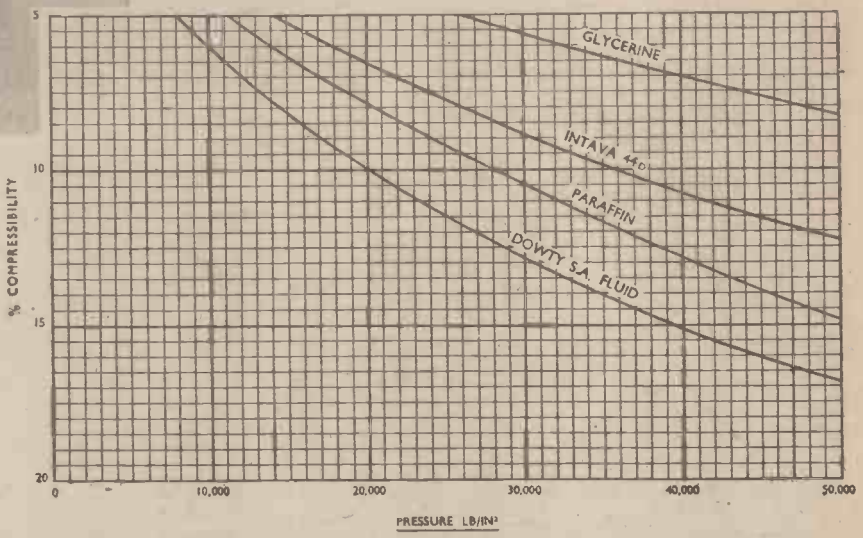
The gland assembly is in three main sections. A steel pressure plate, carrying four dowel pins, butts against the cylinder step. The dowel pins pass through a resilient gland-ring and into holes in a backing plate, which is supported by the gland-retaining nut. A foraminated disc placed between gland and pressure plate prevents a pressure lock. Colloidal graphite can be added to the oil to reduce gland friction.

The cross sectional area of the resilient gland is less than that of the pressure plate, due to the four dowel pin holes. Thus, pressure on the plate is intensified on the gland with the result that the resilient gland tends to "leak" into the cylinder rather than the oil leak out.

The strength and reliability of the liquid spring was shown by a set which, fitted to a Halifax aircraft, survived two crash landings, and was subjected to 500 landings without attention of any kind.

Liquid springs require little or no servicing. They do not lose their resilience, and a separate shock absorber is not required.

Their simplicity—the hallmark of all successful inventions—guarantees faultless performance.




*Graph indicating the compressibility of different liquids at varying pressures. The Dowty shock absorber liquid can be compressed by 20 per cent. of its original volume at 60,000lb. per square inch.*

# Radar Aids to Civil Aviation

IN the course of an address given recently in the Conference Room, Ministry of Civil Aviation, Mr. Dippy, of the Ministry of Aircraft Production, stated:

"Radar can tell us, for the first time, I think, how to measure distance, and it gives us, by the use of pulses, a way of telling how our signals have travelled; whether they have come by a direct route, by a reflection from the 'E' layer, or by a reflection from the 'F' and other layers. It therefore gives us greater flexibility and greater ease of working under conditions which might well be impossible with continuous waves. The use of centimetric waves gives us the possibility of measuring azimuth with high precision by producing very sharp beams with quite reasonable antennæ designs.

"With that introduction we can consider the area and airport control. You have heard a description of A.C.R. Mark III. That is the airport control radar which is basically a straightforward radar. When applied to the civil aviation problem it very soon ceases to be a straightforward radar and grows many display and other features. The designer is faced with the question what information is wanted and how it is to be presented. There is a great deal of research to be done before we can give a satisfactory solution. The sort of solution we can see at the moment is the interim solution in A.C.R. Mark III. It gives us a weapon for dealing with the presentation of aircraft at distances of 20, possibly 50, miles from the airport or control centre. By the use of responders in the aircraft the ranges are increased. The biggest effects of the use of responders are that spurious signals from hangars, hills, etc., are cut out, and the craft may be identified. Possibly one of the biggest problems the controller has to face is the identification of aircraft. I think I am on safe ground therefore in saying the proposal for the future in regard to airport control would be that all aircraft should carry responders. These responders would be quite small and light, and if all aircraft were carrying them they would naturally become cheap and reliable. There is nothing fundamental in them which should make them complex and unreliable. By the use of these responders, then, the ground control is able to gain identification of the aircraft and what is called a 'clutter-free' picture; in other words, nothing but aircraft is shown.

### Surface Movement Detection

"A similar principle can be used for the solution of the problem of surface movement detection. It is not so much surface movement that worries anybody; it is the stationary objects that might be on the runways or the taxiways. One can call into use something similar to the airport control radar, but with a higher definition, to give a picture to the tower or other control centre of the presence of obstacles, aircraft or anything else, on runways and taxiways. Something already has been done; it is by no means ideal but it might form a good basis for future development."

# The Elements of Refrigeration—2

## Absorption Machines : Analyser and Rectifier : Domestic Refrigerators

By R. WINTER-EVANS

(*Continued from page 236, April issue*)

*A Frigidaire domestic electric refrigerator.*

IN the absorption type of plant no mechanical work is done. The energy which it is necessary to supply from some external source in order to effect refrigeration is supplied directly as heat, without any intermediate stage in which the heat energy is transformed into mechanical energy or work.

The plant is simpler mechanically than the compression system, and it may, in fact, be constructed with a complete absence of moving parts. It is suitable, therefore, for installation in situations where there is but little skilled attention available. This, together with the absence of noise, and immunity from mechanical breakdown, renders the system peculiarly attractive for small domestic refrigerating units.

In refrigerating plants of the absorption type two substances are used, having a strong affinity for one another at relatively low temperatures, but easily separable by the application of heat. Ammonia and water are the substances most widely used, the ammonia being alternately absorbed by and separated from the water. The breaking up of the mixture of water and ammonia, which is known as aqua ammonia, is done by the application of heat, driving the ammonia off in the form of a vapour at relatively high pressure. This vapour is then liquefied at constant pressure in a condenser, giving up its latent heat to low-temperature circulating water. The vapour thus condensed is then allowed to re-evaporate after passing through an expansion valve and falling in pressure. During this re-evaporation at low temperature and pressure the vapour takes up heat from its surroundings, and it is at this stage that refrigeration is effected. Immediately the ammonia has re-evaporated, the resulting vapour is reabsorbed by the water, this process being accelerated by keeping the water at a low temperature. This completes the cycle of operations, which is then repeated.

### Absorption Refrigerating Plant

Fig. 5 shows diagrammatically the arrangement of the components of a practicable, continuously acting, ammonia absorption refrigerating plant. There is one vessel in which the ammonia is driven off from the aqua ammonia in the form of a vapour, this being known as the generator; another vessel in which the high pressure vapour is liquefied, called the condenser; a third vessel in which the liquid re-evaporates, called the refrigerator or evaporator, and a fourth in which the vapour leaving the evaporator is re-absorbed by the water, called the absorber. A small pump, to return the liquid which has taken up ammonia in the absorber to the generator, and the regulating valve complete the essential components, although it is possible to operate the system without the pump, and this is, in fact, done in the Electrolux units, as we shall see later.

A simple machine of this class is shown in Fig. 5. The strong liquor in the generator is heated by means of steam passing through the coil shown, liberating ammonia vapour, which passes to the condenser. Here it condenses, giving up its latent heat to the circulating water surrounding the condenser coil. The liquid ammonia thus obtained drains from the condenser into the liquid receiver, from which it flows through the expansion valve to the evaporator. As it evaporates here, the ammonia takes up heat from the medium surrounding the refrigerator coils and passes on to the absorber, where it rises up through the weak liquor in a series of bubbles from the perforated pipe.

In order to ensure the absorption of the ammonia vapour by the weak aqua in the absorber, this latter must be kept comparatively cool, and this is conveniently done by circulating the cooling water discharged from the condenser through a coil submerged in the aqua as shown. This process of absorption liberates a large amount of heat, and the cooling water must carry this away as well as the heat brought into the absorber by the weak aqua. The strong aqua is continuously drawn off from the absorber and returned through the exchanger to the top of the generator by means of the pump. The specific gravity of aqua ammonia is reduced as the proportion of ammonia increases, so that strong liquor rises to the top of the generator, and the weak liquor settles to the bottom, from which it is allowed to pass, by way of the exchanger, to the top of the absorber. In so doing it also passes through a regulating valve, where its pressure is reduced from the high generator value to the lower pressure of the absorber.

### Function of Exchanger

The exchanger mentioned above is not an essential component of the plant, but it is a notable improvement, leading to more economical operation. It acts as an economiser, transferring heat from the hot weak liquor to the cool strong liquor. As we have seen the liquor in the absorber must be kept cool in order to bring about the absorption of the ammonia vapour leaving the evaporator, and it is therefore necessary to cool in some way the hot liquor passing from the generator before it enters the absorber. On the other hand, the strong liquor leaving the absorber and passing to the generator will require to be at as high a temperature as possible at entrance to the generator, in order to reduce the heat necessary for generation to as low a figure as possible. Thus by making the hot liquor leaving the generator pass through a series of coils around which the cold liquor is pumped on its way back to the generator, the hot liquor will

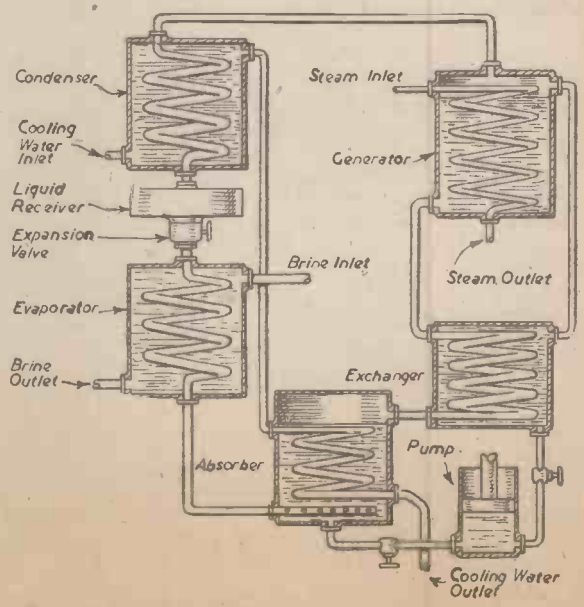



*Fig. 5.—Sectional diagram of an absorption machine.*

give up some of its heat to the cold liquor, reducing the amount of steam needed at the generator, and at the same time the amount of cooling water to the absorber.

In the system shown in the diagram the cooling of the weak liquor is completed in the absorber itself, but in some cases an independent cooler is provided, and the liquor is cooled to the requisite degree before it passes into the absorber. When this is done the cooling water discharged from the condenser is used for the pre-cooling process, and the circulating water from the absorber is taken from a separate water supply.

### The Dry Absorber

There are three types of absorber in common use to-day, these being known as the wet, dry and wet-and-dry types.

The wet type is that shown in Fig. 5, its main feature being that it is always nearly full of liquor, and the ammonia vapour leaving the evaporator is made to pass up through this in a series of bubbles.

The dry absorber, which is shown in Fig. 6, contains only a small quantity of liquor. It will be seen from the sketch that the weak liquor enters the absorber at the top and is distributed over the perforated plate by the conical distribution piece, falling through the plate in the form of a fine mist and entraining the stream of ammonia vapour as it falls. The perforated plate breaks up the stream of the weak liquor and exposes a large surface to the ammonia vapour, making for quicker absorption. The strong liquor that results drains to the bottom of the absorber, from which it is returned through the liquor pump to the generator. The main disadvantage of the dry absorber is the possibility of the circulating water becoming frozen, due to the cold ammonia vapour from the evaporator coming into direct contact with the cooling coil.

Fig. 7 shows the wet-and-dry absorber, with the ammonia vapour from the evaporator entering at the top and passing down through the vertical pipe. This pipe is connected at the bottom to the horizontal perforated pipe, the vapour escaping from this and passing up through the small amount of liquor in the absorber in the form of bubbles. The weak liquor enters at the

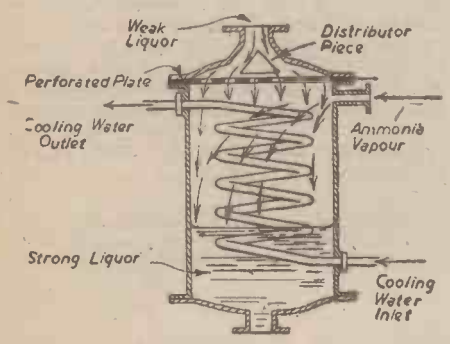



*Fig. 6.—Dry absorber.*

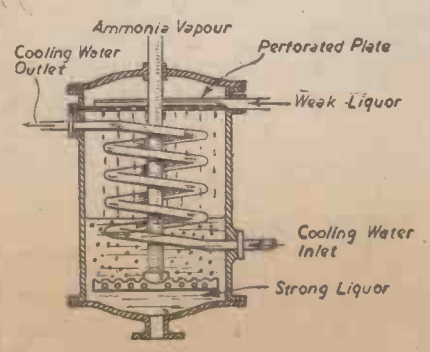



*Fig. 7.—Wet-and-dry absorber.*

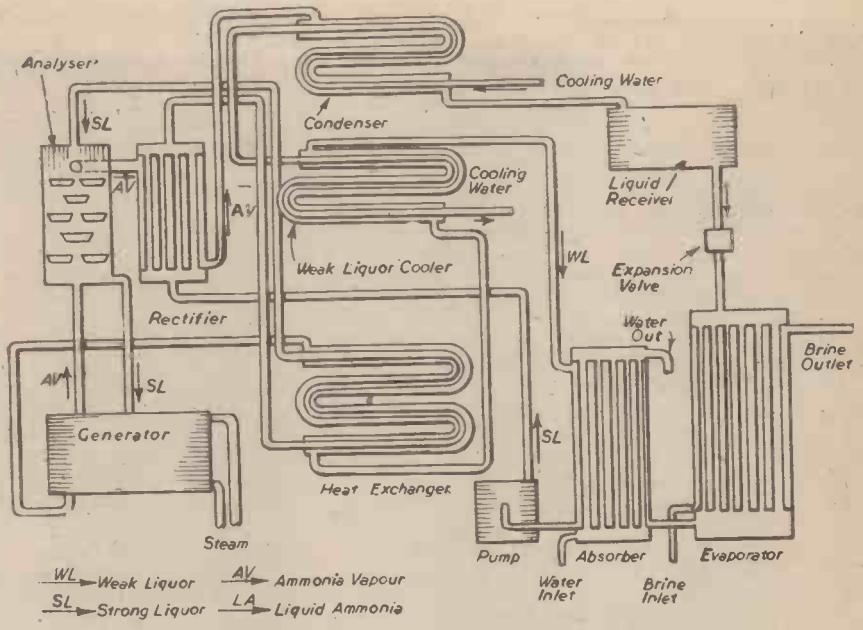



*Fig. 8.—Simplified diagram of an ammonia absorption plant.*

top, and is distributed over the whole cross section of the absorber by the perforated plate, and the rain of weak liquor thus formed entrains any vapour which has passed through the liquor at the bottom without being absorbed. The possibility of freezing occurring is avoided here, the ammonia vapour being heated before it comes into contact with the cooling coil.

### The Analyser and Rectifier

These are best considered together. The purpose of the rectifier is to dry the ammonia vapour thoroughly before it enters the condenser, and that of the analyser, which is generally used in combination with the rectifier, is to extract from the vapour leaving the generator as much of the water vapour present as is possible. The rectifier completes the drying process started in the analyser by condensing any water vapour that remains after the ammonia vapour leaves the analyser. The cooling necessary to bring about this condensation is carried out by passing the vapours from the analyser over a series of tubes carrying the strong liquor to the generator. This liquor from the absorber is relatively cool compared with the hot liquor and vapours from the generator, and will absorb sufficient heat to bring about condensation of any steam present.

If water vapour is allowed to pass into the condenser with the ammonia vapour it will condense there and accumulate, finally passing through the liquid receiver to the evaporator coil and seriously impairing the efficiency of the plant.

A better method of cooling the vapour from the generator and analyser in order to condense the steam present is to use water instead of the liquor from the absorber. The water may be taken from the condenser circulating water discharge or from an independent supply.

The arrangement of an ammonia absorption plant is shown in Fig. 8, which includes both rectifier and analyser. The latter consists of a cylindrical drum placed on end and containing a number of trays placed one above the other. The strong liquor from the absorber is delivered by the pump to the exchanger and then to the analyser, from which it passes to the generator by gravity. Meanwhile the ammonia from the generator passes up through a rain of strong liquor in the analyser on to the rectifier, and so to the condenser. From here the liquid ammonia drains to the liquid receiver through the expansion valve and into the evaporator. The gaseous ammonia from the evaporator passes to the absorber and is absorbed by the weak liquor. The strong liquor thus formed is pumped through the rectifier to the exchanger and then back to the analyser once more, finally being discharged under gravity to the generator ready to undergo a fresh cycle.

### Practical Application

We can now turn to the practical application of the principles already discussed.

Both compression and absorption type refrigerating plants are available for domestic use. Examples of the compression machine are the Frigidaire, Kelvinator, B.T.H., and Prestcold machines, whilst the Electrolux is

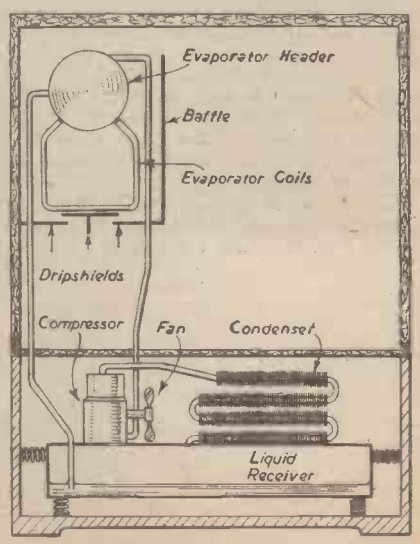



*Fig. 9.—Diagram of Frigidaire system.*

a well-known example of the practical application of the absorption principle. For domestic use the chief disadvantage of the compression system is the noise of the belt or gear drive needed for the compressor and the noise caused by the compressor itself. There is also a greater liability to breakdown on account of the moving parts and the possibility of electrical interference with radio reception. The absorption machine, on the other hand, has no moving parts at all, and is therefore practically noiseless in operation.

The working pressures are, however, higher in the absorption units, and a supply of cooling water is generally necessary against the air cooling, which usually proves satisfactory for a compression refrigerator. There is very little to choose between the two types when it comes to operating costs.

The refrigerants generally used are ice, carbon dioxide, sulphur dioxide, methyl chloride and ethyl chloride, and, in addition to the properties mentioned above, it will be found that these are all to a very great extent non-inflammable and non-explosive.

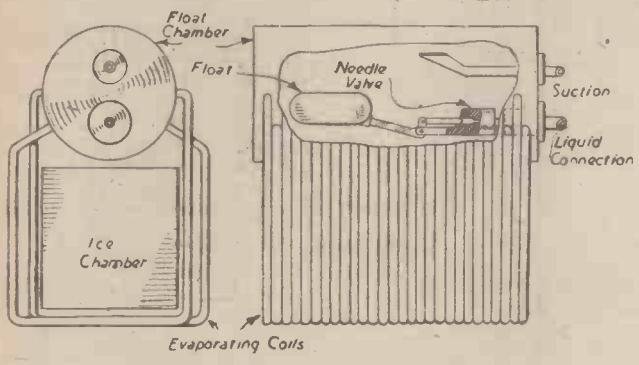



*Fig. 10.—Frigidaire evaporator.*

## The Frigidaire Refrigerator

These operate on the compression system, and are of two general types, with an air-cooled condenser in the usual domestic type and a water-cooled condenser for the rather larger commercial machines suitable for small cold stores and the like, but the selection of the cooling medium will naturally depend to some extent on the temperature of the air and water available.

Fig. 9 illustrates the common arrangement of the domestic unit with air-cooled condenser, and it will be seen that the compressor unit is arranged in a compartment at the base of the refrigerator. The whole system, consisting of the compressor and its driving motor, condenser, liquid receiver, automatic electric switch and circulating fan, is mounted on a substantial steel base, supported from

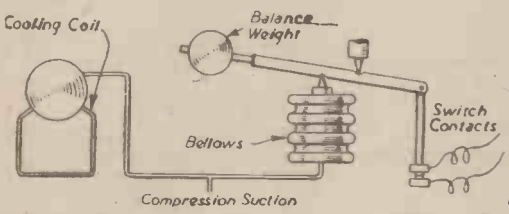



*Fig. 11.—Frigidaire control switch.*

the sides of the cabinet by strong springs. This prevents the transmission of vibration and noise. The refrigerant used is dichlorodifluoromethane, which is commonly known as Freon 12.

In operation the refrigerant absorbs heat from the commodities stored in the cabinet and passes on to the compressor, which raises its pressure and passes it on to the condenser. Here the refrigerant gives up heat to the cooling air and is condensed before passing through the liquid receiver to the float-controlled expansion valve and the evaporator coils, where it once more absorbs heat from the stored commodities and recommences the cycle.

## The Compressor

This is of the single-acting, twin-cylinder type, and is normally arranged to be driven from an electric motor by V-belts. The discharge valve is of the automatic flap type, consisting of a straight steel reed located across the cylinder head, whilst the suction valve is fitted in the head of the piston and is of the thin disc type. An efficient shaft seal is required where the shaft leaves the compressor casing, and this, in the Frigidaire, is of the oil-packed sylphon bellows type, so designed that the internal and external pressures are nearly equal and opposite, reducing leakage to a minimum and making for very small wear on the bearing surfaces.

## The Evaporator

The cooling coils are of copper and are soldered into the float chamber containing the float that operates the expansion valve which maintains a pressure sufficient to keep the liquid Freon 12 at room temperature, and at the same time permits it to flow into the cooling coils sufficiently fast to replace the fluid that has been evaporated.

The construction of the evaporator and the operation of the float and needle valve should be clear from Fig. 10. The space enclosed by the tubes serves as a chamber for ice trays.

## The Condenser

This is of tubular construction, the tubes being placed horizontally and finned to increase the surface presented to the cooling air.

## Temperature Control

In order to maintain the temperature of the food compartment at the requisite figure the refrigerator is fitted with a control switch, the operation of which is illustrated in Fig. 11. From this it will be seen that the compressor motor is cut in and out by the expansion and contraction of the sylphon bellows which are connected to the compressor suction line. As the temperature in the cabinet rises, the evaporating pressure increases, and the bellows expand, bringing the switch contacts together and starting the compressor motor. When the temperature falls below the set limit the bellows contract, opening the contacts and stopping the motor. A number of additional refinements are provided with the switch, such as an adjustable spring to the lever, this enabling the range for opening and closing the contacts to be altered at will, and a secondary adjusting spring with a tensioning device in the cabinet of the unit, so that the temperature can be adjusted within small limits without interfering with the main spring.

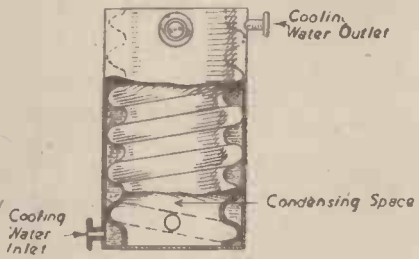



*Fig. 12.—Water-cooled condenser.*

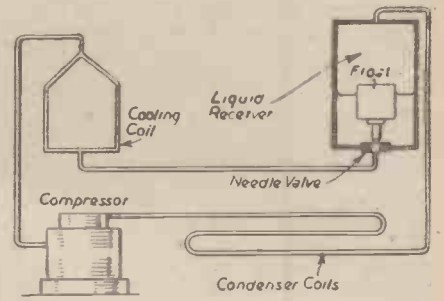



*Fig. 13.—Diagram of the Kelvinator system*

## Water-cooled Condenser

This is fitted in some of the larger units, but the only real difference is in the construction of the condenser itself and the incorporation of water-regulating and shut-off devices. The condenser is illustrated in Fig. 12 and consists of two shells, the outer of which is pressed over the inner, which is formed with a spiral groove. Through this the cooling water flows on the outside and the refrigerant condenses inside. This type of condenser also serves as a liquid receiver.

## The Water Regulator

This controls the rate of flow of the cooling water to the condenser, and operates in a similar manner to the motor control switch illustrated in Fig. 11, the sylphon bellows being operated by variations of the condenser pressure and operating a valve through a suitable system of links. Increase in the cooling water temperature increases the pressure in the condenser; the bellows expand, and the water valve is opened to permit a greater flow. Similarly, a decrease in the temperature of the cooling water shuts down on the flow.

A safety shut-off device is also incorporated in the water regulator, cutting out the compressor motor in the event of partial or complete failure of the water supply.

## The Kelvinator Refrigerator

These units are manufactured in a variety of types and are supplied with both air- and water-cooled condensers, the former being usual for the domestic models. Methyl chloride is usually employed as the refrigerant in these, although sulphur dioxide and dichlorodifluoromethane are also used.

Fig. 13 shows one of these refrigerators in diagrammatic form, and no further explanation should be needed.

## The Compressor

This is of the single-acting type, with one or more cylinders depending on the capacity of the unit. The discharge valves are of the reed or plate type, and are mounted in a cage which is free to move bodily against springs, this construction preventing damage in the event of excessive pressure in the cylinder. The suction valves are in the piston head.

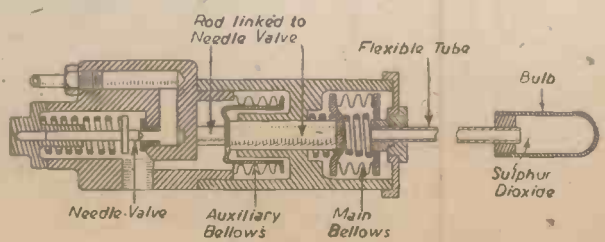



*Fig. 14.—Sectional diagram of a thermostatic expansion valve, showing the main and auxiliary bellows and sulphur dioxide bulb.*

### The Evaporator

The evaporating coils of the domestic unit are arranged so as to form a chamber for the ice trays; they are made of copper and finned, and additional coils are arranged under each tray to facilitate rapid freezing. The tank containing the evaporating coils may be filled with alcohol in order to provide storage of refrigeration, reducing the number of times the compressor is cut in and out.

### The Condenser

The air-cooled condenser is built of copper tubes, finned, and cooled by air circulated by a fan on the motor pulley. The water-cooled condenser is a vertical shell acting as a liquid receiver, with a spiral water tube fitted internally.

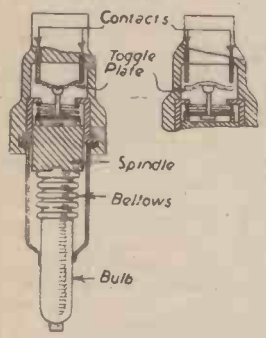



*Fig. 15.—Thermostatic switch.*

### The Liquid Receiver

This is only necessary for the air-cooled models, and may be of the type shown in Fig. 10, or of the vertical type of Fig. 13. The latter has a number of advantages, an exact quantity of refrigerant not being necessary, the purging of non-condensible gases being easier and the capacity being greater for a given space.

### The Expansion Valve

Here again there is a choice between two types. One is a type of automatic valve operated by sylphon bellows, which are under spring control. The variations of vapour pressure cause an operating rod to open or close the needle valve.

An expansion valve operating on a similar principle, but arranged for thermostatic control, is illustrated in Fig. 14. The operating fluid, sulphur dioxide, is held in the metal bulb, which is clamped to the compressor suction line where it leaves the evaporator. Changes of the temperature of the fluid in the suction line are transmitted to the gas inside the bulb, and the consequent changes of pressure are passed through the flexible tube to the sylphon bellows, movement of which operates the needle valve through the rod shown. If the temperature, and consequently the pressure of the fluid within the bulb, rises, the bellows expand, and the needle valve is opened. If, on the other hand, the temperature and pressure of the sulphur dioxide fall, the bellows contract, and the needle valve moves towards its seat.

To avoid the possibility of the evaporator temperature rising much above its correct figure a second auxiliary sylphon bellows is provided. These are arranged to operate after the needle valve is fully opened, when the pressure rises to some predetermined limit, and bring the needle valve back on to its seat.

### Temperature Control

For cutting the compressor motor in and out to suit the load conditions a thermostatically controlled switch is employed. The thermostat is placed on the suction line near the evaporator, and its arrangement is shown in Fig. 15. At the lower end of the instrument is a bulb containing a freezing solution that expands on freezing and causes the bellows to expand. This forces the spindle up against the spring and buckles the toggle plate upwards, breaking the motor circuit. As the freezing solution melts with an increase in temperature, the bellows contract, the toggle plate buckles downwards once more, and the motor circuit is closed.

A modified system is provided with two sylphon bellows, one connected on the high-pressure side in order to operate the motor switch in the event of excessive pressure rise and the other connected to a temperature control bulb on the evaporator, this cutting the motor in and out and maintaining the proper temperature range.

### The Prestcold Refrigerator

The arrangement of the various components of this machine, which uses sulphur dioxide as the refrigerating fluid, are shown in Fig. 16.

### The Compressor

This is of the single-acting single-cylinder type of conventional design, with a shaft seal of the bellows type.

### The Evaporator

Of the brine tank type, this comprises a pressed steel shell enclosing the evaporator coils. The advantage of the brine cooling is that it provides a useful storage capacity, and the amount of starting and stopping of the compressor is consequently reduced.

### The Condenser

This is of copper tube, with continuous strip finning.

### The Expansion Valve

One of two types may be fitted, either automatic or thermostatically controlled. In the latter the valve is operated by a temperature sensitive element located at the outlet from the evaporator.

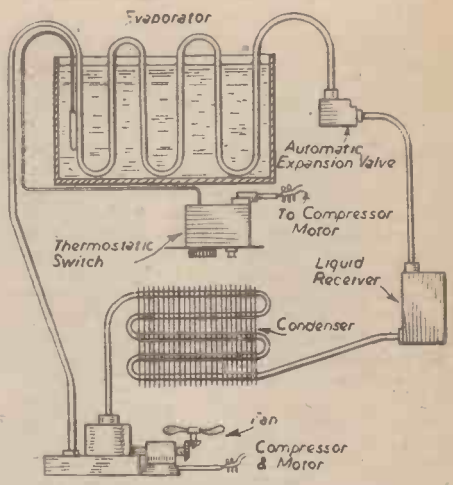



*Fig. 16.—The Prestcold refrigerator system.*

### Temperature Control

Control of the temperature in the cabinet is effected by means of a thermostatic switch controlling the compressor motor. The actuating fluid is sulphur dioxide in a metal bulb clamped to the suction line at the outlet from the evaporator.

There are a number of other refrigerators operating on the compression principle, among these being the G.E.C. and the B.T.H. units, but these are in general similar to one or other of the models described above, and it is only in the arrangement of the various components and in detail that differences are found. There is, therefore, no point in discussing these at great length.

*(To be concluded)*

## New Phototelegraph Equipment

*The facsimile machine shown in the illustration consists of a cylinder which rotates at a speed which is controlled by a quartz crystal and at the same time moves forward along a shaft and progressively exposes every part to a scanning light; the principle is similar to that of a screw cutting lathe and scanning takes place in helical progression. For transmission the scanning light spot illuminates unit areas of the subject and for reception it exposes a photographic film. There are about 100 scanning lines per inch of drum travel and the definition is therefore of the order of .01in. The drum rotates at 60 r.p.m.*

*The cylinder and lead screw are driven by a synchronous motor which derives its power supply from a valve amplifier.*

# Inventions of Interest

By "Dynamo"

### *Blankets for 'Planes*

IT is obvious that airway systems require to reduce to a minimum the load of furnishings and equipment carried on a 'plane. This includes those aircraft which provide sleeping accommodation. It is said that aeroplane engineers have for some time been endeavouring to minimise the weight of sleeping-blankets without materially reducing the insulating or warmth value or the strength of the fabric.

A new invention, for which a patent in this country has been applied, has been designed to provide a sleeping-blanket by means of which thousands of pounds of load yearly, as well as considerable sums of money and a large amount of fuel, may be saved.

According to the new device, lightness is ensured by avoiding the use of large quantities of fibre or yarn. High-insulating characteristics are provided by a triple system of insulating spaces in which air is trapped.

The device emanates from New Jersey, in the United States.

### *New Domestic Flat-iron*

AN Austrian citizen has applied for a patent in this country for a flat-iron which is intended to prevent buttons being torn away, or garments damaged. The new iron has semi-circular recesses to accommodate one-half of the button while the surface below is ironed. These recesses may be somewhat elongated to accommodate simultaneously more than one button.

The recesses are situated a very short distance from the bottom of the ironing surface in such a manner that this surface remains intact and uninterrupted. Consequently, the material is ironed with the whole surface of the iron. And the buttons do not obstruct the ironing process.

### *Like a "Movie"*

AN improved invention relates to apparatus for displaying letters, figures, etc., of the type in which a cinematographic effect is produced by means of a series of stationary pictures viewed by spectators walking in front of them.

The pictures employed are, as in previous apparatus of this description, similar to those of a succession of pictures of a cinematographic film separated, e.g., by partitions, so that only one picture can be seen at a time by an observer.

The new device comprises a number of compartments, each of which has a picture on the inner surface of the front. At the rear appears a mirror, and in the front of the compartment there is a slot through which the reflection of the pictures can be observed.

It is claimed for this arrangement that it possesses the advantage that the pictures seem to be farther from the observer than they would be if they were located at the rear of the compartments.

### *Fish-filleting Machine*

THE cook who prepares for the table a large quantity of fish will be interested in a filleting machine, for which a patent in this country has been applied.

The inventor has conceived a machine in which fish, including the tail feather and dorsal fin, as it is fed to the apparatus is properly positioned and centred so that the mechanism may function effectively.

This filleting contrivance cuts an incision in the back of the fish on each side and near the backbone. It is so arranged that the fish is presented tail foremost and back downward to the incision-making device. And there is a centring trough through which the fish is pushed and wherein it is centred. This trough comprises a feed trough, a positioning trough and a tilting trough in series. A channel guides the tail feather, and there is means to place the fish in a vertical direction, and this vertical attitude is effected by a device. And there is likewise means to position the tail feather and dorsal fin in the channel.



### *Accommodating Seat*

THE intense exploitation of the air which is certain to be a feature of the immediate future inspires special attention to be devoted to the equipment of aircraft. Among current devices of this description is an improved seat which has been designed principally with a view to its usefulness in aeroplanes.

This seat is fitted with means for readily altering the position of the body, whilst seated, from a normal sitting posture to reclining attitudes.

According to the new device, a linkage is formed by a seat portion carried by a forward and rearward link system. This is pivoted to a base, and an independently pivoted backrest is coupled thereto. Consequently, angular displacement of the backrest automatically adjusts the seat to suit the more or less upright postures.

### *Improved Cycle Lamp*

A PATENT in this country for an improved cycle lamp has been applied for.

The lamp has a window for emitting a front light and one for showing a rear light, both from the same source of illumination within the lamp.

There is an L-shaped supporting arm having one limb longitudinally slotted for pivotal and sliding engagement with a clamping screw attached to the cycle. This arm is so arranged as to be capable of projecting laterally from the cycle to offset the lamp as desired, and also of swinging inwardly towards the cycle in order to minimise the projection of the arm and the lamp assembly when not in use.

### *Convenient Tyres*

EASILY detachable tyres is the characteristic of an invention recently submitted to the British Patent Office. It is especially concerned with vehicle wheels of small diameter such as are used on electric trucks at docks and warehouses where it is desirable to obtain a low loading platform.

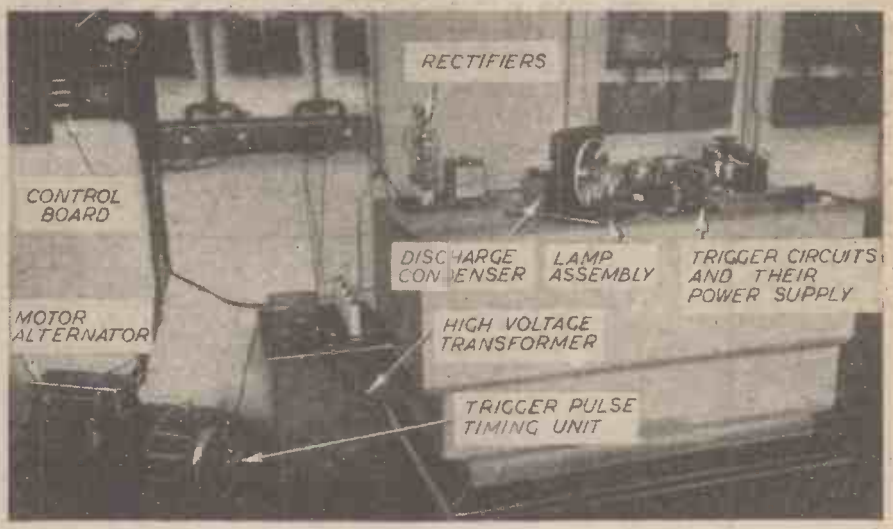
The device consists of a collapsible rim for affording the facility of ready detachability to pneumatically-tyred vehicle wheels, particularly those of small size in which the rim is divided transversely into four or more segments of practically equal size. At least one of these segments has its ends inclined to one another at such an angle as to render the rim self-sustaining against the pressure of the inflated tyre, while permitting the final assembly operation of the rim to be performed without considerable force or complicated tools.

*This flying car has been developed by the Southern Aircraft Division of Portable Products, Inc., of America. The car can leave the road and take to the air. On landing, the propeller and wings are removed and the car can once again continue its journey as a car. It seats two passengers, and thus far is experimental and is not on the market. The photographs were taken during tests in Texas.*

# High-speed Photography of Underwater Explosions

## How Research Work Into the Nature of Explosions Caused by Submerged Mines and Torpedoes is Carried Out

By D. A. SENIOR, B.A., of the Naval Construction Research Establishment of Britain's Royal Naval Scientific Service




*Equipment used for high-speed underwater photography.*

DURING the last hundred years there has been a steady increase in the use of submerged explosive charges in the form of mines and, later, torpedoes and other weapons. Consequently increasing efforts have been made to bring to light the nature of the phenomena involved when explosions take place under water and thus to obtain a better insight into the processes whereby damage is caused. One of the principal difficulties which investigators have had to face is the speed with which explosive phenomena occur, and for this reason the assistance which has been made available by recent advances in high-speed photographic technique has been very welcome. The application of this technique to underwater explosion research dates back little, if at all, before 1941, but it has facilitated the solution of a number of problems when other available methods would have proved costly, tedious, or impossible.

The principle is simple, for, providing the exposure time of a photograph is sufficiently short to "arrest the motion" of the subject, deductions can be drawn concerning phenomena which take place far too rapidly for the eye or any mechanical gauge to follow. It is a logical extension of this principle to devise means of repeating the process at high speed, and thereby to obtain a rapid succession of high-speed photographs.

Two methods of high-speed photography are available. In one the subject is illuminated continuously and exposure regulated by means of various types of high-speed shutter. This method has been developed to give high-speed cine-cameras operating speeds up to 8,000 frames per second. In the other the film is exposed continuously and it is the illumination which is regulated. By means of intense flashes of short duration, good photographs of exposure time less than five micro-seconds can be taken either singly or at speeds up to 1,500 per second.

### The Flash Method

Both types of equipment have been applied to the study of underwater explosions, but, since it cannot be hoped to cover the two adequately in one article, this account deals only with the flash method. This is essentially a development of the well-known technique of spark photography which has been in use for many years.

As is well known, direct shadow photography and "schlieren" spark photography possess certain limitations. In direct shadow methods the area of photographic film used must be larger than the object to be photographed, while in schlieren photography the size of the object is limited by the diameter of the lens or mirror. Moreover, by neither of the above methods can detail within the subject be recorded, since silhouettes only are produced.

This suggests that if short-exposure photographs can be taken by light reflected from the subject those limitations will be removed. However, if an appreciable area (say, several square feet) is to be photographed in this way, spark methods do not provide sufficient illumination.

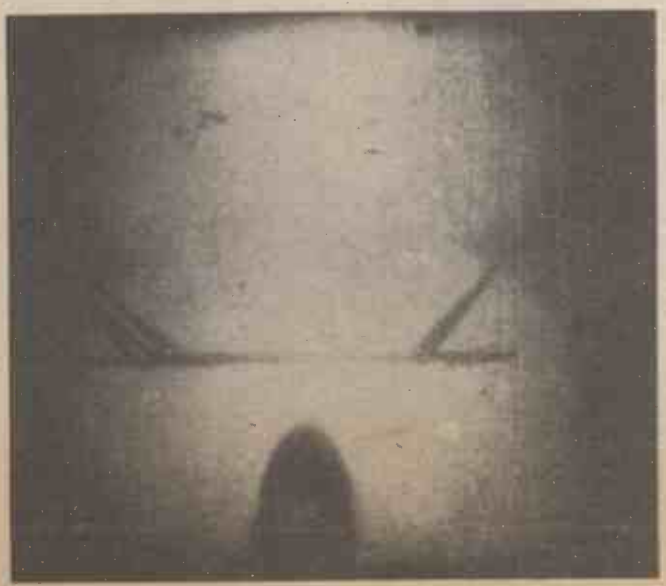


*Fig. 2.—An underwater photograph taken by the silhouette method.*

### Gaseous Discharge Tube—Single Flash Technique

The required increase in illumination can be obtained without serious increase in the duration of the exposure by the use of the gaseous discharge tube. A condenser is discharged, not through an air gap as in spark technique, but between electrodes in a tube filled with a suitable inert gas mixture. The construction of these tubes and the gas filling are such as to give a longer path between electrodes than would be possible at the same voltage with a spark in air. This results in greater light flux for a given energy of discharge.

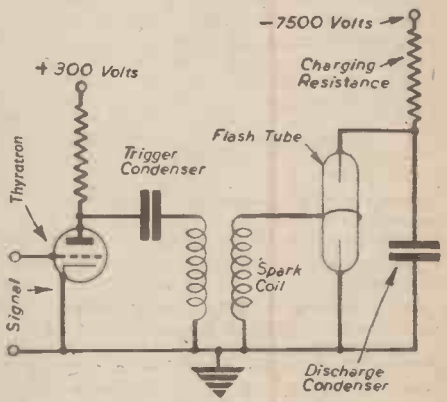



*Fig. 1.—The triggering circuit.*

It is beyond the scope of this article to enter into the theoretical and design considerations involved; the important fact to bear in mind is that flashes can be produced of sufficient intensity for really good reflected light photography of objects at distances up to 15ft. from the discharge tube, without the use of reflectors.

The capacity of the condenser varies from 0.1 to 4 microfarads and its voltage from 2,000 to 20,000 volts. Both condenser and voltage are thus within the range of fairly simple laboratory equipment.

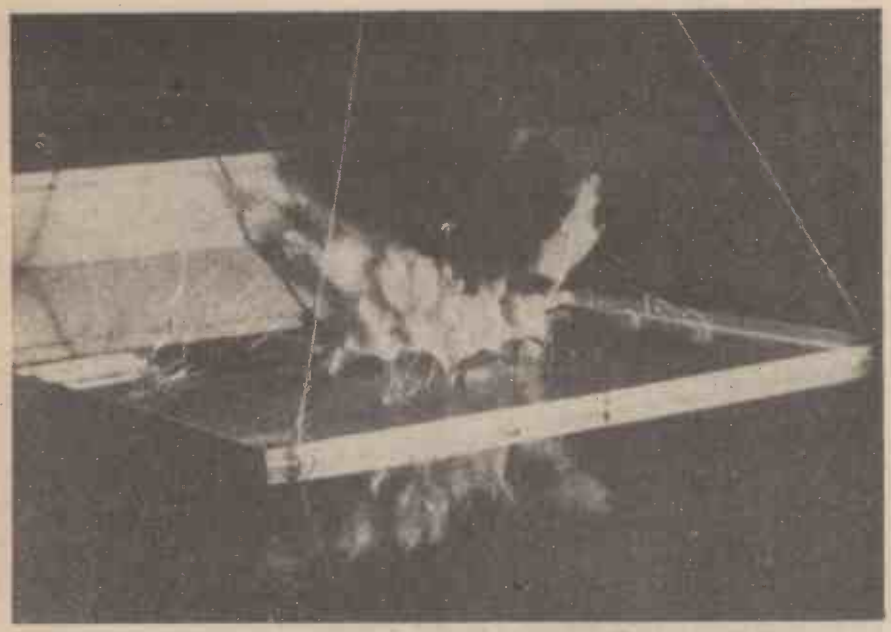


*Fig. 3.—A photograph by the single-flash method.*

For the production of one flash at a time, charging takes place quite slowly, through a high resistance; discharge takes place extremely rapidly through the discharge tube—or flash tube, as it is generally called—which is connected with the minimum of wiring directly across the condenser terminals.

The flash tube is connected in this manner in order to reduce to a minimum the inductance of the discharge path and thereby the duration of the flash. The duration depends upon many other factors, including the gases used in filling the tube and their pressure, the construction and treatment of the electrode system, the size of the condenser and the voltage to which it is charged. A great deal of work has been carried out with the aim of minimising the duration which, with the more recent tubes, is about one or two micro-seconds.

### Synchronisation — Thyratron Trigger Circuit

There now remains the question of synchronising the flash with the event. It is, first of all, essential to be able to initiate discharge of the condenser—or "trigger the flash"—reliably and repeatedly. For this purpose either a triggering band external to the tube or an internal electrode may be used. In either case a voltage—or "signal"—must be generated at the instant when the flash should occur.

The signal, assuming for the time being that one can be obtained, is amplified if necessary, and then applied to the grid of a thyratron valve. This permits the discharge of a small condenser (the trigger condenser) through the primary winding of a spark coil. The secondary winding is connected either as shown in Fig. 1, if an external triggering band is used, or between the starting electrode and one other electrode if the tube is of the three-electrode type. In both cases pilot sparks are produced within the tube. These are followed by the discharge of the main condenser which produces the flash. With well-designed tubes the interval between the arrival of the signal and the flash is of the order of five micro-seconds and is quite reproducible.

The derivation of the signal from the phenomenon under investigation obviously depends upon the nature of that phenomenon. The closing or opening of an electric circuit produces quite a reliable signal, and this covers most impact problems. Alternatively the generation of a shock wave or sound wave may be used. These may be picked up by means of a microphone or hydrophone, but it must, of course, be remembered that this implies a time delay, equal to the time taken for the wave to travel from the source to the microphone. Another method which has been used successfully is the interruption of a beam of ultra-violet light, the signal being given by a photo-electric cell.

Providing that the phenomenon being studied is reproducible and that a signal can be derived representing some "reference event," single-flash photography can be made to cover the remainder of the phenomenon by introducing a known time interval between the signal and the flash. The magnitude of the delay may vary from a few micro-seconds to several hundred milli-seconds, and is generally provided by means of electronic devices. Thus a set of pictures may be obtained, and the history of the phenomenon pieced together.

### Multiple Flashing—Power Stroboscope —High-speed Camera

Basically, the principle is the same as that of the multiple spark; that is, a condenser is repeatedly charged and discharged. Each discharge produces a short duration flash of light which is utilised to record a photograph upon a strip of moving film.

The Edgerton high-speed camera is of the continuously moving film type. The camera takes 100ft. of 35-mm. cine-film, which is drawn from one spool to another by a small electric motor, and travels past the lens over a sprocket wheel at governed speeds between 30ft. and 90ft. per second.

There is no lens shutter; the spacing of the pictures, or framing, being regulated by timing the flashes of the stroboscopic lamps to occur at equal intervals of film. This is accomplished by means of a commutator which forms an integral part of the sprocket wheel mentioned above.

The mechanism of triggering the flash is essentially the same as that used for single-flash photography, i.e., signals (received from the commutator) operate a thyratron trigger circuit at the appropriate instants.

The interval between the segments of the commutator is so chosen that the frame spacing is the same as that in standard cine-film. The records may therefore be projected at the normal rate (16 frames per second) and the subject "slowed down" 30 to 90 times.

The "Power Stroboscope" consists of a 2,000-volt power supply together with lamps and trigger circuit. The trigger circuits and lamps work on the same principle as the single-flash equipment described above; certain modifications in the charging and discharging circuits are, however, necessitated by the high rate of flashing (1,000 to 1,500 flashes per second).

### The Explosion Bubble

One of the first underwater explosion phenomena to be studied by means of high-speed photography was the behaviour of the gas bubble. This bubble is composed of explosion products and grows in volume until the pressure within it has fallen to a value considerably below that previously existing in the surrounding water. The volume then diminishes, reaches a minimum, increases again, and continues to oscillate in this manner until the bubble breaks up.

Shock waves are emitted when the charge is detonated, and at each successive bubble minimum. The shock wave emitted during detonation may cause damage to nearby structures; so also may subsequent shock waves, though the effect of these may not be so great as that of the first. The behaviour of these shock waves is complicated by the fact that during oscillation the bubble migrates in a manner dependent upon its

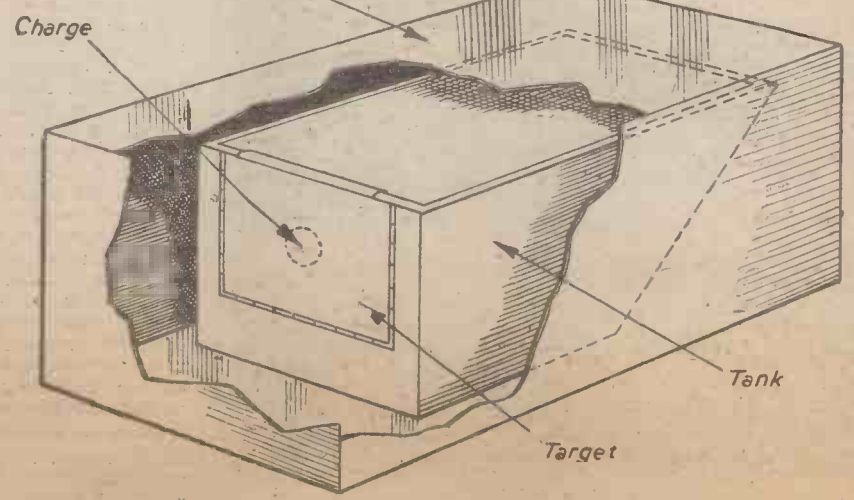



*Fig. 4.—Special armour plate tank used for investigating the effect of explosive blast.*

surroundings, the rise of the bubble due to gravity being modified by its tendency to move towards rigid surfaces and away from free surfaces (such as the surface of the water).

It is thus of great importance, in determining the damaging effect of an underwater explosive charge under given conditions, to know precisely the manner in which this migration takes place. The question has been treated in great detail theoretically, but before the advent of high-speed photography it was extremely difficult to obtain experimental evidence.

The experimental layout normally used is briefly as follows :

A camera is arranged so that its field of view covers the charge and the structure near which it is being fired. The camera may be immersed in a water-tight container fitted with a window, or more conveniently for shallow charges, it may be pointed vertically downwards and the charge, etc., viewed through a mirror placed below the surface and inclined at an angle of 45 deg. to the vertical.

The lamp (consisting of condenser, flash tube and triggering circuit) is either immersed in a watertight container—in which case the bubble may be seen by light reflected from the water-gas boundary—or arranged so as to illuminate a white screen against which the bubble appears in silhouette.

Single-flash technique has been employed in America to photograph the gas bubble from a small-scale underwater explosion at various stages in its history, both in free water and near to rigid and free surfaces, delay circuits and hydrophones being used to time the flash.

By a slight modification in the technique, photographs of the shock waves themselves have been obtained, and of the cavitation phenomena occurring when the water fails to withstand the wave of tension developed when the shock wave impinges on a yielding surface.

Multiple flash technique has been used on high-speed cine-photography of the gas bubble and of cavitation phenomena close to yielding structures. Whilst the detail shown in individual photographs is less than that in single-flash photographs, the advantages of recording a sequence of pictures are manifold. Not the least is the fact that the projection of records at normal speed enables a clear qualitative idea of the behaviour of the subject to be gained before analysis is begun.

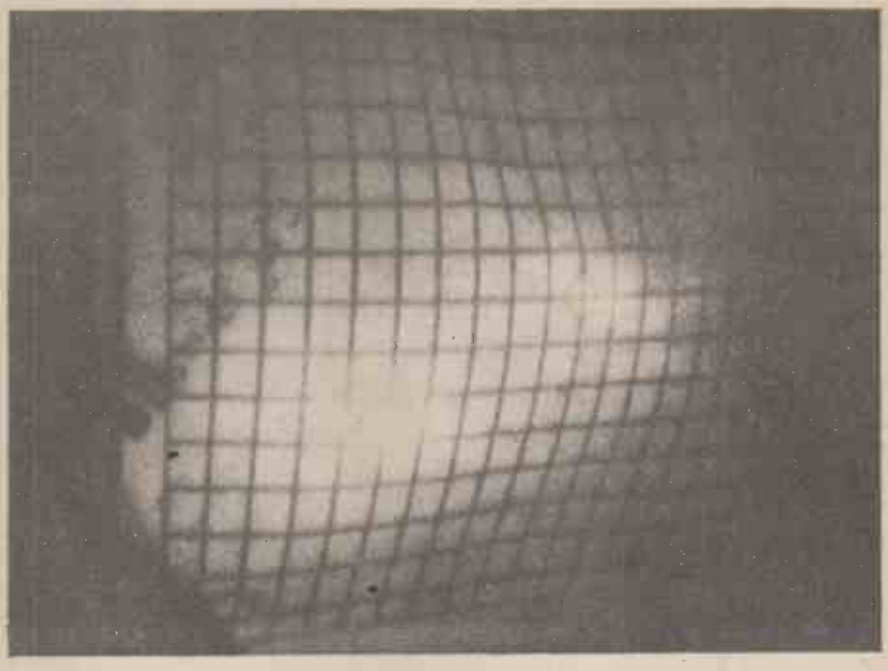


*Fig. 5.—A photograph showing the apparent distortion in a graticule as seen by the camera after the impact of the shock wave.*

One frame from a record taken by the silhouette method is shown in Fig. 2. The charge—a detonator—was fired 6in. below a heavy steel plate. The figure shows the explosion bubble just before the first minimum (i.e., it has expanded and contracted once). It will be noted that the bubble is elongated slightly in the direction of the plate; during the frames following that reproduced here, the bubble gains contact with the plate and performs several oscillations in contact before rising to the water surface, thus confirming theoretical predictions.

### Damage to Structures

The influence of nearby structures upon the behaviour of the explosion bubble has been investigated in some detail. Of greater importance, but less easily investigated, is the behaviour of the structures themselves when the size of the explosive charge is such as to cause damage.

Single-flash methods have been used at Admiralty Undex Works to study the rupture of steel plates attacked by explosive charges. In one set-up a steel plate was placed upon the water surface, a charge being fitted on the underside of the plate in contact with the centre. The signal from a hydrophone placed 10ft. from the charge was used to trigger the flash. The resulting photograph (Fig. 3) shows the hole torn in the plate, the white "plume" of water thrown up, and the black cloud of explosion products. A development of this type of experiment is described more fully when the investigation of the behaviour of underwater protective systems is discussed.

*Fig. 6.—The appearance of a bulkhead with stiffening members before the impact of the shock wave.*

### Photo-Elasticity and Flash Photography

In the photo-elastic estimation of stresses, advantage is taken of the fact that when polarised light is passed through certain media, modification of the plane of polarisation occurs to an extent dependent upon the stresses in the medium. Thus in a statically loaded model, by analysing the interference fringes produced, the principal stress differences at any point in the model may be deduced.

Now when the shock wave from an underwater explosion strikes a ship, the loading is far from static. Indeed, the shock is transmitted to and travels through the ship as a stress wave, because the rate of loading is sufficiently high for considerable local increase in stress to occur before equilibrium is attained. Examination of a xylonite model by polarised light should, therefore, reveal transient isochromatic fringes travelling through the model along the stress wave.

So far as the writer is aware, no direct photography of these transient fringes has yet been carried out. Should it be possible, however, a great deal of valuable information will become available—to quote one example only, the change in stress distribution occurring when the stress wave travelling through a body meets a change of cross-sectional area.

Single-flash technique shows promise of making direct photography of the fringes a possibility, for the required light intensity is available and the flash duration is not excessive (in one microsecond the distance the stress waves and fringes will travel is about .06in.).

A start on this work has been made at Admiralty Undex Works. The principal difficulties are connected with achieving accurate triggering of the flash, and experiments have not yet proceeded beyond this preliminary stage.

### Underwater Protective Systems

The Edgerton Power Stroboscope and, more recently, a similar unit built at Admiralty Undex Works, have been used in investigation of the mechanism of failure, under explosive load, of the multiple compartment protective system used in some large warships. For the purpose of this investigation a special tank has been constructed, in which an attempt is made to simulate on the model scale the conditions obtaining when a ship is damaged by a contact or near miss explosion. Targets

are built to represent typical ship construction to a scale of one-twelfth, and may consist of one or more bulkheads dependent upon the part of the process of destruction under investigation.

The tank itself, shown diagrammatically in Fig. 4, is constructed from 2in. armour plate; it is rectangular in section, 6ft. wide, 5ft. deep and 11ft. long at the top, with one vertical and one sloping end. In the vertical end is a rectangular opening 4ft. 6in. wide, and 3ft. 6in. deep, in which the targets are bolted. The tank is filled with water and explosive charges fired in the water in contact with or at the required distance from the target. Reflections of the shock wave on to the target are avoided by means of the sloping end mentioned above.

The whole tank is contained within a steel cover which serves both to exclude daylight and confine fragments of such targets as disintegrate.

The water within the tank represents the sea, the space in front of the vertical end of the tank representing the inside of the ship. In this space the camera and associated gear are mounted so as to record the phenomena as seen from inside the ship. Camera, lamps, etc., are suitably protected from the effects of explosion blast and fragments by means of steel covers with armour-plate windows, the lamps being spring mounted.

### Silhouette Photography

Depending upon the type of damage being studied, silhouette and reflected light methods have been used. If the bulkhead under observation should rupture, much information may be gained from silhouette photographs.

Here the camera is arranged so as to look at an oblique angle across the target, which is foreshortened into a straight line on the left of the picture. On the side of the target remote from the camera, a frosted screen is erected. This is illuminated stroboscopically from behind. Thus, as the target breaks up, explosion products, fragments of the target and water move across the field of view of the camera, and from the sequence of pictures obtained velocities and displacements may be deduced.

### Photography by Reflected Light

The process may also be viewed by reflected light from the same camera position. In this case the stroboscope lamp is placed directly above the camera. The outline of the water mass is then less clear but the shape of the "petals" and the increasing size of the hole in the bulkhead can be seen more clearly.

Records have been obtained with the camera and lamp facing the target (obliquely so as not to intercept fragments). These show, as does the single-flash photograph of Fig. 3, that the water mass bears strong resemblance to the plume of water thrown up by a shallow depth charge or mine.

The last-mentioned method of photography is, however, of most value in the case of non-rupture (e.g. with single bulkheads and non-contact shots or with multiple bulkhead systems and one or more of the compartments water-filled).

Even when rupture does not occur, it is of great help to know the manner in which deflection occurs as this gives an idea of the way in which energy and momentum are accepted by the target. The camera is mounted with its axis making an angle of 45 deg. with the plane of the target. Its field of view covers the target and the edge fixing to the tank. If plain bulkheads without stiffeners are under trial the target is painted white with a graticule of black lines, and illuminated as evenly as possible by means of the stroboscope lamps.

A typical frame is shown in Fig. 5. This shows the apparent distortions in the graticule as seen by the camera 15 milliseconds after the impact of the shock wave. If it is assumed that points on the target move in lines perpendicular to its original plane, the displacement time curve for any point may be deduced from the record.

Some work has been done on bulkheads with stiffening members. Fig. 6 shows the state of affairs in a typical shot before the impact of the shock wave.

Stereo-photographs of phenomena such as that shown in Fig. 3 have been taken by means of the light from a single flash. Two similar cameras are placed side by side with lens shutters open. The flash then records simultaneous photographs—from different viewpoints—in both cameras.

Targets of the type shown in Fig. 6 have been recorded stereoscopically at 1,000 pictures per second. Two continuously moving film cameras are used. The first camera controls the rate of flashing and each flash records on both films. Corresponding pairs of photographs may readily be identified, enlarged and viewed by means of an ordinary stereoscope.

### Problem of Under-exposure

The high-speed photographs reproduced in Figs. 2, 5 and 6 are selected from multiple flashing records. The fact that all are under-exposed is immediately obvious, despite the fact that the film used is the fastest panchromatic film available and the camera lens is of wide aperture (F/1.5). The technique of development is such as to give maximum contrast, even at the expense of a certain increase in grain size in the negative.

The quality of the photographs would be much improved if more light were available, for then not only could the ideal exposure be given but the lens aperture could be reduced resulting in greater depth of focus and finer detail.

In single-flash photography the increased light may be provided simply by increase in the energy of discharge (the energy is ultimately limited by that which the flash tube will stand without disintegrating). In multiple-flash photography the problem is not so simple, since it may involve the dissipation of several kilowatts in the flash tube.

This problem is being tackled in many ways and by a number of establishments. At Admiralty Undex Works a unit has recently been completed which operates at a fixed frequency of 1,000 flashes per second and gives five times as much light per flash as was available when the photograph of Fig. 2 was taken.

# Descaling a Boiler

## How This Can Easily be Done at Home by Any Handyman

By C. A. M. BOWMAN, M.A.

IN hard-water districts the scale is periodically removed from inside the domestic boiler by crude mechanical means which have changed little in 25 years: the process has always been sufficiently expensive and unpleasant to encourage the sale of various water-softening devices and substances, some completely spurious, and none entirely satisfactory.

### Scale-removing Solution

There has been on the market now for some years a water scale remover bearing the trade name of "Epheta" and which is likely to change all that in due course. It has been extensively used for cleaning out kettles and boilers of all descriptions, and has withstood many stringent tests already.

A domestic water system can be descaled by any complete novice who has half an hour to spare, and it is not necessary to tamper with one single nut or washer. The chemical can be obtained readily from any ironmonger; for a fairly small hot-water system, one capable of giving not more than two hot baths a night, unless it is suspected of being badly choked with scale, one gallon of the scale remover will suffice—and there will be a little change from a one-pound note.

The first practical step is to empty, as far as possible, the cold-water tank. This is simply done by tying up the ball-valve and turning on the hot-water taps. When water stops running from the latter the "Epheta" is tipped into the tank and the ball-valve released to allow a steady trickle of fresh water. The diluted chemical gradually passes down into the cylinder and is encouraged to circulate by starting a small fire. The hot taps are turned down to a drip as soon as the "Epheta" reaches them, and is detected by its distinctive odour. Nothing further need be done for two or three hours, during which time the cleaning process may safely be forgotten.

Progress may be judged from the volume of the gurgling noises which can be heard near the boiler and cistern. When these cease or become infrequent, it only remains to release the ball-valve and turn on the hot taps until the water runs colourless again. In the case of an old system in which the pipes are almost choked with fur and rust, the water may be coloured for several days: this may be something of a nuisance, but is at the same time a measure of the good work done.

### Badly Corroded Pipes

Normally there are no complications, but the process may conceivably, like the thaw, show up existing though hidden defects. If pipe or cistern is corroded right through but the hole blocked by scale, then removal of the latter may cause a leak. Such fault would eventually have become apparent in any case, and it is better that it should occur when one is alert to the possibility. It may also occasionally happen that the ball-valve will fail to rise after being fully depressed and then, should the overflow pipe prove inadequate, flooding may take place. Minor attention to these possibilities should prevent serious trouble.

The process is particularly desirable where pipes are so choked that valuable time is wasted whenever the bath is used. Mechanical clearing of the pipes is usually impossible, whilst replacement is expensive and troublesome.

A further point is that "Epheta" removes one basic difficulty in the use of the same boiler for central heating as well as bath water. Heretofore this has been inadvisable, though possible under certain conditions, owing to the resultant furring and loss of efficiency of the radiators and the heavy expense or impossibility of removing the deposit.

The manufacturers guarantee that "Epheta" is harmless to any metal such as aluminium, brass, copper or iron which is likely to be found in cooking utensils or heating systems, and there is no cause to doubt their judgment in the matter. It is difficult to see what reasons can be found for the retention of obsolete methods in the face of such a challenge by simplicity.

# The Story of Radar—7

## "Leigh-light" Successes : Radiolocation in the Army

*(Continued from page 244, April issue.)*

*How radar and radio are used for controlling aircraft from the ground. Known as the "ground control approach," its principal advantages are that it obviates the need for much bulky and heavy equipment in the aircraft and, being contained in a truck and therefore mobile, it can be taken to the selected landing-strip to which an aircraft is directed in fog or other conditions of bad visibility. The apparatus enables the ground crew to pick up an aircraft thirty miles away and to direct it right on to the airstrip, the pilot being required merely to operate the controls to instructions, and to make the actual touch-down. It is now being employed at principal Transport Command airfields in Britain and on the Continent. The illustration shows a "Liberator," landed by G.C.A., passing the radar trailer.*

IN June, 1942, an important development was put to operational use. A powerful searchlight, with a flat-topped beam and an azimuth spread of about 11 deg.—the "Leigh-light"—was mounted in a retractable cupola underneath the fuselage of a Wellington aircraft fitted with 1½ metre A.S.V. Instead of searching in the dark for a U-boat which had been picked up and homed on to by the A.S.V. the Leigh-light operator was now able to switch on this searchlight when about one mile distant from the target. The operator could control the azimuth and elevation of the searchlight beam to facilitate the illumination of the U-boat. The attack was then carried out almost under daylight conditions. This sudden illumination and attack during what had previously been regarded as "safe" hours upset the U-boat crews so much that, although the total number of night-sightings during June and July were only about 20, by August the U-boats were no longer surfacing at night, but during day-time, for recharging purposes. This enabled the day forces of anti-submarine aircraft to be deployed with such good effect that in September, 1942, nearly 40 sightings occurred in daylight. Statistically, this was equivalent to 100 per cent. sightings of U-boats known to be operating in the Bay area.

The incidence of the U-boats listening to the aircraft 1½ metre transmissions had one obvious technical solution at least as a temporary measure—namely, to make a major change in the wavelength of the transmissions. 10 cm. A.S.V. had been under development even before the development of "$H_2S$" started in late 1941, but by the autumn of 1942 it was obvious that, due to the greater pressure on the production of $H_2S$, this equipment would be available many months before the production of A.S.V. Fortunately, $H_2S$ had been designed so that it could be used as A.S.V.—the project was known as $H_2S$/ASVS—and although many people objected to the loss of certain refinements, the main issue at stake—that of defeating the listening—was so great that a decision was made in the autumn of 1942 to divert some of the $H_2S$ equipment for fitting into Leigh-light Wellingtons for use as 10 cm. A.S.V.

In the evening of March 1st, just one month after the first $H_2S$ operation by Bomber Command, two A.S.V. Mark III Wellingtons took off from Chivenor for the first Bay Patrol with 10 cm. A.S.V. Mark III. One of our greatest doubts about the apparatus —that of serviceability—was soon dispelled. On the night of March 17th, 1943, the first submarine was picked up on the A.S.V. at a range of nine miles by H538, but the Leigh-light jammed and no attack was made. The next night H538 obtained another sighting at seven miles range and this time succeeded in attacking with six depth charges —"both times the submarine was fully surfaced and under way, showing no signs of suspecting attack."

### Destruction of U-boats

From then on a most extraordinary change occurred in the Bay battle. The A.S.V. Mark IIIs obtained 13 sightings in March and 24 in April and this had precisely the same tactical effect as the successful night operations in June, 1942—namely, the U-boats were so scared by the night attacks that they submerged during darkness and surfaced in the day-time. This time, however, the day forces of Coastal Command were much superior in strength and possessed more lethal weapons than in the summer of 1942. Consequently, in May, 1943, an absolute slaughter of the U-boats occurred. Nearly 100 daylight sightings were made during that month, which represented a 200 per cent. sighting of U-boats known to be operating in the Bay area. In 1943, however, the Germans had no immediate technical countermeasures—they were taken by surprise and were forced to fight the battle in daylight while the A.S.V. Mark III Wellingtons kept them submerged at night. By June, 1943, our merchant shipping losses had fallen suddenly to a very low level—and stayed there. In fact, a month or two later, Hitler announced "—— the temporary setback to our U-boats is due to a technical invention of our enemies——"

During the inception of A.S.V. Mark III there were many pessimistic estimates of how long it would be "safe" from the German countermeasure of listening. There was certainly justification for this pessimism because of the use of $H_2S$ over enemy territory and hence the certainty that the enemy would quickly recover apparatus from lost aircraft and know what frequencies to listen on. In the Spring of 1943 steps were therefore taken to develop new A.S.V. systems which would defeat the enemy's listening countermeasure should it ever be employed.

### Radiolocation in the Army

It is impossible to realise the extent to which the advent of radar has revolutionised Anti-aircraft and Coast Artillery in the Army without knowing something of the difficulties under which the guns had to operate before it came. Accustomed as we now are to the radar set as a standard feature of the A.A. and C.A. gunners' landscape, it seems almost incredible that aircraft or ships could be hit at all without its help; the fact that on occasion they were merely emphasises the fact that, even with inadequate tools, skill and patience will sometimes work wonders.

The A.A. gunner used to get a general "area warning" from the Observer Corps system; after this, pick-up of actual targets had to be accomplished by means of trained "visual spotters"—men armed with high-power telescopes who gazed endlessly at the sky. Even under reasonably good weather conditions a spotter was most unlikely to pick up a target at ranges greater than 12,000 to 14,000 yards. When the target was under observation, it could be picked up by the bearing and elevation telescopes on the

predictor and, weather permitting, followed in. However, before the fire control system could produce the necessary data that the guns need for firing, the height of the target must be ascertained and this had to be found in practice by determining the range by means of an instrument known as the "optical range-finder." This instrument, quite apart from the fact that it, too, needs good visibility, suffers from the grave disadvantage that the error in any one range reading is proportional to the square of the range; at about 10,000 yards the error of a single reading on an aircraft is likely to be as much as 750 yards.

The "blind fire" situation—aiming at night or when the aircraft is hidden by cloud—was even worse. The only method available was to use information provided by sound locators; and although this method had been developed to the highest possible degree, it suffered from serious fundamental disadvantages. Sound travels at about 800 miles per hour, and this speed is appreciably affected by the atmospheric conditions prevailing; and by the time the sound has reached the locator the information it gives is seriously out of date. The sound from an aircraft 12,000 yards away will take about 30 seconds to reach the locator; and if the plane is flying at 300 m.p.h. it will travel about 2½ miles in this time. It may even have completely changed its direction. Not only this, but sound locators must be very carefully sited or the amplification of unwanted sounds may be a source of great difficulty. Even an average sort of wind causes difficulty; and traffic noises may make normal operation completely impossible. Also, though a single locator can calculate bearing and elevation of a target, estimation of range requires two or more stations some distance apart, with the attendant complication of a central control or plotting room, and the difficulty of ensuring that all locators are following the same target.

In the case of Coast Artillery, the enemy had an additional means of causing trouble—he could ensure bad visibility by using smoke screens. As far as possible this was countered by setting up a large number of observation posts so that there was a chance that some at least of the observers would be able to see the ships well enough to take bearings. If his screen were really successful, any normal means of visual observation was completely impossible, and all that could be done was to exercise a very approximate gun control by means of "running commentaries" from observation aircraft. In conditions of naturally bad visibility, or at night, the situation was just as bad, and the whole of the coast defences were rendered practically non-effective.

Furthermore, range could only be determined accurately by computation of angles from more than one position; because of the necessity for this, and for ensuring that any post that could see the ships could communicate rapidly with those that couldn't, the communications of a C.A. fortress system were extremely elaborate, and only too liable to interruption by the activities of the enemy.

### The Rise of R.R.D.E.

Bawdsey, of course, was an Air Ministry Establishment; but the War Department was not long in seeing the vast possibilities of radar, and in October, 1936, the first Army representative took up residence in Bawdsey as an observer. He was seconded from the Air Defence Experimental Establishment (A.D.E.E.) at Biggin Hill, then entirely devoted to investigations into the design of searchlights and acoustic devices. Two further members of that Establishment joined him in February, 1937, and the "War Department Nucleus" within Bawdsey was born. It was increased from time to time as more scientists and assistants from A.D.E.E. and from the Signals Experimental Establishment (S.E.E.) at Woolwich were introduced to this work; they worked side-by-side with their Air Ministry colleagues, though always with the needs of the Army before them.

Eventually, in August, 1939, the "Bawdsey Research Station" moved to Dundee to become T.R.E., whose story is told elsewhere in these pages; the now flourishing Army section moved simultaneously to Christchurch, where it was soon joined by, and re-absorbed in, its parent A.D.E.E. from Biggin Hill. From this moment the character of A.D.E.E. began, slowly but remorselessly, to change; the baby—radar—soon overshadowed its parent, until it became the major pre-occupation of the Establishment. This change was reflected in its changing title—first to the "Air Defence Research and Development Establishment," later and finally to the "Radar Research and Development Establishment." This was actually a trifle unfair to its parents, because the work on searchlights and acoustics, though subordinated, continued and still continues to-day.

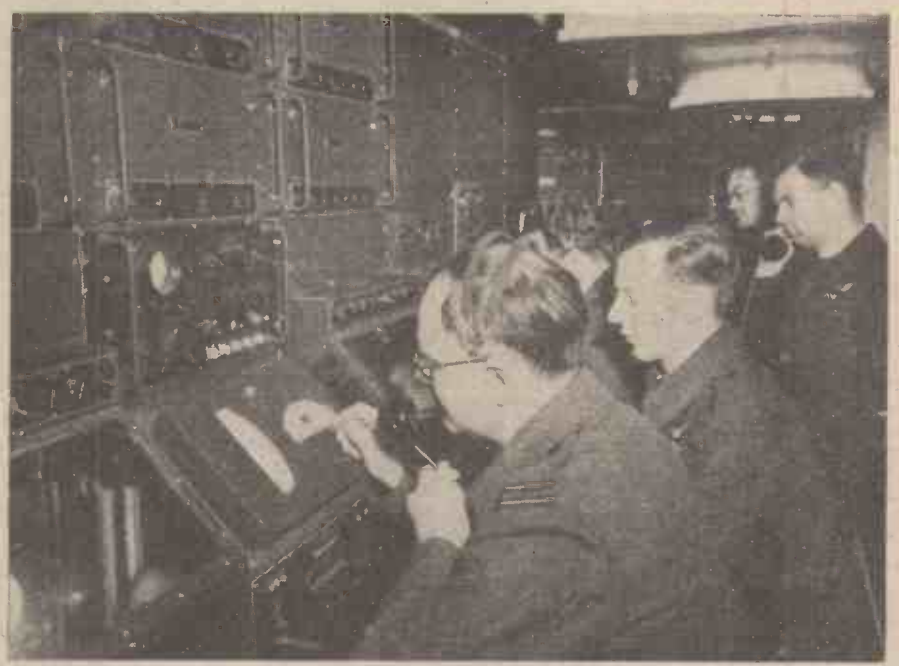
### C.A.E.E.

We cannot close this Section without a reference to a less well-known body—the Coast and Anti-aircraft Artillery Experimental Establishment (C.A.E.E.). The job of this Establishment, in peace and in war, has been to carry out trials of new fire control equipments, on the results of which the Ministry of Supply makes its recommendations to the General Staff as to use and deployment of these new equipments in the field. Before the war it was situated in Culver, Isle of Wight, but in September, 1940, it, in common with so much else, made the long trek north and settled in a new home at Llandudno. During the war it was assisted in its work by "user trials" held at the War Office Artillery Schools; and it is fair to say that no new equipment, even during the stress of war, has gone into the field without being thoroughly tried and tested, so that its successful operation has been assured.

### G.L. and the A.A. Guns: The Mark I

The Army's special province in the radar country has always been the measurement of position of an aircraft from the ground with the greatest possible accuracy. The methods in use before the advent of radar have already been mentioned. We may here recapitulate the major disadvantages of sound and visual location and see how these are overcome by radar. Visual location is, obviously, limited by weather conditions; it also suffers from a considerable range inaccuracy, increasing with increasing range. Sound location, which had to be resorted to at night or in conditions of bad visibility, had a stultifying time lag between aircraft and locator; it was disturbed by extraneous noise; and it was extremely cumbersome, requiring a complicated plotting control to ascertain range and height.

Radar is free from these great disadvantages. The speed of radio waves is of the order of 186,000 miles per second, and is known with great accuracy; moreover, it is scarcely affected by atmospheric conditions. The aeroplane cannot have time to move more than a fraction of an inch during the period that the pulse is travelling to and from the aircraft; and so, if the time taken for this "go and return" can be measured accurately, the range is known to the same accuracy. The application of radar to this problem had actually been discussed at the now classical demonstration at Daventry on February 26th, 1935, but had been temporarily subordinated to the more urgent need for a coast watching system. Work was begun by the War Office section at Bawdsey in 1937, and by October of that year trials of a "lash-up" system showed that range accuracy of ±25 yards should be attainable.



*Interior view of the G.C.A. trailer, with operators at stations and controller in foreground. He gives the final instruction to the pilot at a quarter of a mile from the touch-down point: "LOOK AHEAD FOR RUNWAY—YOU ARE CLEAR TO LAND!"*

The first experimental "G.L. Mark I" ("G.L." was an abbreviation for "Gun Laying") underwent its trials at Landguard Fort in the early summer of 1938. It was a large and robust equipment—it must be realised that an equipment for this particular job must be capable of withstanding the blast of a heavy A.A. gun—and was housed in two cabins (one transmitter, one receiver), each weighing several tons. The 6 metre transmitter produced pulses of radio frequency power, each lasting about three-millionths of a second, and each reaching a power of about 50 kilowatts at its peak; as each pulse went out it started a spot of light moving rapidly across a cathode-ray tube in the receiver.

This spot of light moved steadily across the tube until the return echo arrived, when it was deflected upwards for the period of the pulse. As this process was repeated about a thousand times per second, the tube showed a bright horizontal line across its face with a "break" in the form of an inverted V; and the distance of this "break" from the start of the "Timebase" line, as it is called, was a measure of the time taken for the pulse to go and return, and therefore of the range of the aircraft from which it had been reflected.

The two most important features of the equipment were, first, the means of determining bearing, and secondly, the method of measuring accurate range. Two bearing aerials were used placed end to end; a second cathode-ray tube in the receiver cabin showed the "break" received from them. When the equipment was "on bearing"—the whole cabin was rotated by a sort of bicycle-crank system—the break vanished. The measurement of the range was carried out by an electrical system which imposed on the operator only the duty of turning a handle to keep the "break" on a cross-wire marker, the range then being automatically indicated and fed to the predictors. This necessitated the development of a potentiometer of extremely complex design and hitherto unattempted accuracy. The final result was that G.L. Mark I measured range out to about 30,000 yards with an accuracy up to about 15,000 yards of ±50 yards, and bearings to an accuracy of about ±1 degree; but it could not measure elevation at all.

The first production prototype of this equipment, made by a commercial organisation (or, rather, two commercial organisations—one the transmitter, one the receiver) was delivered to Bawdsey in the summer of 1939, and was in fact demonstrated to Mr. Churchill in the course of a visit to the Station on June 20th; the first production model actually deployed in the field to take up its intended rôle was set up at Felixstowe on September 3rd, 1939, the day war was declared. By the summer of 1940 it was extensively deployed in Britain, and it was ready to help the guns on that night of September 6th, 1940, when the night raids on London began in their full strength.

### The Mark II

It would in theory have been possible to design and add an elevation-finding attachment (of this more anon); but for a very good reason it was decided to put all the available effort on the design of a completely new Mark. The reason is interesting, and has a tremendously important bearing on G.L. design. Whatever else can be cut down, we cannot reduce much further the time taken for a shell to travel from the gun to the aeroplane; and this time may be as much as 25 seconds. In 25 seconds an aeroplane flying at 300 m.p.h. will have travelled about two miles, and the shell must therefore be prophetically aimed, not at where the aeroplane is, but at where it will be when the shell has got there. It is the job of an instrument known as a predictor to work that one out; and its first step is to calculate the *rates* at which range, bearing and elevation are changing. To do this properly, it needs to be fed *continuously* with all three quantities. Now, G.L. Mark I will pass out continuous range information; but bearing is obtained by "bracketing"—moving from side to side of the target, deciding on the bearing at the particular moment and passing it on as a series of disconnected readings. It was very soon clear that G.L. Mark II *must* provide facilities for "continuous following" in all three quantities.

Anyway, development contracts were placed with the selected manufacturers in the autumn of 1939, and in the summer of 1940 the first works prototype G.L. Mark II was delivered. It had three new features. First, it had an elevation-finding system, based on the comparison of signal strengths in two aerials at different heights—a version of the system that had long been in use in the C.H. sets. Secondly, it had the long-awaited "continuous-following" facilities in both bearing and elevation; and thirdly, it had something called a "strobe." This was a device whereby the target being dealt with was selected by the range operator, and *only this target* could be seen by the other two operators; hence the attention of the angle operators could not be distracted by the appearance of other targets, and operation was made considerably simpler.

Now, the manufacture of an instrument the size of G.L. Mark II is a big job; and full production did not really get going until 1941. Meanwhile, something had to be done about elevation. An ingenious device for this purpose was produced by an engineer of one of the large commercial organisations, and this—known mostly as the "S.P.A." (short for its terrifying scientific designation of "switching preamplifier")—was fitted to a number of Mark Is in the late summer of 1940 together with an elevation aerial of the same design as the Mark II, upon whose design, already by then established, it had been based. It was a considerable success except for its feeders. These had an unexpected habit of changing their electrical characteristics daily, and had to be solemnly flexed from top to bottom by the operators; and the G.L.'s "daily massage" quickly became a commonplace of gun-site life.

G.L. was still working on about 4 to 6 metres; and it is perhaps fair to say that G.L. Mark II was about as perfect an equipment as could be made on that wavelength. But so long a wavelength (in those days it was regarded as extremely short, but ideas change!) has great fundamental disadvantages. Unless an aerial array of immense size is to be used, the beam cannot be made as narrow as is needed for great accuracy; and the accuracy of elevation is dependent on the characteristics of the surrounding ground. In fact, the surrounding ground is tacitly assumed to be (a) level, (b) flat, and (c) perfectly reflecting. This in general is simply not true, and it became necessary to do something about it. The solution was found in installing an artificial ground, in the form of a wire-netting mat over 100 yards in diameter. This, which so interested the people of London, wasn't an aerial or anything like that; it was merely the best method of providing the conditions of surrounding country that elevation-finding needed. The real difficulties were domestic—the greatest, in the case of all mats fairly close to the ground, was to prevent grass from growing up through them.

### The Answer

The stage was now set for what is perhaps the Army's greatest single achievement in radar—G.L. Mark 3. In the summer of 1940, work at other establishments, at certain manufacturers and in certain university laboratories, had shown that the generation of centimetre wave radiation was at last a practical proposition. This meant that a beam sufficiently narrow to give really high angular accuracy could be produced while still retaining an aerial system of a manageable size; it would now be possible to take a simple aerial and back it with a focusing mirror essentially similar in type to that used in a searchlight. In order to obtain the so-necessary continuous following, recourse was made to a technique invented in connection with a much earlier equipment—C.H.L.; this was the "split" system. The beam is not made to point directly at its target, but is switched rapidly over a very small angle from side to side of it; the signals obtained from each of the two positions are displayed, side by side, on a cathode-ray tube. If the diminishing signal from the half from which the aeroplane was just about to escape and the increasing signal from the half into which it was penetrating were compared, and kept equal by turning the aerial, the target would always lie exactly between the two beams; and, since this was a continuous process, a continuous measure of bearing could be obtained. By switching the beam up and down elevation could similarly be obtained; and, in fact, the beam takes up the successive positions up, right, down, left, several thousand times each minute.

The first precursor of G.L. Mark 3—it wasn't then called that—was made by one of our commercial undertakings in the summer of 1941; it was known, with single grandeur, as "A NOUGHT." It bore little resemblance to its modern counterpart, rather was it used as a basis for argument and discussion and, above all, as a means of determining whether the job could be done at all. Its trials triumphantly proved that it could; in fact, a few models of even this early effort were made at the request of the Air Ministry and became "C.M.H." (Centimetre-height). Ultimately, the first of the five experimental models of G.L. Mark 3 proper was delivered in December, 1941, and the first of the "preproduction" models followed about nine months later.

Many improvements went into the final models. The ranging system was made even more accurate, and yet at the same time simpler; transmitter and receiver were housed in one cabin (weighing 9½ tons); the pulse was shorter and sharper, the power greater than in previous Marks; and, for the first time, accuracies of one-sixth of a degree were obtained in both bearing and elevation.

The final step was the most ambitious of all—it was to make the equipment "automatic-following" in bearing and elevation. That is to say, once the equipment had been, as it were, shown the target by its operators, it followed it without any further assistance from either of the angle operators—and slightly more accurately than any fallible human being could hope to do. It is an impressive and uncanny experience to watch such an equipment following, by means of its aerial system, the precise movements of an aeroplane—perhaps completely hidden in or above thick cloud, or too far away for the unaided human eye to see. However, it can be done; the necessary research work was carried out in 1942, and the design was ready for production early in 1944. It was not at once put into effect; the work of clearing the basic design absorbed practically all the available effort of those skilled in G.L. problems. The U.S.A., however, had considered automatic-following at a very early stage, and it was there decided to incorporate automatic-following into the design of the corresponding U.S. equipment, SCR.584. It was therefore with much gratitude that, at the time when England was suffering daily attacks from the flying-bombs, we received and installed a number of these U.S. equipments, embodying auto-following in a "production" set.

### Durability Trial

The story is not yet finished—such stories are never finished while scientists and engineers go on having new ideas—but at this point we must leave it. Nor is there space to recount all the ingenious uses to which G.L. Mark 3 has been put, quite apart from its intended rôle of anti-aircraft fire control. However, one particular adaptation with obvious peacetime applications is of great general interest. GL. Mark 3 can be made to follow a reflector attached to a balloon, and by this means considerable information on wind speeds in the upper air has been obtained for meteorological purposes.

*(To be continued)*

# THE WORLD OF MODELS

## A "00" Gauge Model Railway Layout: Specialist Craft for D-Day: Super-detail Model Yacht: Model Ladder Van made for War Record Purposes

*By "MOTILUS"*

THE name of Boyd-Carpenter is well-known in industry, and there is one member of the family who is a very well-known figure in the model railway world. Mr. V. Boyd-Carpenter is a gauge "0" enthusiast, and his colleague Mr. T. Pearson specialises in "00" gauge work. Fig. 1 shows a very realistic model G.W.R. tank loco. on Mr. Boyd-Carpenter's railway, and Fig. 2 shows the excellent layout of part of Mr. Pearson's "00" gauge railway.


*Fig. 1.—The gauge "0" G.W.R. engine 3621—one of the finest model locomotives on Mr. V. Boyd-Carpenter's railway.*

*Fig. 4.—An adaptation of the L.C.T.4—the double-deck type—with Bailey Bridge sections supporting the upper deck, which is used for transporting light vehicles.*

### Model Landing Craft

Many amazing operations were undertaken during the war about which we knew very little, and about which even now that the veil of secrecy has been to some extent withdrawn, we are still not as fully conversant with as we might be. We know that a vast "Armada" was prepared to cross the English Channel and land in Normandy, and we have been told that there were "hundreds" of types of craft used for the D-Day landing, but how much do we know about these different vessels—all "specialist" ships in their way—which range from 28ft. long to a length of nearly 400ft.—as big as a modern liner.

To make this huge invasion fleet more comprehensive, I have mentioned in a previous article that it was reproduced in model form, and the scale adopted for the training models was ¼in. to the foot—1/48th actual size—which made the smallest type—the L.C.P. or Landing Craft Personnel—about 7in. long. The L.C.P., as will be seen from Fig. 3, was an adaptation of the cobble, and generally, true to type, was of clinker construction.

Another type was the Landing Craft Emergency Repair—the L.B.E.—built on the same lines as the Thames barge, with the addition of a bow door facilitating the landing of the vehicle, which was a complete travelling workshop.

The L.C.T. 4 produced a model 3ft. 6in. long and was one of the most efficient medium-sized Tank Landing Craft. This vessel was adapted for various purposes, and

*Fig. 3 (Right).—The L.C.P. (Landing Craft Personnel)—smallest of the invasion craft—built to a scale of ¼in. to the foot.*

*Fig. 2.—The approaches to Arthurston with Penmaen Lake in the distance, a scene on the North Midland Railway of Mr. T. Pearson, where excellent realism has been achieved in "00" gauge.*

Fig. 4 shows one adaptation of the double-deck type, with Bailey Bridge sections supporting the upper deck. It was used in the transportation of light vehicles.

The L.C.T.s were built purely for tank transportation, landing the vehicles through bow doors, but this type of vessel was adapted for many purposes, such as being completely decked in and mounted with guns, in the case of Fig. 5. The famous Bailey Bridge sections have been brought into use, and another deck has been constructed over the tank deck, used for transporting light vehicles such as ambulances and service vehicles.

The larger vessels, known as L.S.T.s—Landing Ship Tanks—pictures of which appeared in the press in the early stages of the Normandy landings, made models up to 6ft. long, while the largest of all, the L.S.D.—

*Fig. 8.—Model of the Humber Ladder Van—1/10th actual size—made by Bassett-Lowke, Ltd., to the order of the Rootes Group.*

Landing Ship Dock—is a completely powered ship, which can also act as a floating dock, capable of carrying out salvaging operations to vessels up to the size of the L.C.T.4. So it will be seen that the range of models to the same scale varies from 7in. up to 8ft. in length. What a headache for the model makers who constructed them!

### Model Steamer from Odds and Ends

After describing in previous articles in this series the excellent work by experienced model makers, I find myself drawn to appreciate another quality in the model maker—economy.

Mr. Robert E. Hanson, of Newcastle-on-Tyne, sends me a picture of his S.S. *Alaska*—2ft. 6in. long (Fig. 6).

He writes: "I am enclosing photo of one of my models. These cost practically nothing to make—mostly scraps, odds and ends. I made all myself, and bought nothing except paint and cordage for rigging.

"I often wonder in reading PRACTICAL MECHANICS if there are many like myself—little money and no real tools, no lathe and no real workshop, *but what a hobby.* I would like to say this to anyone like myself—go to it and try. I have been making models out of odds and ends since I was eight years old, and that is over forty years ago, and I am still an enthusiast."

*Fig. 5.—L.C.F.—an L.C.T.4 conversion which was used as a flak ship. Scale ¼in. to the foot, making a model about 3ft. 6in. long.*

they are now back on some of their peacetime model shipbuilding work. The first ship model they have completed since war broke out has been a replacement of a ¼in. to the foot model of M.Y. *Philante*, the famous motor yacht of Mr. T. O. M. Sopwith, noted challenger for the America Cup with his *Endeavour I* and *II* in those piping days of peace (pre-war)!

*Philante* was designed and made by Messrs. Camper and Nicholson, Ltd., of Southampton, in 1937, and at that time Bassett-Lowke, Ltd., made a special super-detail model of this turbine-driven luxury yacht. The original model made for Messrs. Camper and Nicholson was so admired by the owner of *Philante* that he persuaded them to let him have it. The model could not be replaced during the war, but it was the first peacetime model to be made in the Bassett-Lowke shipyard, and is exactly to the same scale and detail of finish. (Fig. 7.)

*Fig. 7.—The latest model of* Philante, *shown in the special new glass case with light base. Scale of the model is 1/48th actual size.*

The *Alaska* is a triumph in ingenuity—the hull carved from solid yellow pine, with four carved built life boats. The ventilators are of brass tubing with cast lead heads, and the motor is adapted from a cycle dynamo.

### Model of M.Y. "Philante"

I was pleased to see the other day, on a visit to the Ship Model Department of Bassett-Lowke, Ltd., at Northampton, that

### Model Ladder Van

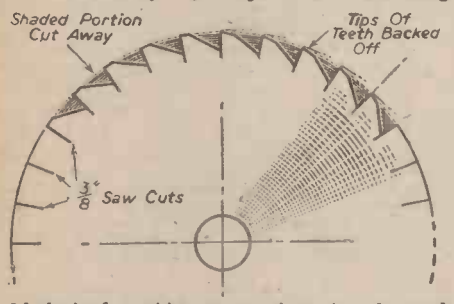
Just to pass from rail and water to finish up by road—here is a very attractive 1/10th actual size model (Fig. 8) of a motor vehicle by the Rootes group—the Humber Ladder Van—which did excellent service in various phases of the war both with the Army and the A.R.P., N.F.S., etc. This is a further addition to the range of models that are being made for record purposes.

*Fig. 6.—The S.S.* Alaska, *the work of Mr. Robert E. Hanson, of Newcastle-on-Tyne. The model is 2ft. 6in. long.*

# Letters from Readers

### Small Circular Saw

SIR,—I recently had reason to require a small circular saw about 6in. diameter, but on trying to purchase one was informed that delivery would be in six to nine months. As the saw was urgently needed, I decided to make one myself, and pass on the following information which may help other readers in similar circumstances.




*Method of marking out, and cutting the teeth for a small circular saw.*

A centre-pop mark was made at the widest part of an ordinary handsaw, and a circle approximately 6in. diameter was scribed. This was carefully cut out by means of a narrow chisel, the rough edges being removed on the grinder. The disc was divided into 32 parts and slits ⅜in. deep cut with a fine-toothed hacksaw. The teeth were then cut to the shape shown in diagram by means of chisel or saw, and the tips backed off in the manner of a milling cutter. The teeth were given a slight set and the centre drilled as required. The steel was not annealed before making, owing to the risk of warping when re-hardening. The result is extremely satisfactory and well worth the trouble.—R. CHEETHAM (Stockport).

### Electric Bed Warmer

SIR,—Referring to the article, "An Electric Bed Warmer," in your March, 1946, issue, I feel sure that the lamp size advocated by Professor Low is too large to use in the amateur-made apparatus which he describes, even with the ingenious fins arrangement.

After much experimenting with electric bed warmers before the war I found that 19-20 watts was ample loading to provide a reasonable and safe source of warmth, and many commercial warmers were made at this loading.

The real danger arises when an amateur (a) uses a slightly smaller tin than that specified, and (b) decides to put in the two lamps mentioned for "regulation" purposes. There is then a definite risk of fire occurring even before the lamps burn out due to overheating. I would suggest any amateur apparatus of the nature should employ not more than a 25-watt lamp, preferably 15-watt to be really safe, yet efficient.

Perhaps you would be kind enough to pass my remarks on to Professor Low for his consideration.—GEORGE WATERS, Chartered Electrical Engineer (Leamington Spa).

### Observatory Beehive

SIR,—I wish to construct a three-comb observatory beehive to take three standard brood frames arranged vertically above each other with four comb sections above. The whole to be visible from either side through the glass sides, with arrangements for shutters to allow the bees to work in darkness when not actually under observation. Can one of your readers supply me with working drawings or other information on the subject?—R. H. MELVILLE LEE (Presteign).

### Whitefield Model and Engineering Society

SIR,—At a meeting of the above Society held on March 8th, a member, Mr. Garside, gave a most interesting lecture on "The Ignition of Internal Combustion Engines," and showed a very full knowledge of his subject. As time limited the talk to coil ignition, Mr. Garside has promised to deal with magnetos at some future date.

Meetings are held fortnightly on Fridays, at 7.30 p.m.—A. F. STEVENSON, Hon. Sec., 2, Newlands Drive, Prestwick.

# The Microid Nalik Press

A NEW British-made press for use in extruding the alkali metals as wire, has just been introduced by Griffin and Tatlock, Ltd., and is shown in the accompanying illustration.

Sodium is an extremely effective reagent for removing water by destruction from such liquids as ether, toluene and benzene. In the preparation of a Grignard solution thorough drying of the ether is essential; and when such liquids as benzene are used in the Friedel-Crafts reaction much better results are often obtained after efficient dehydration. The use of sodium has the additional advantage over most other reagents, that the liquid can be stored in contact with the metal and merely poured off when required, neither filtration nor distillation usually being necessary.

For rapid and effective drying the sodium should have as great a surface area as possible, and should be distributed throughout the body of the liquid. Both of these objectives are attained by extruding the metal in the form of wire. Potassium and sodium are easily extruded through a 0.5 mm. diameter orifice, the resulting wires having a surface area of 93 and 82 sq.cm./gm. respectively. Lithium, a harder metal, which is finding increasing applications in organic chemistry, requires a 1 mm. orifice. The wire falls into large, loose coils, which are self-supporting in the body of the liquid. Wire is also the most convenient form in which to use sodium as a reagent in many organic preparations such as that of ethyl acetoacetate.

Before the war, sodium presses were largely of foreign origin. In the Nalik Press many improvements have been introduced. The one-piece die and mould and the floating plunger are of stainless steel. The body, stove enamelled to eliminate corrosion, can be attached to the bench in a few moments by means of a single bolt. Rotation of the press when in use is prevented by two lugs which bear against the edge of the bench. An adjustable bottle stand is provided, so that bottles up to a capacity of one Winchester Quart can be used and their necks brought up to the under side of the mould.

*The new Microid Nalik press.*



## An Improved Wooden Sole

AN improved blend of leather and wood is employed to meet the emergency of the short supply of leather, according to the subject of an application accepted by the British Patent Office.

The aim of the inventor is an economical method of manufacturing a durable and practical shoe having an outer sole or tread surface made of wood.

The originator of this sole remarks that it has long since been proposed to manufacture shoe soles in part or entirely from wood, but various difficulties have been encountered. Among these may be mentioned the stiffness or lack of flexibility of the sole, the problem of fastening it securely to the upper, the absence of wearing qualities and, last but not least, the high cost of manufacture.

The method of making this shoe includes cementing a wood layer to a flexible supporting layer with fibres of the wood extending perpendicularly to the plane of the layer. The wood layer is cut in different directions to produce a multiplicity of separate equal-sided small wood units that are independently movable both lengthwise and transversely. The sole is attached to the upper in a manner which ensures permanent connection of the wood portions.

## HOUSE WARMING

HAVING remarked that present methods of heating buildings are by no means free from disadvantages, an inventor describes an improved system which he has submitted to the British Patent Office.

His plan for heating, he asserts, is suitable for the smaller type of property, but is equally effective when applied to all kinds of buildings.

The apparatus comprises a hollow trunk or casing placed at or near the floor level and connected to an electric heating device. Through this a current of air is driven by a fan along the trunk, to pass out into the room by way of louvred or vaned openings. The vanes extend into the trunk and are inclined to meet the air flow.

# QUERIES and ENQUIRIES

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

## *Paint from Old Records; Gas-fire Elements*

**CAN you please inform me how to make black paint from old gramophone records? Also, what are gas-fire burners composed of? —A. Ferguson (Cowes, Isle of Wight).**

YOU cannot make a really satisfactory black paint from old gramophone records. However, if you wish to experiment there are two lines which you can work on. The first of these is to break up the records into very small pieces and then to immerse them in methylated spirit. Allow them to remain therein for a week, with frequent vigorous shaking. After this, strain the resulting liquid. You will then be able to use it as a spirit paint, and it will tend to give a gloss finish. If its consistency is too thin dissolve more record material in it. The other line of experiment is to immerse the record material in a mixture of about equal parts of turpentine (genuine) and boiled linseed oil. You may use the oils warm so that they will dissolve the record material more speedily.

The gas-fire burner material to which you refer is generally composed of an unglazed porcelain. It is produced by heating various mixtures of china clay, borax and stone dust to white heat in a muffle furnace. Its manufacture cannot be attempted on the small scale. A plaster of paris and asbestos composition would be useless for the purpose. You might, however, have some success by experimenting with a mixture of china clay and powdered asbestos, this mixture being made into a paste with waterglass (sodium silicate), then fashioned into shape and allowed to dry out slowly in a warm oven.

## *Luminous Powders*

**CAN you tell me the name of a good luminous powder and, if possible, where to obtain it, and the approximate price?—S. Trowell (Newport, I. of W.).**

BOTH calcium sulphide and zinc sulphide are luminous in the dark after exposure to a bright light. Special "phosphorescent" brands of these are made and are sold by most chemical suppliers, as, for instance, Messrs. Griffin and Tatlock, Ltd., Kemble Street, Kingsway, London, W.C.2. Luminous calcium sulphide costs about 1s. per oz., and there is a "special" grade of this material at about five times this price. Luminous zinc sulphide costs about 8s. per oz.

There is also the permanently luminous zinc sulphide containing a little radium barium bromide. This is very expensive. We imagine that the ordinary luminous calcium would suffice for your needs, since it is quite satisfactorily luminous after exposure to a bright light or to sunlight for a few seconds.

## *Making Walls Sound-proof*

**WILL you please give me some information on the following points? (1) I wish to reduce the sound between two rooms. The walls are brick ones. (2) Is it possible to put a 1in. partition up and fill with sawdust or some other material, or shall I have to take up the floor boards and pack the joists about a foot from the walls as well? Is there any other way this sound can be reduced with the minimum of cost?—E. Hunt (Peterborough).**

YOU do not say whether the walls to which you refer are one-brick thick or whether they have an air cavity between them. Neither do you mention whether the walls are on an upper or a ground floor. However, you can go a long way towards sound reduction by lining both sides of the wall with material of the beaver-board type, particularly if the boards are fixed out of actual contact with the walls over large areas so that there is a small air space between the greater part of the surface area of the boards and the wall surface itself.

You could, of course, construct a 1in. or a 1½in. partition as you suggest, but we do not recommend that you fill up the intervening space with sawdust, since this material is apt to "pack" and to become semi-solid. Also, in the presence of moisture, it might give off a bad smell. A good filling material is asbestos wool, loosely crumpled pitch paper, coarse cork grains, horse hair, or kapok. Even dried seaweed has been used very successfully for such purposes. The whole idea should be to break up the continuity of the sound waves which tend to travel from room to room, and this end will best be met by having an air-space as suggested above, the air space being *loosely* filled with some fibrous or other sound-absorbent matter.

You do not give us any idea of the type and intensity of the sound which you wish to insulate, but, provided that the sound is not too intense, we do not think you need go to the trouble of packing the floor joists. It is true, of course, that a proportion of the sound travelling from room to room, proceeds by direct conduction along continuous solid materials, but we do not think that, in your case, this joist treatment will be necessary.

Your case is really one for personal inspection and investigations of all the relative details. The efficiency of the method adopted must necessarily depend upon the volume of sound which it is desired to eliminate. For instance, a thin, filled partition would be suitable for deadening-out loud conversations, but it would not isolate the efforts of a trombone player going "all out" in the adjoining room.

## *Ethyl Silicate*

**WILL you please supply me with details of the use of ethyl silicate, and where same can be obtained?—W. A. Munro (Beddington).**

ETHYL silicate (otherwise known as "silicon ester"), is a colourless, peculiarly smelling liquid, made by treating silicon chloride with alcohol and water. It slowly absorbs moisture from the air and is converted into silicic acid, which latter is finally converted into pure silica. For this reason, it is sometimes used as a stone-filler in the treatment and

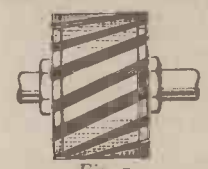


*Fig. 1.*

*Fig 2.*

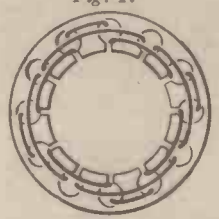


*Fig. 4.*

*Fig. 3.*

*Armature and stator details for a gramophone motor (G. E. Golding).*

preservation of important stonework. The liquid is brushed into the stone, which absorbs it. Within the stone, it becomes converted by degrees into insoluble silica, which binds the stone particles together and thus "rejuvenates" the stonework. For this reason, ethyl silicate is of some importance in preserving ancient stonework. It can also be used as a cement for stonework.

The present cost of ethyl silicate is about 10s. per lb. It is manufactured by Messrs. Albright and Wilson, Ltd., Oldbury, Birmingham. It is sometimes obtainable in small quantities from laboratory chemical suppliers, such as Messrs. Baird and Tatlock (London), Ltd., 14-17, St. Cross Street, Hatton Garden, London, E.C.1, or Messrs. W. & J. George and Becker, Ltd., 17-29, Hatton Wall, London, E.C.1, or 157, Great Charles Street, Birmingham, 3.

## *Extracting Iodine from Kelp*

**WHAT is the modern method of extracting iodine from kelp? Could you let me know the manufacturing price of iodine, and also can you suggest any books on the manufacturing of iodine (non-kelp)?—T. J. Ryan (Belfast).**

AN article dealing with the manufacture of iodine from sources other than kelp appeared in the issue of PRACTICAL MECHANICS dated December, 1945. Relatively little iodine is now produced from kelp. To produce iodine from kelp, the latter substance is carefully extracted with boiling water in large iron pans. The water is then filtered off and concentrated to small bulk by evaporation. Sulphates, carbonates and chlorides crystallise out after the liquid has cooled. The remaining "mother liquor" contains the iodine. It is filtered off and sulphuric acid is added to it. The liquid is then distilled by gentle heat, a little manganese dioxide being added to it. Iodine is evolved and condenses in the receivers.

The process is not one which can be worked satisfactorily on a small scale, since the amount of iodine obtained is very small.

The wholesale price of iodine is extremely variable, particularly at the present day; 16s. per lb. would be, perhaps, an average figure.

We believe that The Iodine Educational Bureau, Bishopsgate, London, E.C., issue a free booklet dealing with the production of iodine from sources other than kelp. Possibly this publication might assist you. The Bureau would also give you free help on any other problems concerning iodine.

## *Gramophone Motor Details*

**I WISH to make a gramophone motor using, if possible, the laminated stator of a cycle dynamo, energised from a transformer of 6v. 5a. I have made a laminated armature (Fig. 1), enclosed with 15 copper bars, and soldered into copper end discs (Fig. 2). Is this correct, or should it be rings instead of discs? Also, I would like to know if it is possible to wind starting coils on the poles of the dynamo stator (Fig. 3)? If not, is there any other way of starting with a strong torque, or would you advise making a stator as in Fig. 4? Could you please give me winding instructions for obtaining the best results?—G. E. Golding (Bristol).**

THE rotor which you have constructed should be satisfactory. The field system shown in Fig. 3 could be used in the construction of a self-starting motor if you slot each pole, and fit a short circuited copper band to encircle about half of one side of each pole face, but it is rather doubtful if there is sufficient space for this without cutting down the field windings considerably. Another suggestion would be to wind two opposite poles as running poles, and the two remaining poles as starting poles; this would, however, give the machine a speed of about 2,900 r.p.m.

In the circumstances we think you would obtain the most satisfactory results from the stator system shown in Fig. 4, making this of laminations with an air gap clearance between rotor and stator of about 0.006in. The motor could hardly be expected to develop more than about 1/100 h.p. The machine would then be wound for 4 ⁂ poles indicated in Fig. 3, each pole of the running winding having two concentric coils with 160 turns each of 40 s.w.g. S.S.C. enamelled wire. Each pole of the starting winding could have one coil of 250 turns of 47 s.w.g. S.S.C. enamelled wire, the starting winding being switched out when the motor has started up.

## *Silvering Solution*

**MANY years ago I did a great amount of "silvering"; first chemically cleaning, and then dipping articles in a "silver" solution. I have forgotten what this solution is and would be glad if you can refresh my memory.—P. A. Walker (Dublin).**

YOU say that you wish to silver "objects," but you do not give us the important information as to whether such objects are metallic or otherwise. If the articles are metallic, there is no silvering solution which will give the bright and lasting results of ordinary silver plating, but we take is that you do not wish to use the electro-silvering methods.

The following chemical solution will give good (but thin) deposits of metallic silver on well-clean metal articles which are immersed in it:

| | | |
|---|---|---|
| Common salt | .. .. | 80 parts (by weight) |
| Potassium bitartrate | .. | 80 ,, ,, |
| Silver chloride | .. .. | 10 ,, ,, |
| Water | .. .. .. | 1,000 ,, ,, |

The salt and potassium bitartrate should be dissolved first in a small amount of the total quantity of water. The silver chloride is then added and, after it has dissolved, the solution is made up to its total bulk. The exact amount of silver chloride in the solution is quite immaterial so long as there is sufficient to do the work of silvering.

The solution should be used warm. The silver will be deposited in the "white" condition, but it may be subsequently brightened by polishing. The process, however, is *not* an effective substitute for ordinary silver plating.

## *Oxygen from Potassium Permanganate*

**WILL you please state the easiest way of obtaining 2 litres of oxygen gas from potassium permanganate? I should like your opinion on whether heating the chemical alone, or with an acid is better. Please state proportions or weights necessary for the above amount of gas. Also, do you consider this method the safest for obtaining oxygen for this amount of gas?—S. Flaherty (Sheerness).**

IN order to prepare oxygen by the permanganate process you must heat the permanganate with dilute sulphuric acid. The permanganate must not be heated alone.

The correct procedure is to heat a mixture of about 20 grammes potassium permanganate with 100 c.cs. dilute pure sulphuric acid, this dilute acid being prepared by adding 1 part of pure strong sulphuric acid to 4 parts of water, the acid being added to the water, *not* vice versa. Under the above conditions, oxygen gas will be liberated at a temperature of about 55 deg. C., so that there will be no necessity to heat the mixture very strongly.

Twenty grammes of good quality permanganate heated with 100 c.cs. dilute sulphuric acid will generate *approximately* 2 litres of fairly pure ogygen, which is the quantity of gas you require. The method is reliable, efficient and cleanly, and, in our opinion, is superior to the method of generating oxygen by heating a mixture of manganese dioxide and potassium chlorate, which latter method sometimes results in an explosion, particularly when the manganese dioxide is impure, and contains carbonaceous material.

## *Removing Lime Deposit; Destroying Wood-boring Beetles*

**WOULD you kindly inform me what to use to remove lime deposit out of a brass kettle? Also, can you recommend a solution for killing the insects which bore holes in furniture?—H. Eames (Sheffield).**

FOR removing the lime deposit, place a heaped-up tablespoonful of either caustic soda or soda ash into the kettle and then fill the latter three-quarters full of water. Let it boil gently for half an hour and then pour the liquid away. The inner sides of the kettle should now be quite clean. If they are not, repeat the process. Finally, give the kettle a thoroughly good rinsing in order to remove all traces of the caustic.

There are many methods of attacking wood-boring beetles, but an inexpensive method which is as good as any other one comprises the use of creosote and paraffin.

Mix together about equal proportions of creosote oil and paraffin oil, and brush this mixture liberally over the area of the woodwork in which the wormholes appear. The mixture should preferably be used hot, for in this state it is absorbed better by the wood. The creosote will stain the wood black or dark brown, but this will not matter if, as is often the case, the wormholes are at the back of the furniture. If, however, the holes are at the front of the furniture, you will either have to use paraffin alone, or paraffin mixed with a much smaller proportion of creosote.

If objection is taken to the smell of creosote, an alternative method is to obtain a quantity of copper naphthenate, which is sold under the name of "Novonate Copper," price about 3s. 6d. a pound, from Messrs. A. Boake, Roberts and Co., Ltd., Carpenters Road, Stratford, London, E.15. Dissolve a large tablespoonful of this dark green pitch-like compound in a quart of paraffin and use this (preferably hot) for the treatment of the woodwork. The copper naphthenate has no smell, and it remains in the wood permanently, rendering it perfectly resistant against insect attack. The copper compound is, of course, no better than creosote in this respect, but since it is without smell, it enters into the composition of the proprietary wood beetle eradicating preparations.

You should note particularly that the insects emerge from the wood from the end of March to the end of July each year. Hence you should get busy at once on the job and apply the treatment now. The dormant insects will be killed and you should have no more trouble. Despite this fact, the treatment needs persistence. It is not sufficient to treat the wood once only. It should be treated about half a dozen times between now and the end of the summer, and also once or twice during the spring of next year. Only then can you be perfectly certain that the insects have been perfectly eradicated. The need for this treatment is seen to be imperative when it is remembered that during the summer the tiny adult beetles fly, and thus are very readily able to infect other articles of woodwork and furniture in the same room and even, indeed, in other rooms.

## *Leather Dyeing; Heavy Water*

**CAN you inform me regarding the method of dyeing leather from its original colour (biscuit) to nigger brown or dark blue? The leather is basil for a jerkin.**

**Also, what is heavy water?**

**Water is $H_2O$. If hydrogen is an explosive gas and oxygen—shall I say—an accelerator—why is water not dangerous?—Geo. D. Elliot (Strabane).**

LEATHER dyeing is not an easy job, particularly for an amateur, the trouble being to get the colour to fix itself on to the leather without subsequently tending to "rub."

The general method is to dissolve an oil-soluble dye in a suitable organic liquid. This is then rubbed into the leather until the desired colour is obtained. On the large scale, the leather is actually immersed in the dye solution, sometimes under pressure.

A suitable solution for your purpose is the following one:

| | | | | | | |
|---|---|---|---|---|---|---|
| Oil-soluble dye | .. | .. | 10 | parts | (by weight) |
| Oleic acid | .. | .. | .. | 6 | „ | „ | „ |
| Acetone | .. | .. | .. | 6 | „ | „ | „ |
| Benzene | .. | .. | .. | 6 | „ | „ | „ |

All these ingredients are, unfortunately, very difficult to obtain at the present time of shortages and restrictions, and, really, we are in much doubt as to whether you will be able to obtain them. Normally, however, they are all obtainable from Messrs. A. Boake, Roberts and Co., Ltd., Carpenters Road, Stratford, London, E.15. You might, possibly, also be able to obtain them from either Messrs. W. and J. George and Becker, Ltd., 17-29, Hatton Wall, London, E.C.1, or from Messrs. A. Gallenkamp and Co., Ltd., 17-29, Sun Street, Finsbury Square, London, E.C.2.

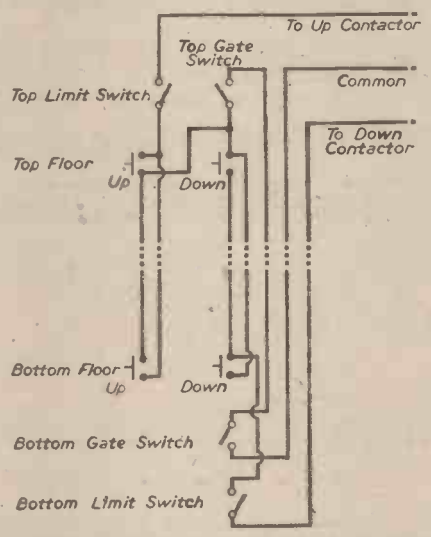
There are two kinds of hydrogen, one, the common form, and the other, a rarer variety which is slightly heavier than the common form. In a nutshell, "heavy water" is merely water which has been produced by the chemical union of this heavy hydrogen with oxygen. Both ordinary hydrogen and its "heavy" variety unite with oxygen to form water, $H_2O$, in identical proportions, but since the rarer variety of hydrogen is heavier than the common variety, it follows that the water produced from it is heavier than that made by the combination of ordinary hydrogen with oxygen.

Hydrogen is not an explosive gas, neither is oxygen. It is the *mixture* of hydrogen and oxygen which is explosive. Oxygen and hydrogen have a great affinity for each other, but after they have united to form water, this mutual attraction is satisfied, for which reason water is a perfectly stable substance.

## *Circuit for Operating an Electric Lift*

**I WISH to motorise a light parcels lift which only serves one floor. The maximum weight of the load, combined with the lift itself, will not exceed 5 cwt., the travel being 10ft.**

**Can you advise me on the horse-power of the electric motor required, also suitable circuit to operate on three phase 400 volts, together with the name and address of any firm likely to be able to supply suitable switch gear?**




*Circuit for operating an electric lift (J. Manton).*

**The lift is already in use, but is hand operated, and we, of course, realise that gates will have to be provided which prevent the lift starting until the gates are closed. We take it this is the only safeguard necessary to comply with the Factory Acts.—J. Manton (Battle).**

WE consider that a motor of 3 h.p. would be quite adequate, provided a suitable counterbalance is provided for the lift. For a lift of this type you could use an electrically released brake on the motor coupling, the motor driving the holsting wheel through worm gearing. The motor could be controlled by an oil immersed direct-on-line reversing contactor oil switch, such as the type R.D.L. manufactured by Messrs. J. A. Crabtree & Co., Ltd., of Lincoln Works, Walsall.

The lift will presumably be controlled by an up and a down push button fitted on each landing only. Limit switches operated by the car will then be necessary to stop it at each end of the travel; an ultimate limit switch, preferably connected in the main three-phase supply to the machine, will also be needed to cut out the motor in the event of serious over-running due to failure of the control gear or other cause. Gate switches should also be fitted to ensure the lift cannot be started until the landing gates are closed. We presume persons will not travel in the lift.

The Factories Act requires every hoist to be examined by a competent person at least once in every six months, and a signed report entered in the general register, gates on landings with electrical interlocks, the safe load to be marked on the lift, efficient devices provided to prevent over-running, the platform or cage to be supported by at least 2 ropes or chains each capable of carrying the whole weight of the platform or cage and load.

The accompanying circuit diagram shows a suitable control circuit.

## *Small Electric Furnace; Induction Coil*

**I SHOULD be very pleased if you could supply me with the following information:**

**What is the best way to construct a small electric furnace to reach a maximum of 1,000 deg. C., and the method of holding a constant temperature at any given degree?**

**I have a small step-down transformer, giving 3, 5 and 8 volts, and I want to construct a 4,000 volt induction coil. Would I need a rectifier, or could I use the transformer to give the input?—R. Fishwick (Wirral).**

IT should be possible to obtain a suitable "Vitreosil" muffle from Messrs. The Thermal Syndicate, Ltd., Wallsend, Northumberland. This could be wound with Brightray resistance wire, as supplied by Messrs. Henry Wiggin and Co., Ltd., of Grosvenor House, Park Lane, London, W.1, the wire being secured with Purimachos or Pyruma fire cement. The wound muffle could be placed in a sheet iron enclosure with insulating medium between the muffle and outer casing. Suitable insulation is "Newtempheit" (Newalls Insulation Co., Broxbournbury, Broxbourne). A mica lid could be used.

If the furnace is kept closed it will eventually reach a certain constant temperature at which the heat generated is equal to the heat dissipated, but a considerable amount of experiment would be necessary to ensure this occurs at the required temperature. A more convenient method would be to supply the heating element through a tapped transformer or have an external resistance or choke which could be hand controlled.

In using a transformer to supply an induction coil having vibrating contacts, a rectifier is required, and the input to the coil should be as smooth as possible. On the other hand, you could build up a high voltage transformer fed from the supply mains.

## *Cutting Tiles*

**I WOULD like to know of a method whereby tiles for fireplaces, hearths, and kerbs, etc., could be accurately cut to any size with a minimum of waste or time.—J. Wilson (Glasgow).**

THE only way to accurately cut composition tiles and other stoneware or stonelike articles of the type you infer is by means of a carborundum saw. This consists of a high-speed wheel tipped with carborundum against which the article to be cut is pressed just in the same manner as a plank of wood is pressed up against an ordinary circular saw. With the carborundum saw, there is no waste of material and certainly no waste of time. A clean cut is made and, with a little practice, many intricate curves can be cut in hard material.

You will probably be able to obtain a carborundum saw or wheel of the type you need from The Universal Grinding Wheel Co., Ltd., Stafford.

## *Varnish for Spraying*

**I WISH to finish some model work by painting with water colour paint covered with a layer of colourless varnish. I do not wish to obtain a high degree of glaze, but something intermediate between the flat water-colour and the high gloss of a brush-applied varnish; also, I do not wish to obliterate fine relief.**

**I shall be glad if you will recommend a water-white varnish suitable for spraying.—G. S. Gowing (Stockton-on-Tees).**

AN oil varnish will not suit your requirements, in view of the high glaze which it would produce. We think your purpose would best be suited by the use of a pyroxylin varnish. This can be purchased from chemical supply firms, or it can be made by dissolving nitro-cellulose in a 50 : 50 mixture of alcohol and ether. The varnish is highly volatile and inflammable.

Alternatively, you could use a slower drying varnish made by dissolving clear scrap celluloid in a mixture of approximately equal amounts of acetone and amyl acetate. If this is found to dry too shiny, increase the proportion of acetone in the solution and decrease the corresponding amount of amyl acetate.

Again, it is probable that a solution of ordinary gelatine in water might give you the "varnish" which you want and act as a satisfactory fixative for the paint. To this end, dissolve 4 parts of cooking gelatine in 96 parts (by weight) of warm water. Spray (not brush) this on to the paint, and when dry, spray on to it a solution made by mixing equal parts of commercial formalin and water. This will insolubilise the gelatine layer and render it tough and enduring.

THE Cyclist
Editor: F. J. CAMM

VOL. XIV MAY, 1946 No. 291

*All letters should be addressed to the Editor, "THE CYCLIST," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.*

**Phone: Temple Bar 4363**
**Telegrams: Newnes, Rand, London**

*Comments of the Month*

By F. J. C.

# Ex-Servicemen in the Cycle Trade

MANY cycle retail businesses were closed during the war because the proprietors were called to the Services, or because supplies were not available. It would obviously be unfair, therefore, for newcomers to enter the cycle retail trade in those districts where such closures have occurred. It would be equally unfair in districts where traders have kept going on the very meagre amount of material which has been available for the home market. In fact, it has been one of the difficulties of the cycle trade for many years that there were too many retailers in some districts catering for a commodity demand which did not justify so large a number, with the inevitable result that few of them were able to make reasonable profits. We learn from the British Cycle and Motor-cycle Manufacturers and Traders Union, Ltd., that they receive by every post letters from returned ex-Servicemen who state that they wish to enter the retail cycle or motor-cycle trade, and who ask for assistance in obtaining supplies of bicycles, motor-cycles, components, accessories and so on. We agree with the President of the Union when he says that it is an unpleasant task to have to disappoint these men, particularly as in many cases they have already committed themselves to the acquisition of premises. But facts must be faced, and it is beyond question that there is no chance at present, owing to shortage of labour and materials, and to the concentration of the industry on exports, of anything like adequate supplies of these goods becoming available for newcomers to the industry for some time to come.

The war arrears in the production of bicycles for this country can be put at a full year's output, and whilst the industry hopes to produce five million units in bicycles and parts this year, about three and a half million of these are already booked for overseas, leaving only one and a half million units to meet the demands of existing traders.

Where possible, therefore, men are advised to return to their old jobs and to await the time when it is opportune to change occupation. The failure of many thousands to return to their pre-war job is creating the labour shortage of which all manufacturers complain, with the result that, even allowing for the export of a large proportion of our manufacture, the British public is being kept short.

## The New Road Research Board

THE Research Board of the Department of Scientific and Industrial Research has been reconstituted under the Chairmanship of Sir Frank Smith, and the terms of reference of the Board have been extended to enable it to deal more specifically with problems of road safety and traffic flow, as well as with problems of road construction and maintenance. The change is to meet the relevant recommendation of the Report of the Select Committee of the House of Lords on the preventing of road accidents. This report was published in 1939, and the task of implementing the recommendations concerning the research was begun that year, but owing to the calls on scientists, research organisations and Ministries during the war, the work was delayed.

The Board is charged with recommending a programme of research advising on its execution and reporting each year on the work done. The use of the knowledge obtained will be the responsibility of the Ministries concerned. In its work on road materials and methods of construction, the Road Research Organisation has already concerned itself with some problems, such as those concerned with slipperyness and other characteristics of the road surface which are closely related to road safety. The road, however, presents only one aspect of road safety. The road user, individually as well as in mass, at rest as well as in motion, is a vital factor. Accident proneness is a matter upon which the Medical Research Council will advise. The Road Research Organisation will not, of course, bring immediate results, for its first task is to assemble the means of doing the work. Science is thus being brought to bear at long last on our road problems.

## Road Safety

SIR ALKER TRIPP, Assistant Commissioner of Scotland Yard, was the guest speaker at a recent meeting of the Roadfarers' Club held at the Savoy Hotel. He dealt with the root causes of road casualties, and said that the whole trouble is that motor traffic during the present century has been loosed upon our towns and villages without even a tithe of the preparation required to make things safe. That amounts to an indictment of the various Governments who have imposed heavy taxes to put things right and failed to do so. That did not happen in the case of the railways, for our forefathers clearly saw that if vehicles were to run at high speeds their tracks must be fenced off from general public access. In other words, the tracks were provided first and the high speeds followed. In the case of motor traffic he said the process has been exactly reversed, hence the road casualties. We should, however, like to interject here that our forefathers who dealt with the locomotives should have used their wisdom in dealing with road traffic. They did make some half-hearted attempt by introducing the famous red-flag act, and since then we have tried by means of speed limits, one-way streets, traffic signs, traffic lights and two thousand regulations to make our obsolete road system work.

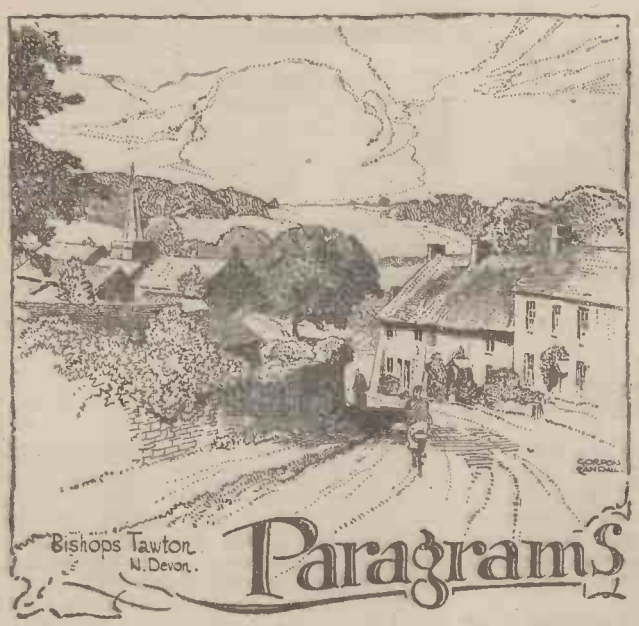
We agree with him when he says that our road system, to which everyone has access, is quite unfit for high speeds, for there is not a single major road in the country that is fully fit from that point of view. The great thing is for all of us to get rid of the coach-and-horse mentality in relation to road transport. Some things, said Sir Alker, are quite obvious. The main traffic streams ought to be kept clear of the daily haunts of the populace. It is because we mix the two that we get a huge number of casualties.

That means that we want motor-ways, reserved for motor-cars only. Such roads are wanted, not only to give the motor drivers a road to themselves, but to suck all the fast arterial traffic out of the present roads, which are open to everyone. Equally it means that on existing main traffic roads no more shop frontages should be created, nor any service roads which are merely an excuse for ribbon development. There are still people who, when designing a ring road round a city, make provision for pedestrians. That road is required to meet the needs of traffic and if pedestrians are admitted they are wantonly exposed to danger. If a new road is chopped out in the middle of the city pedestrians should not be allowed on it any more than pedestrians are allowed in the tramway tunnels.

The interim report of the Road Safety Committee says that all new arterial roads should be one-purpose roads for motor traffic only and all new sub-arterials should be for vehicular traffic only, pedestrians being excluded.

In the meantime we have to deal with the country as it is with the present roads and their mixture of motor traffic, public service vehicles, pedal cyclists and pedestrians. Of the total fatalities nearly half are pedestrians. Pedal cyclists are nearly a quarter and drivers of motor vehicles only 5 per cent. The motor driver is much more likely to kill other people than himself, but the deaths are not always his fault, far from it. Casualties are caused by human errors on the part of pedestrians, pedal cyclists and drivers in direct proportion to the percentages each forms of the total number of accidents. The lethal effect of every error is increased as vehicle speed is increased. The thirty mile speed limit resulted from the establishment of this principle. Just as at sea collisions are prevented by the Board of Trade regulations, so everyone must be bound to honour the laws of the road. Most people try to obey the law except in the matter of speed limits and leaving their vehicles about in the street.

Then why, we ask, does not the Government provide proper parking places? Garage accommodation is totally inadequate and people will continue to use their cars and leave them about if they cannot park them in an approved place. It is the duty of the Government to solve this problem and they will not solve it by prosecution, which merely wastes the time of the police and of the magistrates. Very many people are still shaky on the Highway Code. The great thing is to know the rules of the game and to be as honest in observing them as we are at football or cricket.




### *Kettering Club Re-starts*

SEVEN pre-war members and seven new members attended the first post-war annual general meeting of the revived Kettering Amateur Cycling Club. Mr. H. T. Garley was elected president, and Mr. J. R. Smith, secretary.

### *Humber Bridge Scheme*

THE proposed Humber Bridge scheme is to be further considered at a conference to be held at the Guildhall, Hull, in the near future, between Lindsey County Council, Hull Corporation and the Humber Conservancy Board.

### *Boston Wheelers Alive Again*

THE Boston Wheelers and Athletic Club, which was disbanded in 1940 owing to the majority of the members having joined the Forces, has been revived. Some 30 old members and would-be new members were present at the preliminary meeting and plans are being made for the forthcoming year's activities. Mr. J. W. Hayes, who was chairman of the Club in 1940, and has been acting secretary since 1941 during the Club's temporary eclipse, has been appointed chairman.

### *Cycle Racks for Leicester*

AS an experiment, Leicester Highways Committee have decided that cycle racks shall be fitted at the Charles Street car parks. There will be accommodation for some 220 cycles, and there will be staples provided so that cyclists who bring their own padlocks can lock up their machines. The charge will be 2d. for each machine, and if this experiment is successful further racks will be provided at other parking places.

### *In Training*

A CYCLIST who was fined £2 by Northampton Divisional magistrates for riding without lights was stated to have said in a letter to the Court: "I don't wish to break the law as I hope to go into the police force when I have increased my weight." But this was the man's fourth offence of cycling without lights, and the unsympathetic chairman of the Bench said: "In spite of the defendant's proposal to become a policeman in the future, we shall have to make an example of him on this occasion."

### *Honesty Doesn't Pay*

A STAVELEY (Derbyshire) man bought a bicycle one dark night for 20s., and when he later discovered it was worth about £10 informed the police, but lost his 20s. by his honesty. The seller of the bicycle, who had stolen it, was sent to Borstal by Chesterfield County Bench for the offence and 9s. 1½d. of the 20s. was recovered from him. Instead of handing this sum to the purchaser of the bicycle, who through his honesty had lost both bicycle and money, the Bench ordered it to be put into the Court's poor box.

### *Above the Law*

PRISONERS-OF-WAR in England seem to do pretty much as they like, even to cycling without lights. While R.A.F. men quickly make an appearance in the local police court if they cycle without lights, prisoners can regularly be seen riding along a Lincolnshire road near Scunthorpe completely lightless.

### *Ask a Policewoman*

THE first County policewoman in Bedfordshire has just been sworn in. She is 23-years-old Miss Irene Constance Walters, who in 1940 was the first volunteer for the Bedfordshire Women's Auxiliary Police Force.

### *Less Tramlines*

LEICESTER is to abolish its trams and the work has already commenced. The cost of repairing and making good the roads after the tramway system is finally abolished is estimated at £105,000.

### *Still Dropping Them*

A 4,000lb. bomb, which fell from a R.A.F. lorry on a Lincolnshire road, smashed into a passing private car and injured the driver, an airman on leave, his wife and baby son. The three occupants of the car had to receive hospital treatment.

### *The Bloomer Girl*

MRS. ALICE HAWKINS, who was a member of the old Leicester Clarion Cycling Club and the first woman in the city to go for a run wearing the so-startling "bloomers," has died, aged 83. She was a very keen cyclist for many years. During the demonstrations by the suffragettes, Mrs. Hawkins was imprisoned five times for her activities, which included throwing a stone through the only remaining pane of glass left in the Home Office windows after a crowd of suffragettes had finished "demonstrating."

### *The Sense of Ease*

IN industry it is becoming more and more the attitude of employers to train folk for the work needing high skill and technique. It pays, but it has taken industry a long time to discover the fact, since the apprenticeship system almost disappeared from our working lives. Team games long ago adopted the principle, hence the high performances in the field of athletics. Racing cyclists are conscious that to reach a decent standard of performance they must live strenuous days and practise a certain amount of self-sacrifice, even to the point that their pleasure cycling suffers. And what pertains in the higher performances of the speed game is, in a very mild degree, desirable in the rider who would be the complete cyclist. There is no need to train in the usual sense of that term, but regularity in riding is mere wisdom, so that the miles you want to cover are as nothing when the chance to make them comes your way. Like the man in training, never hurt yourself with the burden of too-ambitious a programme; in other words, when it hurts, weather or hills or distances, go slowly, or, if you are touring, take the first chance of accommodation. You can get tired cycling if you will not heed, and think you are better than the wind and the hills; but why do it when time is your own and there is another day waiting behind the night storms to smile you on the way? It is part of the philosophy of the game to know when to stop and to measure your happiness by the tether of your energy. Miles, after all, are only a calculation of distance, not to be considered in the same category as the visions they bring in the process of their unreeling. "This is beautiful; let us stop and smoke"; and the sign of "Teas" in a comely cottage garden halts a man on a warm day; that is the kind of companion I like, and if he has a camera to amuse him, all the better; I can wait where he wants to take a picture, for be sure it is good.

### *Different Angle*

JUST as we cyclists are prone to suggest that every motor-car driver should graduate through the pastime of cycling, so it may be said that cyclists will be enlightened by taking an occasional ride in a motor-car, so that they can look at things from the other fellow's point of view. At the beginning of February a lecture engagement called me away to a place 68 railway miles (69 road miles) from home, and I came to view the Sunday return journey with consternation, seeing that it involved a wait of about four hours in a main-line railway station—four hours in which one could do nothing but fume and fret at the gross waste of time.

My son, who owns a fast open car, came to my rescue by offering to run over to the lecture venue and cart me home—an offer which was accepted with alacrity. He did the outward run in 1¼ hours, the homeward journey requiring a further 15 minutes. We passed everything on the road and if it had all been crammed into one mile there would have been no congestion. He drove carefully but fast, and I do not think there can be any objection to speed so long as it is not in the wrong place. He commented, without complaint, on the many bends in the main road which formed part of our route, and I am glad he did not suggest the need for the ironing-out process. I observed a slight tendency on the part of some of the drivers we overtook to be sluggish in making way for us, but that is usual, and is part of "man's inhumanity to man," so often displayed (and in far worse form) by motorist towards motorist. However, nobody was endangered in the slightest during that quick journey, and I was interested in seeing things from an angle different from the usual one. I was also grateful for being prevented from being guilty of the gross waste of time which the rail journey would have involved. F. J. URRY.

---

### *A Simple Dual Lock*

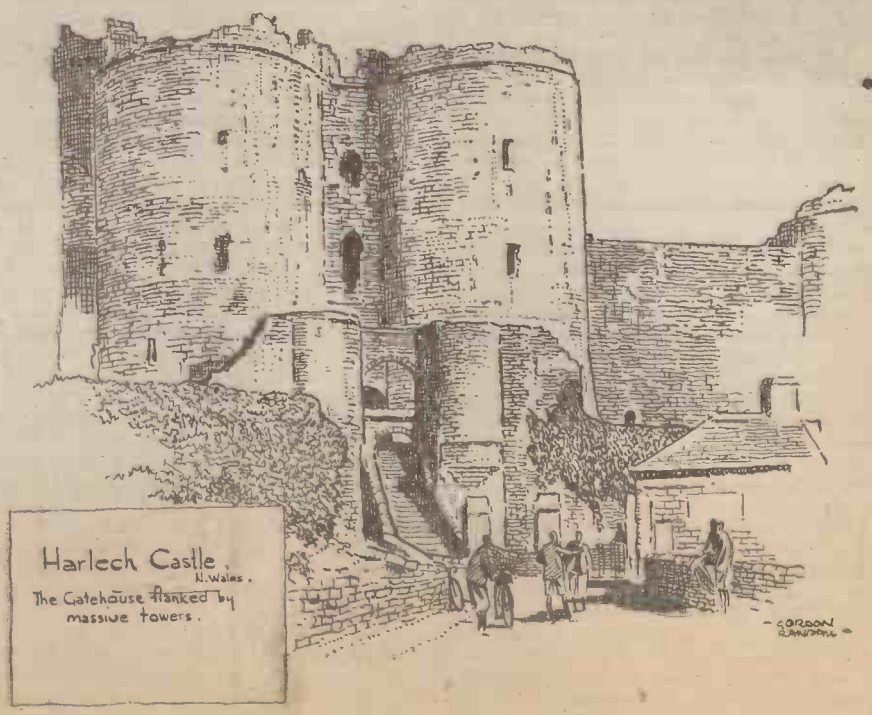
WE recently examined a locking device made by R. N. Saxby, Ltd., of Bridge Road, Mossley, Liverpool, 18, which secures both cycle and pump at one operation, and we think it is a sound article. It can be fitted to any existing machine, retails at 3s. 3d., is light and simple in operation.

Two special pump pegs, the top one carrying the lock, and short length of strong Bowden cable and a screw key are all the components. The pump is secured by a racking quadrant, fixed when locked, and the rear wheel by the loop of cable, the end of which is locked into the top clip on the right by pushing home.

Release is by the screw key, when the cable-end is housed on the left of the pump peg without locking the wheel or pump.

Full details and illustration can be obtained from the address given.

We feel the time has come for all cyclists to use some form of locking device when they leave their machines, for if we do not take some pains to preserve our property, we may be in danger of the introduction of a system of registration, which, of course, means taxation.



# Around the Wheelworld

By ICARUS

### "The Devil on Wheels"

ROBERT DINWIDDIE of Dumfries is shortly publishing a book entitled "The Devil on Wheels." It is the story of the world's first pedal cyclist, Kirkpatrick Macmillan. Sir Harold Bowden will unveil a tablet on the wall of the smithy where the first bicycle was made and the ceremony is to take place on May 19th. Copies of the book will be available to all those who are present at the ceremony and it will, of course, be on sale to members of the public. The author has gone to a great deal of trouble to establish his facts, following on the full details written in an article by James Johnstone, Secretary of the Glasgow Cycling Club, in a magazine called "Gallovidian" in December, 1899. The illustration here is from a post card which Dinwiddie is publishing for the occasion. It shows the original home of the first bicycle—Courthill Smithy, Keir Village, 14 miles north-west of Dumfries. When Macmillan cycled for 70 miles to Glasgow in 1842 (his first bicycle was built in 1839 and this journal produced a special centenary number in 1939 in honour of the occasion), he was reported by the Press at the time as "the devil arriving in Glasgow riding a hobby-horse." As soon as copies of this book are off the press I shall review it in these columns.


*The original home of the first bicycle, Courthill Smithy, Keir Village, near Dumfries.*

### The T.T. Bicycle Race

THE Manx International T.T. Bicycle Race will take place over the Tourist Trophy Course, Isle of Man, on Thursday, June 20th.

The massed start will take place at 2 p.m. It is organised by the Manx Viking Wheelers' Cycling Club in conjunction with the Douglas June Effort and Season Extension Committee, and as the event is run on a closed circuit it is held under N.C.U. rules.

The last T.T. Bicycle Race was six years ago. First held in 1936, over one lap of the course, in 1937 the race was extended to two laps, a total distance of nearly 76 miles. The massed start of one hundred riders wearing multi-coloured racing dress has extended in popularity. The winner receives the Raleigh Challenge Cup and Silver Replica whilst the winning team holds for a year the Sun Team Challenge Trophy. There are, of course, other awards. Previous winners have been Charles Holland, J. Fancourt, Pierre Chazaud and W. A. Messer (not to be confused with another Messer associated with the Bath Road).

### The Southern Counties Cycling Union

THE S.C.C.U held its annual meeting on February 19th and approval was given to a road programme of nine events,

It was agreed to inaugurate a B.A.R. Competition based on performances at 25, 50 and 100 miles; the competition to be open only to first claim members of affiliated clubs riding in S.C.C.U. events.

S. M. Butler, 246, Grange Road, S.E.25, was re-elected road secretary.

C. G. Bowtle and S. Amey were elected vice-presidents.

### R.T.T.C. News

E. WOOLLEY, of the Altrincham Ravens C.C., having submitted an unsatisfactory receipt as a voucher for prize money, was charged with raising money on a prize in an amateur event in contravention of Regulation 16c. The appropriate committee of the R.T.T.C., having considered all the evidence, accepted the explanation given by Mr. Woolley that no deliberate attempt to evade the regulation was made, but are of the opinion that the laxity of his conduct produced what was in effect an offence against the regulation, and they decided that he be severely reprimanded and cautioned as to his future conduct and that this decision be issued to the Press for publication. W. B. Chapman of the same club was charged with the same offence and the committee found the charge proved, and have suspended Mr. Chapman from competing in events under R.T.T.C. regulations until May 17th, 1946.

At the first meeting of the year held recently, Mr. A. E. Armstrong was unanimously re-elected Chairman of the National Committee, and S. Amey re-appointed General Secretary.

It was agreed to permit the waiving of subscriptions (for 1946) from inactive clubs, but such clubs will not be taken into account for purposes of representation at the Annual Meeting of the National Council. D.C. Secretaries are asked to submit to the General Secretary by June 1st a list of member clubs, including those excused payment of subscriptions; such clubs to be indicated.

Following upon the announcement of a claim by the Pyramid R.C. to have established a Women's 25 miles Team Record with a performance of 3h. 39m. 53s., other and better performances have been indicated. Claims to this record must be sent (accompanied by proof) to the General Secretary by May 1st.

### Southern Roads Records Association

AT the annual general meeting of the S.R.R.A., J. W. Daymond was re-elected president and P. A. Huggett, of 490, Chipstead Valley Road, Coulsdon, Surrey, was elected hon. secretary and treasurer. The assistant secretary is S. Armstrong, 7, Alexandra Road, Coulsdon, Surrey.

### Streatham Hill Cycling Club Expanding

THE Streatham Hill Cycling Club, which has been carrying on a limited social and touring programme whilst most of its members were away during the war, is embarking on a full-scale programme for 1946/7. Saturday, Sunday and mid-week runs are planned, also week-ends, club tours and social functions. The Streatham Hill is an old-established club, founded 1911, and has always catered for the touring element, although members often combine this with road-racing under another Club's banner. Before the war, for a number of years, parties carried out Continental tours in areas as far apart as Norway and the Pyrenees. The hon. secretary, Mr. T. F. Dowden, 48, Azenby Road, S.E.15, promises a warm welcome to new members of either sex from any part of South London, especially those who enjoy the quiet byways.

*A recent luncheon meeting of the Roadfarer's Club at the Savoy Hotel, London. (Extreme right) Marquess of Donegall in the chair. (Centre) Sir Alker Tripp. (Left) Mr. E. Coles Webb.*

# A Cyclist Sees Them

RALEIGH'S are awake and astir. We went to Nottingham recently to see the new Raleighs, Humbers, Rudges and Robin Hoods; a miniature Olympia replete with flags and slogans, many friends, and numerous beautiful bicycles. And we use that adjective literally, for we've not seen so many beautiful bicycles under one roof for over seven years. It was a pity that the show was only open to the firm's dealer-customers and friends, for we feel that public interest would have been overwhelming had it been given the chance to examine; and, of course, that's how the Raleigh executive looked at the matter, and could not cope with it.

Always for us the Raleigh welcome is warm, and on this occasion it was supplemented with a proper pride in achievement, for there were many new things under the famous old transfers. Chief, perhaps, is the development of the Dynohub in its latest phase. It has gone into the rear wheel in conjunction with a three-speed hub, wide ratio, and by this combination some 10 oz. of weight is saved. But that is not the only advance. It was bound to come one day, and here it is: car lighting on a bicycle. An accumulator is fixed on the seat tube, cylindrical in shape and remarkably light. The A.C. current is fed to this by the Dynohub, goes through a rectifier to be converted to D.C., and then charges a special three-cell dry battery from whence the head and tail lamps are supplied. This, of course, means steady illumination at any speed, or none, so that the truest criticism against dynamo lighting is completely answered. These accumulator cells are dry, so there is no acid to spill, and the only attention they need is the periodic addition of distilled water, which is at once absorbed by the cells. Here, indeed, we have the last word in cycle lighting. It is a certain seller.

### Thief-proof Locks

Key-operated thief-proof locks are part of the equipment on Raleighs, Humbers, and Rudges, but the Raleigh form is the neatest, being housed in the tubular crown fork, while the others are situated on the bottom head lug. Each system gives a three-point fixing of the steering, and all are simple in operation.

After six years of war it is a genuine joy to see bicycles carrying a uniform of colour and chrome. They shone and sparkled again, and made you feel glad. But under the skin there is substance, and the eyeable neatness is reinforced by the beauty of outline that announces care in design. The new hexagonal lock-nut on the head is sound and simple, spanner equipment has been improved, forks redesigned, and finishes in colour and chrome have given grace to the products. We confess our interest was attached to the R.R.A. model, with its alloy rims, bar and brakes, and the nattiest little bag support we have ever seen, secured by studs engaging sliding slots, and detachable without spanner aid in a few seconds. This particular mount, with three-speed, Brooks touring saddle and full equipment, only scaled 27lb; but it was tantalising to learn it would not be in production until the end of the year.

### "Thus We Served"

As a fact, the big factory will not have completely gone back to peacetime progress until '46 is old, which is not surprising, considering Raleigh was one of the biggest ammunition factories during the war years. The company are proud of their part, and a brochure giving details of their war performance, under the title of "Thus We Served," tells the tale in the modest language of that pride.

They have also published an instruction book which sells at 1s., and it is the best thing in text and illustration we have seen for years. This is mainly the work of Fred Koller, their publicity expert, who is to be congratulated on a fine effort.

Lack of space prevents us giving further details, except to say that prices range from £10 9s. 8d. to £18 18s. 7d. for the adult models, including purchase tax, while the figure of the R.R.A. machine has yet to be fixed.

It was a fine show, and the atmosphere of welcome pervading it, led by Mr. Geo. Wilson and his jolly staff, made one feel they have the proper pride of cycle making, selling, and riding. When a visiting cyclist can feel this, he carries away with him a sense of decent well-being.

# From My Notebook

By Waysider

### *More Leisure*

I MISSED the B.B.C. discussion on the question of leisure, when I gather that doubts were expressed as to whether the man in the street would know how to employ extra liberty. Shortly afterwards, however, I was reading the report of the evidence given before a Home Office Committee dealing with the hours of shop assistants. It was mentioned that the final goal of the principal Trades Union concerned was a five-day week of 40 hours, with Saturday free for all such workers. Meanwhile, another Union aimed at a half-day closing hour of 12 noon instead of 1 p.m.

It would probably be out of place for me to discuss the main proposal outlined above, but one naturally comes back to the point concerning the ability of the average man to use his leisure to advantage. There are, of course, thousands of folk who employ their hours of recreation wisely, through the medium of (for example) cycling, walking, gardening, etc. But literally hundreds of thousands of people are at a loose end when freed from the obligation to work. It is thus just a question whether extra leisure is going to do more harm than good. Generally speaking, I am all in favour of more and more leisure, and most certainly I strongly approve of the noon closing of shops on the weekly half-day holiday, but I feel strongly that some form of education is urgently needed if the proletariat (i.e., you and I!) are to extract proper value from hours of liberty. Here, I imagine, is work for organised cyclists and also for individual cyclists—if only the "raw material" can be obtained. There's the rub!

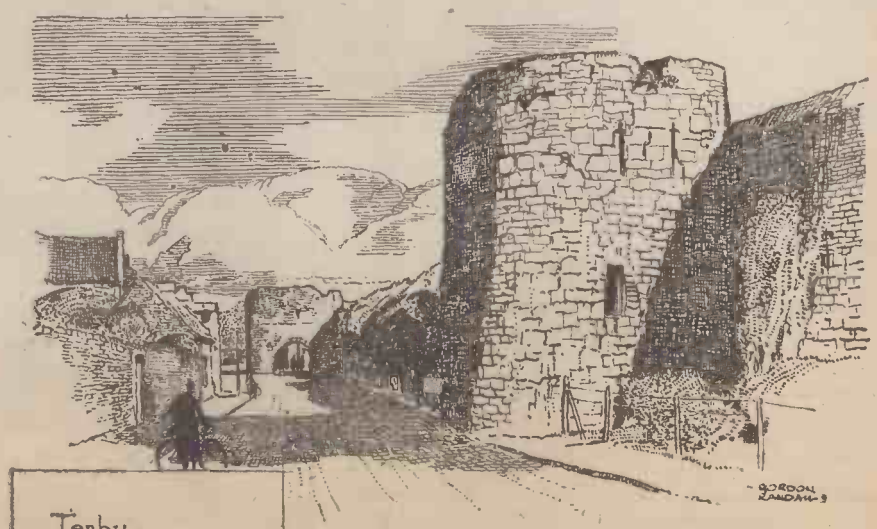
### *Co-ordination Needed*

CERTAIN steps are taken with the object of avoiding the clashing of dates as regards cycle club annual dinners and also (I believe) road events, but nothing appears to be done to prevent the simultaneous descent on caterers, by three or four separate clubs, for Saturday or Sunday tea. This seems to me to be a point worthy of some little thought, particularly in view of the reduced number of caterers and the limited quantities of food now available. It is difficult to know what to suggest for the "spreading" of this custom, but the desirability, if not the necessity, of the course indicated admits no question.

On two successive days recently I had a chat with a couple of caterers on the point here raised. The first caterer, speaking to me on a Saturday, said: "So far as I know, there's nobody coming to-morrow. Last Sunday I had three parties booked, and I was compelled to turn away three or four odd cyclists who came along for tea. There was plenty of food, but I had no accommodation for them. How I wish the business would come in a steady stream, avoiding this all or nothing system!" The second caterer said that on the previous Saturday she had a total of 31 booked for tea (against a capacity of 25), with the certainty of a few "strays." So she had to write to one of the booked parties suggesting the cutting of numbers with the alternative of staggering the process of sitting down to tea. Certainly a method of "spreading" club parties would be to the advantage of everybody concerned, but who is going to operate the machinery? And how?

### *Open-sided Tyres*

ALWAYS a believer in light wheels, the late war struck me a savage blow, as a cyclist, through the suspension of the manufacture of open-sided tyres which, normally, I desire to use to the extent of 100 per cent. of my cycling. It may be fancy; it may be fact; but I find such tyres much easier to propel than fully-rubbered tyres and, seeking to follow the line of least resistance in this respect (as, indeed, in all other respects), I am all for the open-sided variety of tyre. If, in the long run, the cost of cycling is enhanced, then I cheerfully pay the increased price, in return for the energy saved and the ease of propulsion achieved. I reached the end of my small stock of open-sided tyres last August and am now using the fully-rubbered article. Fortunately, these are of the pre-war class, and I have not had to sample war-grade or synthetic tyres. But oh! how I long to hear that open-sided tyres are once more available. I shall certainly get in by the early door, if this is at all possible.




Tenby, Pembrokeshire.
The massive walls of the town dating from Norman days.

### WAYSIDE THOUGHTS

We regret we have had to omit F. J. Urry's notes this month, but they will be resumed in the next issue.

# CYCLORAMA

By H. W. ELEY


## Traffic Problems

ON Friday, March 15th, I had the pleasure of attending a luncheon meeting of that virile organisation "The Roadfarers' Club," and listened to a most interesting and suggestive address by Sir Alker Tripp, the Assistant Commissioner from Scotland Yard. He had some practical suggestions to make towards the solving of the great problem of Road Safety, and his audience, under the chairmanship of the Marquess of Donegall, was composed, of course, of representatives of every class of road user; it is the great merit of the Roadfarers' Club that its membership is not confined to *one* section of the road-using community—there are cyclists, motor-cyclists, motorists, and enthusiastic pedestrians among its growing membership, and this brings a realisation of the fact that we *all* have our part to play in promoting road safety, and doing whatever we can to reduce the still tragic toll of our roads. Of course, the problem is a many-sided one—and one cannot overlook the fundamental fact that most English roads, constructed in the dim past, were not constructed for fast-moving motor vehicles. The goodwill engendered on this knotty problem by the activities of the Roadfarers' Club is something to be warmly commended. With Lord Brabazon as president, R. A. West as a hard-working secretary, and the enterprising F. J. Camm as the "motive spring" of the organisation, the club should go from strength to strength.

## Bringing the Countryside to the Townsman

BIG efforts are being made—by more than one organisation—to bridge the gulf which unfortunately all too often separates the country-dweller from his town cousin. Of late, there has been welcome activity on the part of the National Farmers' Union, and the Ministry of Agriculture, to bring the two closer together, and give the urban dweller some better idea of how the farming community works, and how dependent all townsfolk are on the enterprise and hard work of all who work on farms and on the land. Exhibitions have been arranged in several big centres—notably Birmingham and Manchester—with the object of showing the town dweller the vital importance of the countryside and all who work in it. Now, the bicycle has always appeared to me as the ideal "instrument" for bringing town and country folk together; and countless cyclists have found an understanding of the countryman and his ways by riding out to villages, talking to farmers and their workpeople, and seeing something of the fascinating pageant of Nature. Just one more merit of the cycle!

## Never Too Old . . .

AN aged country vicar of my acquaintance has just been consulting me about the desirability of switching over from a cycle to a tricycle; he is about 84, still in active parish work, and has been an ardent cyclist for many years. Because of rheumatism, he finds mounting and dismounting a little trying now, but obviously this veteran has no idea of giving up his life's pastime.

## Close Season

IF you are not a fisherman you may be bored by this reference to the angling season; but to me, who combine the joys of cycling and fishing, this last week has marked an epoch; for, from March 15th to June 16th is the "close season" for coarse fishing, and not until June shall I again be able to tie my rod to my bike, see that everything is in my creel, and ride away to some pools I know . . . there to try my luck with "gentles" and creed malt, and paste . . . in an effort to catch the good bream and tench which inhabit the water. Master Tench, of course, loves the mud . . . and he is a wily fellow, not to be caught by every boy who arrives with a home-made rod and a wrong-sized hook! But then, there is no fun in fishing when no skill is required, and I look forward to happy July days, when I shall forget all the frets and fumes of the city and find new peace of mind beside the still, mysterious water—over which, if the sun is out, the gaudy kingfisher will flit—a lovely flash of azure; and when I see that vivid flash, I shall wait to see whether the bird joins me in fishing—for the kingfisher is an expert, and one may see him dive swiftly into the water and emerge with a minnow in his long, strong bill.

## "It isn't Far from London"

SOME few years ago, there was a book published with this title, and I seem to remember that it was written by that lovable writer on the English scene, S. P. B. Mais; but I am not sure of this. Anyway, I am reminded of the intriguing title because, the other day, I noticed an illustration in the daily Press of a meet of the hounds at a farm in Edgwarebury Lane, Edgware. Now, this farm, which I know well, is within 10 miles or so of Charing Cross! In my Edgware days, when the suburb was truly rural, this farm was one of my favourite spots. Acres of good pasture land surrounded it, and I remember shooting hares in the farmer's fields. The Hunt concerned was the Aldenham, and the purpose was to exterminate some of the foxes which have been ravaging the poultry runs of the farms around. It is an intriguing thought; pink coats, eager hounds, all the historic pageantry of the Hunt—and, so near, the red coaches of the Northern Line tube! I must cycle out to Edgware one of these days, and see whether I can mingle with the Hunt before the season ends!

## The Easter Call of the Road

THE best "festival" of all—Easter—is drawing near, and Easter is the traditional time when many a cyclist takes out his machine for the first time with serious thoughts of touring, and longish rides. Well, Easter comes late this year, so we may hope for sunshine and good riding weather. Plan that little tour now! Make up your mind that you will see something of England; and it does not matter much whether you choose the Home Counties, or the Cotswolds, or grey Derbyshire. Our country is full of varied charms, and she calls you to her lanes, and broad highways, and nesting villages; and—you will be wise to answer her call!

## Good News from the Rubber Front!

THOSE cyclists who are also tennis players, or golfers, will have been glad to read that crude rubber has been released for the making of golf and tennis balls. This is a welcome indication that the rubber situation is improving . . . and because rubber is a product of a thousand-and-one uses, and touches our daily lives at almost every point, its return to its place as a raw material in manufacture is of tremendous importance.

## Jubilee of the Motor Industry

GREAT doings this year of grace—to celebrate the Jubilee of the Motor Industry. It was, I think, in the month of November, 1896, that the "red flag" was abolished, and to celebrate that great emancipation there will be all kinds of pageantry organised by the Society of Motor Manufacturers and Traders. And because these are matters connected with the road—the immemorial road—they affect cyclists. Just as do inns, and wayside cafés, and signposts, and hostels, and rights of way.

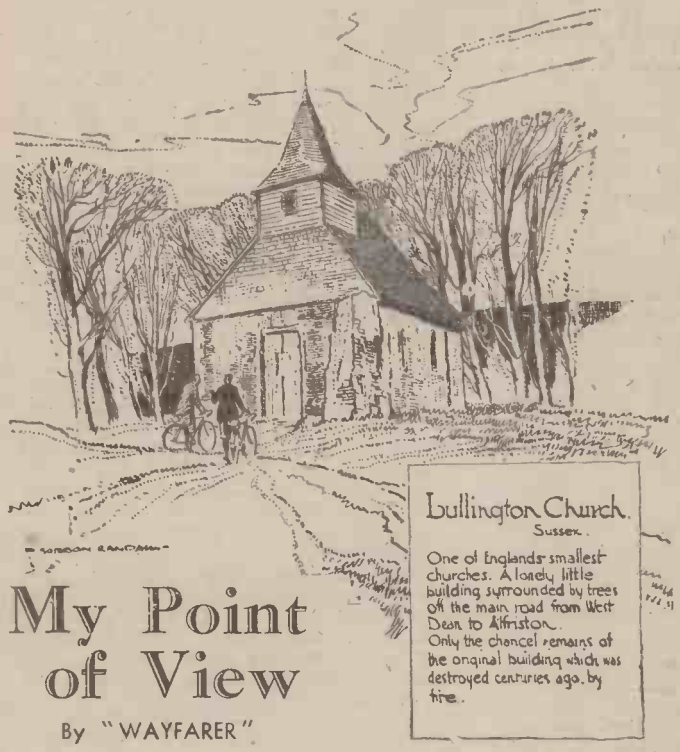
## More Threatened Beauty

THE lover of the English countryside who loves it passionately, and wishes it to be preserved, has to be vigilant. "Schemes" keep emerging which so often threaten to destroy, or engulf, whole stretches of beauteous land. The Manifold Valley is the latest tract of lovely country to be menaced—by, I think, Leicester Corporation, in connection with a water scheme. Now, I am not a water engineer. I know nothing of the needs of the city of Leicester. But I do hope that no great project will be allowed to go through which threatens to spoil the matchless Manifold Valley, without the most careful consideration and without probing every other possibility. We can ill spare another acre of England's loveliness; our heritage has been assailed too often, with sad results.

## Cycles from Central Wales

A THOUSAND cycle frames a week are now being despatched by the G.W.R. from Newtown, Central Wales. This figure is expected to rise to 5,000 a week within twelve months.

Newtown, far removed from an industrial area, has a population of 5,000. It was previously noted for its wool trade.



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

# My Point of View

By "WAYFARER"

### *Very Funny*

A FRIEND told me of a very "funny" incident which occurred recently. An acquaintance of his, who has the reputation of being a practical joker, thought it would be a "great joke" if he turned on the water of my friend's gas lamp long before it was required. He did so, and when my friend came to light up he had the trouble of cleaning out and re-charging his lamp; fortunately, he makes a point of carrying a spare lot of carbide. This "joke" is much more amusing than the older prank of letting the air out of another cyclist's tyres. Much funnier!

### *Luggage-carrying*

A CORRESPONDENT who tells me that he has "decided to take up cycling on a larger scale than before" (good news this!) seeks my advice as to the best method of carrying his luggage. He is in doubt because some people recommend a rucksack and others a saddlebag. Personally, I do not see how, from the purely practical point of view, there can be the slightest divergence of opinion. A rucksack is the thing for walkers; a saddlebag should be "the only wear" for cyclists. It is foolish to burden your person with the weight (and heat) of your pyjamas and tooth-brush, when the bicycle will carry these things for you—and without your being aware of the fact. So I plump for the saddlebag, and would on no account use a rucksack for cycling.

### *Filling in Time*

ON that cold Saturday at the beginning of March, I cycled 26 miles to obtain a welcome lunch at a well-known riverside town. Making a clean sweep of a generous table, I realised that the place where I designed to have my tea was only a dozen miles away. I filled in time to such advantage that the afternoon journey occupied three and a half hours. I crossed from one main road to another, and back again, by way of lanes, some of which were uncomfortably rough. I did a bit of exploring, which helped to complete the details of my existing knowledge. I revisited scenes which had been neglected for a year or two. I inspected a couple of small churches.

This whole process kept me so busy that, two hours after commencing my afternoon journey, I was six miles from my lunch-place—and rather more than that from my projected tea-place. It was all rather delightful, this leisured period with time to burn, and when at long last I again deigned to look at my watch, the dallying process was brought to a sudden end, and I put my best foot forward (as the saying is), finally sitting down to tea half-an-hour later than is usually the case. That March day of low temperatures and generous sunshine yielded me, in all, 73 miles, and I was content.

### *The Former Days*

DURING part of the journey outlined in the preceding paragraph, my mind ran back to the early days of my cycling career, and I realised that such a ride would then have been viewed as bordering on the impossible—though, to be sure, many people would so characterise it to-day! In the former days of which I speak, about 50 years ago, it was the habit with many cyclists, myself included, to put our bicycles into cold storage for the winter months, having first carefully applied Vaseline to the plated parts. There were stalwarts who viewed this policy of hibernation with the contempt it deserved, and I am glad to say that it was not long before I joined their ranks, thus becoming—"for keeps"—an all-the-year-round cyclist.

Before my conversion, however, a long ride on a winter day seemed to be unthinkable, whilst I would never have contemplated a week-end jaunt in the "off-season" for cycling. How different is the position nowadays! As has been previously quoted in these pages, "winter is as fine as summer," and I cycle as regularly in the October-March period as in the other half of the year, whilst the fact of "December" or "February" is ignored when a week-end expedition is afoot. Of course, we have better roads now than in those former days, and the whole outlook on cycling has changed—for the better.

### *Euphemistic*

ONE day, in the course of a shorter-than-usual expedition, I had tea at a popular (and very indifferent) place a few miles from home. When my food and drink were brought the serving-woman ejaculated: "One and threepence, please," and money exchanged hands. Then I observed a notice asking customers "in order to avoid mistakes" to pay for their teas in advance. One does not mind in the least, of course, being deprived of the short credit which practically all tea-places give. What *is* amusing is the excuse put forward for this prompt and before-you-eat cash. It may be that "mistakes" have occurred—but that is not what I would call them!

### *Free*

YOU'D never believe that air is obtainable free, gratis and for nothing when you realise (a) the reluctance of the general public to obtain their share, and (b) the failure of many cyclists to use it, in sufficient quantities, in their tyres.

### *Brief Vision*

DAY by day, as I cycle to business through a not unpleasant suburban area, I come to a point where the falling-away of the land provides me with a brief vision of a well-wooded countryside which, as a cyclist, I know so well. This far-flung view constitutes an acceptable interlude in my journey, filling me with longings, and inevitably projecting my thoughts to coming week-ends, when leisure will allow of more intimate association with loveliness now distantly seen. The probability is that I visualise more—much more—than the picture spread out before me, because imagination has a trick of leading one on and expanding one's outlook. So that, if the delectable lanes of Warwickshire and Worcestershire appear to contribute to that brief vision, and if I fancy the Cotswolds and the Malvern Hills form part of the tapestry—well, who can blame me?

The vision fades. I slide down a hill bordered by vast fields where the unending story of seed-time and harvest can be watched day by day—within three miles, mark you! of the heart of Birmingham—and go on my way, enriched in mind and spirit by the brief vision, to answer the call of factory chimneys vomiting black smoke into the heavens. That brief vision of the countryside is yet another thing for which to thank the little old bicycle.

### *Salesmanship!*

DURING my last holiday (August, 1945) I discovered a slightly "sore place" on one of my tyres, the fabric showing through the rubber at two points. I applied patches on the outside of the cover, making certain that the solution was given a long time in which to get tacky. It then seemed to me that I was in a pretty safe position, so long as the weather remained fine, as it was promising to do; and, as the back tyre was the one involved, I lost no sleep over the matter. Later, however, I decided to be 100 per cent. secure by buying a new tyre. Entering a shop for this purpose, I saw a batch of covers of the size required. They were a wartime product, of course, and my enthusiasm did not climb very high. Nevertheless, the purchase would have been made but for the fact that the dealer, in telling me the price, bluntly added: "Can't be much good at that figure!" This superb specimen of salesmanship put me right off the projected transaction, and I emerged from the shop empty-handed. My defective tyre carried me safely home—about 300 miles on the distorted route followed—and I then made the desired change, drawing on my diminishing stock for a replacement.

### *A Single Thought*

SCENE: a suburban road. Just as I stooped to retrieve a bottle which, if left where it was, would soon have been broken up, thus becoming a menace to all cyclists passing that way, a workman bent down and picked up a half-brick, which he threw over the hedge with the laconic remark that "it might break somebody's neck!" It was clearly a case of "two minds with but a single thought," and I realised that here was a man after my own heart. When those two minds have been multiplied many times over—in other words, when every cyclist makes it his business to remove bottles, half-bricks, etc., from the road—we shall all proceed on our lawful occasions in greater safety and comfort.

### *Policy Differs*

I WAS discussing with a motoring friend a week or two ago the question of routes to a certain place, and I detailed the way I would go. He demurred, saying that the route he had in mind was probably a couple of miles shorter. I smiled inwardly at the thought of how his 12 horses would deal with that slight excess of distance. Then, when I suggested that he should go one way to his destination and return by another route, he objected. He knew the itinerary he proposed to follow on his outward journey and, as he would be coming back in the dark, he thought that he had better stick to the same way. I would hardly have thought that night made much difference to a motorist, having regard to the power of his lamps, but everyone to his taste. For my part I, as a cyclist, am perfectly at home on strange roads on the darkest of nights, and I find a peculiar measure of delight and romance about such a journey.

### *Not Much Difference*

HAVING always specialised in short cuts (which are anything but short!), it is surprising how little difference in mileage is effected by some of these roundabout runs. I am not speaking at the moment of a 50-mile journey to a place only a dozen miles away, but rather of the route which diverges slightly from the normal, gradually edging away until the time comes for you to make a definite right-hand (or left-hand) turn in order to achieve your destination. It is almost as though you set forth from the apex of an isosceles triangle, travelling down one side and then along the base. At the outside, the increase in mileage may not be more than 10 per cent. As I have indicated above, there are other short cuts which are not so short. On a Sunday recently, at the time of writing, I did half-a-century of miles to have tea at a house only 17 miles from home. Another 25 miles brought me home again in the evening!

GRANTHAM.
LINCOLNSHIRE.
The lovely spire of St. Wulfram's church 281 ft (14th century) in the distance. On the extreme left the quaint Beehive Inn.

B.A. thread screws, one gross useful sizes, 2/6; ditto nuts, 2/6 gr.; assorted gross screws and nuts, 2/6; ditto brass washers, 1/6 gr.; fibre washers, 1/6 gr.; assorted soldering tags, 2/- gr.; assorted small eyelets and rivets, 1/3 gr. Large stocks of screws, etc. State wants. Rubber-covered stranded copper wire, 1½d., 2½d. yard. Tinned copper connecting wire, 20ft. coil, 6d.; ditto R.C., 10ft. 6d.; finest quality stranded push-back wire, 12 yds. 2/3; resin-cored solder, 1lb. 3/6; twin bell wire, 12 yds. 2/3; ditto flat rubber-covered, 3d. yd. Cotton-covered copper instrument wire, 1lb. reels, 18, 20, 22, 24g. 1/6; 26, 28g. 1/9; 30, 32g. 2/-; 34g. 2/3. Enamelled ditto, same prices, including 36g., 2/3; 38, 40g. 2/6. Silk-covered ditto, 2oz. reels, 24, 26, 28g. 1/6; 30, 32, 34, 36g. 1/9; 40, 42g. 2/-, 46g. D.S.C., 1lb. 5/-. Laminated Bakelite panels, ¼in. thick, 6in. x 4in. 1/3; 6in. x 6in. 1/9; 8in. x 6in. 2/3; 10in. x 6in. 2/9; 10in. x 8in. 3/6; 12in. x 8in. 4/-. Highly polished Ebonite panels, 3/16in. thick, sizes as above, 1/9, 2/9, 3/6, 4/6, 6/-, 7/- respectively. Special sizes of laminated Bakelite panels to order. New "Lucerne" permanent crystal detectors, 2/-. "Lucerne" crystal set: coils with wiring instructions, 3/6; glass tube detectors, complete, 2/-; reliable crystal with cats' whisker, 6d. Reconditioned headphones, complete, 4,000 ohms, 12/6. All postage extra.

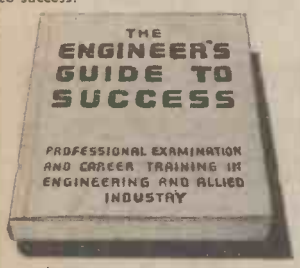
**POST RADIO SUPPLIES,**

33, Bourne Gardens, London, E.4.

---

## Which Professional Qualification for You!

Government and Industry urge you and others like you to train for the highest post-war technical posts within your capacity. Write to-day for "The Engineers Guide to Success"—free—and use the FIRST PLACE COURSES of the T.I.G.B. to attain the engineering knowledge and qualifications necessary to success.




**The Technological Institute of Great Britain,**

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

---

*For your Bungalow, Caravan, Workshop or Week-end Hut.*

New, well-tested design for building

## WIND-CHARGER

with (1) Slow running Propeller,
(2) Geared 3½ to 1 Shaft Drive to
(3) Car dynamo at ground level.

Every Part accessible. NO sliding contacts or excessive top weight. Ample speed for ANY Car dynamo. SET OF CLEAR DIAGRAMS AND INSTRUCTIONS for building same complete from easily and readily obtainable parts ONLY. PRICE, 4/-.

**P. M. BARHAM, La Hougue, Vale, Guernsey, C.I.**

Posted promptly. As represented or immediate refund.

---

## "DORSET"

## 5 Valve 3 Wave Superhet

The finest drawings and instructions ever produced for the enthusiastic set builder. Theoretical circuit, under chassis layout, above chassis layout, heater wiring, group board assembly and point-to-point wiring instructions, also parts list. PRICE 5/-. Available April. This set can be made without previous radio experience and can be built in stages out of income. 3 wave coil pack specially designed for the job. Group board assembly obtainable ready made. Also available: "WIZARD" 4 valve TRF A.C./D.C. circuit, 5/-; "DORSET" battery, 3 circuit, 3/6. "DORSET" Amplifier circuit. A.C./D.C., 6-8 watts, 5/-. Write Weldona Radio Accessories, Ltd., 12, Gilbert Road, Swanage, Dorset.

---

**Varley** TRADE MARK

★ 40 YEARS RELIABLE SERVICE TO THE INDUSTRY ★

## POWER CHOKES
## TRANSFORMERS
## WIRE WOUND RESISTANCES
## DELAY SWITCHES

MADE BY

**OLIVER PELL CONTROL LTD**

CAMBRIDGE ROW · WOOLWICH · S.E.18

TELEPHONE: WOOLWICH · 1422

---

COMPLETE

# CONTROL

The specially processed Fibrax material gives maximum frictional control of revolutions under all conditions. Fitted as brake liners its retarding effect is sure and definite. Used in clutches it is recognised as the best method for conveying power in a smooth, constant and economical way. Fibrax is made from the finest asbestos, reinforced with zinc or brass wire (or non-metallic), and supplied as follows:

**FIBRAX FLEXIBLE** supplied in rolls in all widths with selvedges.

**FIBRAX DIE PRESSED BRAKE LINERS,** processed to withstand heaviest braking and great frictional heat. Supplied in any radius, length, width and thickness.

**FIBRAX TM2 LINERS,** for the lighter type of brakes used on conveyor plants, etc.

**FIBRAX CLUTCH RINGS,** in all types and sizes.

**Fibrax** REG. TRADE MARK — *Brake and clutch linings*

*They always Grip!*

FIBRAX LTD., 2, TUDOR STREET, LONDON, E.C.4

---

# SMALL TOOLS

DRILLS, REAMERS, LATHE TOOLS, MICROMETERS, ETC.

## EVERYTHING for the ENGINEER-MECHANIC

BENCH MILLERS, LATHES, BENCH DRILLS, ELECTRIC MOTORS A.C. and D.C. (*Send 4½d. for Lists*)

**SPECIAL LINE:** 6-way Leather Punches 7s. 0d. each. Plus 1s. 0d. postage and packing.

**NUTTALL'S (LATHES) LIMITED,**
**MANSFIELD, NOTTS.**

---

**BOOKS**

| | | |
|---|---|---|
| A.B.C. OF L.M.S., L.N.E.R. ... | each | 2/- |
| A.B.C. OF G.W.R., S.R. ... ... | each | 1/6 |
| G.W.R., L.N.E. TITANS ... ... | each | 1/6 |

Postage 2½d. each extra.

OUR RAILWAY HISTORY, complete NEW EDITION, with Map ... ... 15/-
Postage 3d. extra.

| TRACK PARTS M.E.T.A.: | Gauge 0 | Gauge 00 |
|---|---|---|
| Steel Rail (3ft. lengths) | doz. 3/6 | — |
| Brass Rail (3ft. lengths) | doz. 6/6 | 4/- |
| Nickel Silver (3ft. lengths.) | doz. — | 6/- |
| Wood Sleepers ... ... | per 100 3/- | 1/6 |
| Diecast Chairs ... ... | per 100 3/- | — |
| 3rd Rail Chairs ... ... | per 100 3/6 | gross 9/- |

PARTS LIST '0' or '00' 3d. each.
Postage extra.

**TYLDESLEY & HOLBROOK (M.E.T.A.)**
109, Deansgate, Manchester 3.

---

You'll be glad you kept on saving when you can again buy an

# ADANA

*Adana Printing Machines*

—TWICKENHAM, MIDDLESEX—

---

**ELECTRIC MOTOR.** 4½ volt. Complete kit of parts, including Permanent Magnet. Laminated Tripolar Armature, wound and connected. Ready for immediate assembly. Send P.O. value 8s. 6d. to Kimber, 8, Harwood Avenue, Bromley, Kent.

---

Easily made From Our Castings.

**J. HALLAM & SON,**
Upton, Poole, Dorset.

**MINIATURE PETROL ENGINES for Aeroplanes and Speed Boats.**
*Send 3d. for particulars*

---

## MIDLAND INSTRUMENT CO.

Comprehensive range of Lewcos instrument wires, eureka and nickel chrome res. wires. Flexes and cables, electrical accessories, sleeving, Empire tape, rubber grommets, L.T. rectifiers. Avometers, Wee-Meggers, Ohmmeters, speakers, chassis, dual-range and s.w. coils, var. conds., counters, synchronous motors, microphones, plugs and jacks, etc., etc. Lists, 1d. s.a.e. Trade lists 1d. s.a.e.

18, Harborne Park Road, Birmingham, 17
Tel. HAR-1208 or 2664.

---

*Fit an* **OILCOIL**

For increased power, improved petrol consumption, better starting. *Send for interesting booklet Z17.*

RUNBAKEN, MANCHESTER, 4.

---

## SPARKS' DATA SHEETS

Provide full constructional details, theoretical diagram, component list, and full-size black and white prints of Tested and Guaranteed Designs.

**AT LAST**

I announce the release of my

**A.C./D.C. MIDGET RECEIVER.** No. L/UM. The Set you have been waiting for. Three valves plus rect. M/L waves. Self-contained aerial and Speaker. Fine results. All parts obtainable... ... ... ... ... 2/6

**THREE-VALVE S.W. RECEIVER** (Batt.). H.F. Stage. Band-spread. The set for DX. logging. Plug-in coils ... ... ... ... ... ... 2/6

**MIDGET 1-VALVE PORTABLE.** All-dry batt. M/L waves. 9v. H.T.... 2/6

**MIDGET 3-VALVE PORTABLE.** All-dry batt. Med. wave. Self-contained aerial and speaker. 8 x 6 x 3½ 2/6

**MIDGET TWO-VALVER.** All-dry batt. Med. wave. 9v. H.T. 5½ x 5½ x 3½ ... ... 2/6

**THREE-VALVE T.R.F. SET.** Batt. M/L waves: (No. L.O./4) A fine set 2/6

**A.C. THREE-VALVER** (No. L.O./9). M/L waves. 3½ watts output. Quality 2/6

**FOUR-VALVE T.R.F. SET** (No. LO./8). M/L waves. P.P. output. Power and quality. Batt. operation. P.U. 2/6

**A.C. 8 WATT AMPLIFIER.** Neg. feed-back. P.P. output. Power with quality ... ... ... ... ... 2/6

**A.C./D.C. PORTABLE AMPLIFIER.** 6 to 8 watts output ... ... ... 3/6

**A.C. QUALITY RADIOGRAM.** Designed for quality rather than range. Med. waves. 8 watts. P.P. output 3/6

**RADIO UNIT.** Two valves for use with A.C. or A.C./D.C. amplifiers ... 2/6

**A.C. QUALITY 2-VALVER.** Med. waves. A most popular set ... 2/6

**3½ WATT A.C. AMPLIFIER** ... 2/6

**TWO-VALVE AMPLIFIER** (Batt.). Pentode output. Fine vol. ... ... 2/6

**THREE-VALVE** ditto with push-pull output. Ideal for P.U. ... ... 2/6

**SUPER S.W. TWO-VALVER** (Batt.). A popular well tested Bx. ... ... 2/6

**COMPACT STRAIGHT 3 SET** (Batt.). Med. waves. Good vol. ... ... 2/-

**HIGH GAIN CRYSTAL SET.** Med. waves. Selective ... ... ... 1/6

**ELECTRIC GUITAR UNITS** ... 5/-
Other Data Sheets. Elec. One-String Fiddle; A.C. Charger; D.C. Charger; Ohms Law; Auto. G.B. Circuits; Colour Code; Shocking Coil, etc.

*Please send stamp with order and for List.*

**L. ORMOND SPARKS (M),**
9, Phoebeth Road, Brockley, S.E.4
(Ladywell S.R. Station) (Lee Green 0220)

---


**HE used the wrong material. YOU need not!**

We can supply the right material for your specific needs.

**GUNMETAL. STEEL. BRONZE. DURALUMIN. FIBRE. EBONITE, ETC.**

*Send for complete List "P.M."; 2d. post free.*

**RETAIL MATERIAL SUPPLIES**

377, Milkwood Rd., HERNE HILL, LONDON, S.E.24. (*Close to Station*)

---

## GIVE THOSE YOU LOVE

**A Radio You Have Made Yourself.**

The "JB VICTORY FOUR" is:

(a) Child's play to build.
(b) Suitable for work off A.C. or D.C. mains and bang up to date.
(c) Portable, it needs no aerial or earth.
(d) Ideally suitable for Bedroom, Nursery, Workshop, etc.
(e) Guaranteed 6 months and subject during this time to free service.

Complete kit of parts, including valves and all items, even nuts, bolts, wire, etc., with full detailed layouts and wiring instructions. £7/17/6. Diagrams, etc., only, 5/-; refunded if complete kit bought later.

**V.E.S., Radio House, Ruislip.**

Published about the 30th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printed in England by the Newnes and Pearson Printing Co., Ltd., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand—Gordon & Gotch, Ltd. Sole Agents for South Africa—Central News Agency, Ltd., Subscription Rates (including postage): Inland, 10s. 6d. per annum. Abroad, 10s. per annum. Canada, 10s. per annum. Registered at the G.P.O. for transmission by Canadian Magazine Post.