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PRACTICAL MECHANICS

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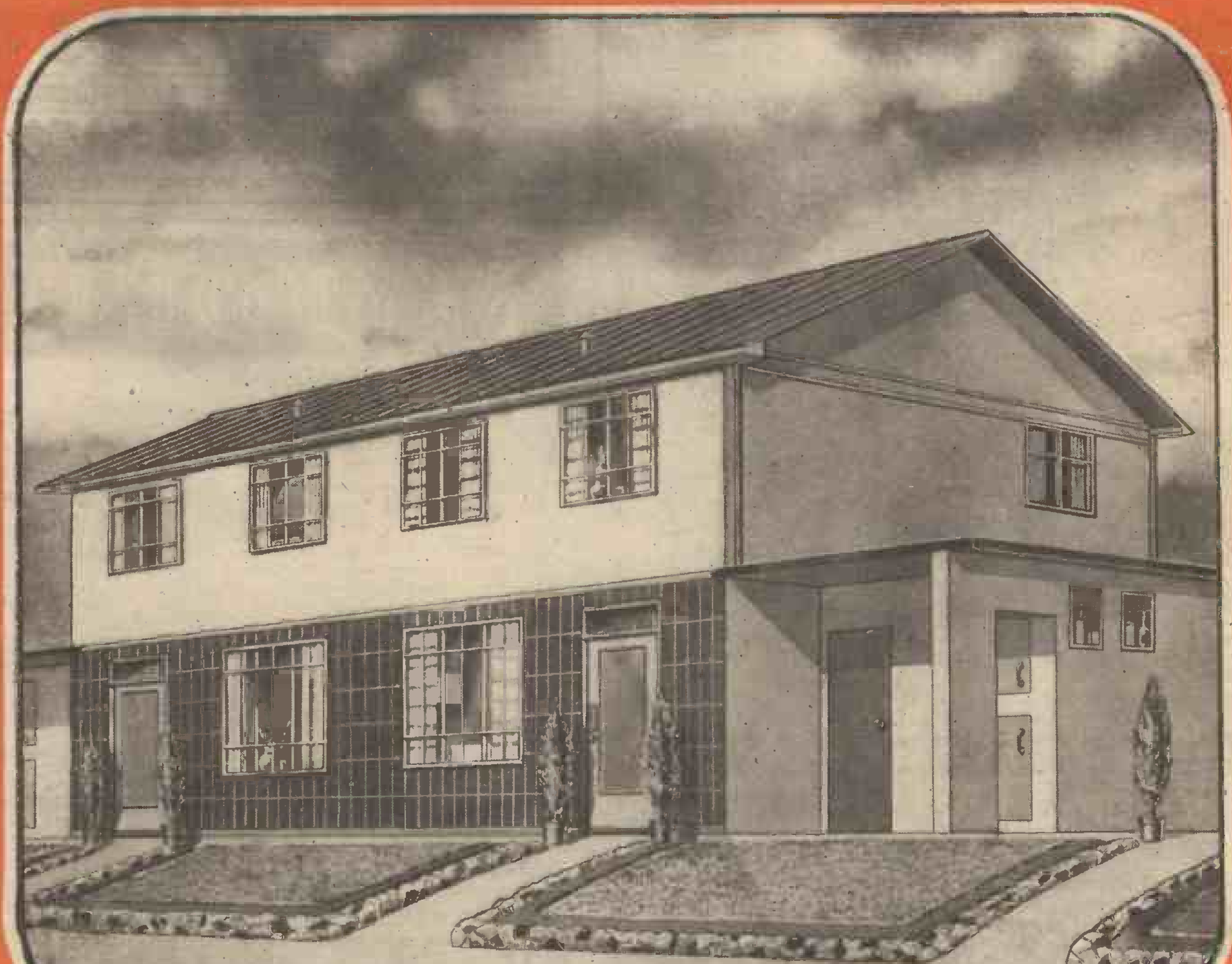
MAY 1944



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Editor: F. J. CAMM

VOL. XI. MAY, 1944 No. 128

FAIR COMMENT——BY THE EDITOR

English or Metric?

ONE of the major problems which will confront this country after the war is the re-establishment of our overseas trade. We shall need to import large quantities of raw materials, and these must be paid for by increased exports. Already conversations are taking place on the question of formulating a basic English for all English-speaking countries, and the time has come when we must consider some universally accepted standard of weights and measures. Such a standard already exists in the decimal system, which has been adopted by the whole of Continental Europe, all South America, and important parts of the Middle East, including Turkey and Greece.

Additionally, Russia and Japan have adopted it, and thus removed one of the greatest arguments formerly advanced against the adoption of the metric system in this country. As long ago as 1917 the Dominions Royal Commission reported that there was a considerable body of opinion in favour of the change to the metric system.

The extraordinary thing is that scientists in all countries have adopted the metric system as the basis of their work. The present chaos of Imperial weights and measures causes waste of time, confusion of thought, multiplies the possibilities of error, and is costly to manipulate. There are strong educational reasons for the adoption of the metric system. If the matter were left to the schoolboys of this country its adoption would be immediate.

Whereas the metric system uses multiples and sub-multiples of ten as its base, both for coinage and for measures of weights, length, area, and capacity, in this country there is no such uniformity. Twelve inches to a foot, three feet to a yard, five and a half yards to a rod, a pole, or perch (no one seems to have decided!). A *hundred*-weight is 112lb.; then we have the ridiculous confusion in our measures of capacity. A barrel of wine is not the same as a barrel of beer. Instead of our units proclaiming by their very names what they are (for example, a millimetre is a thousandth of a metre, a decigram is a tenth of a gram, and so on), we use firkins, and runlets, and pottles, inches, feet, yards, gills, gallons, etc.

Now whilst we are all aware of the defects of our stupid system of weights and measures which have arisen out of local custom, and was finally standardised in our Weights and Measures Act to eliminate the varieties of local standards adopted throughout the country, there are reasons why it is not possible immediately to switch over to the metric system. It would be costly to start with, and there would be some confusion in industry.

In the aircraft and automobile trades a considerable number of the dimensions are expressed in millimetres, and within a few years those industries will undoubtedly have completely changed over. Whilst, however, even in those industries, English and metric systems are still employed, technicians are compelled to convert English to metric, and vice versa, and to compile conversion tables. It may come as a surprise to many to know that there exists in this country a Decimal Association, which is urging the Government to rearrange the British coinage on the decimal system, and to accelerate the transition from our National system to the International metric system of weights and measures, and thereby to eliminate the waste of time and money now unavoidably incurred in conversion from and to the metric system in an ever-increasing number of transactions. There have been demands for the decimalisation of our coinage from such important bodies as the Association of British Chambers of Commerce, and the Federation of the Chambers of Commerce.

Long-term Policy

The metric system was legalised in this country in 1897, so for 47 years we have dallied with the problem. We could now on a long-term policy gradually effect a changeover and declare that after a given date (say five years hence) buying and selling in other than the metric system would be illegal. Manufacturers establishing new industries or new standards in old industries would thus be encouraged to base their new designs on the metric system at the outset. We could in any case delete redundant British standards such as the apothecaries' weight, for which there is no justification. Troy weights are similarly unnecessary. In the avoirdupois weights we could abolish the stone, quarter, hundredweight and ton, and express them in pounds only. We could abolish the fathom, pole, chain and furlong, expressing their length in yards only. We have no need of the gill and the bushel. Our gallon and the American gallon differ from one another by about 20 per cent. These preliminary moves would pave the way for the gradual adoption of the metric system, and we see no reason why such changes should not be immediately instituted so that within a few years there will be only one system of weights and measures in use throughout the world.

Of course, the metric system itself has been subject to change. The myriametre, the dekametre, the hekometre, and the decimetre have disappeared, the length measures being thus reduced to only four items.

When the Swiss changed over from the English to the metric system they made the transition easier by adopting certain standard equivalents; thus the foot was made equal to 30 centimetres, while the quart was reduced nearly 10 per cent. in order to make it exactly equal to one litre. The pound was raised to half a kilogram. None of these changes approached in magnitude that which was effected in 1824, when our old Winchester gallons was increased by 20 per cent. to make it contain 10 pounds of water, and the troy pound was replaced by the avoirdupois pounds, which is fully 20 per cent. heavier. These changes were effected in this country without the confusion which people apprehend would follow a changeover to metric. International financial transactions would undoubtedly benefit, and there can be no doubt that banks would welcome the change.

Heat Measurement

In heat measurement the kilogram calorie is a convenient unit, being approximately equal to four British thermal units, so that a coal which we would describe as giving 13,000 British thermal units per pound would be described metrically as giving 7,500 calories per kg.

The Whitworth screw question is easily answered, as the metric engineers continue using Whitworth, and care no more about its inch origin than we care about the metric basis of a B.A. thread.

As to the teaching of metric measures to a pupil who will never meet it again in his life, there is no question about its futility, but the same might be said of our whole teaching of decimals. A week's use of decimal coinage gives more decimal teaching than five years' worry over them at school.

The questions concerning twelve *versus* ten and their divisibility were highly reminiscent of the "last ditchers" of 40 years ago, when the opponents of metric reform worshipped at the shrine of "twelve" and held tenfold divisions as accursed. To-day they love an inch even when divided into thousandths, hoping that their old measures decked out in decimal feathers may still survive.

Instruments for Motor-cars and Aircraft

Their Uses and Methods of Operation.

By JEREMY MARTIN

AN instrument might be defined as the means whereby a definite end is achieved. To the musician the word will imply the means of producing sound—to the surgeon the means of performing an operation—to the meteorologist, gauges will provide means of calculating the weather. In cars and aircraft the word is meant to imply certain recording instruments which will serve to indicate the position ruling at the time, or at any given time, showing a movement, that is, a measurement of motion, or recording a quantity or capacity.

Such instruments are installed in the car or 'plane to give the maximum amount of information to the driver or pilot in an endeavour to assist him in the arduous work of driving or flying. Without such instruments everything would be an unknown quantity, and control of the machine hazardous. With them everything can be investigated, for such instruments show at a glance all the required information. Therefore, possessed of the knowledge with regard to what should be indicated at normal conditions, it is possible to see at a glance whether there is anything wrong. Thus it is an assurance against mishap.

Aircraft and car instruments are often comprised of two parts working together—the transmitter and the indicator. The former part takes the movement, and relays it to the latter. Thus we shall use the term "instrument" to embrace all forms of gauges, etc., used in aircraft and automobile.

It will be noted that instruments are either direct type or transmitting type, and the difference will quickly be seen as outlined.

Various types of instrument are available, in many cases several different types give the same result, and it is proposed to deal here with the available instruments of common usage, under three distinct headings, as follows:

1. Physical Instruments.
2. Mechanical Instruments.
3. Electrical Instruments.

It will be found that instruments incorporating the principles of one or more of these types are used for different purposes.

Automobile Instruments

The modern car is fitted with the following instruments which are used for the purposes given.

Speedometer.—This instrument is used to indicate the speed at which the car is travelling. It is used to assess the time which may be taken over a given journey, the amount of time available when part of the journey has been completed and as a restriction on the speed of the car within certain areas.

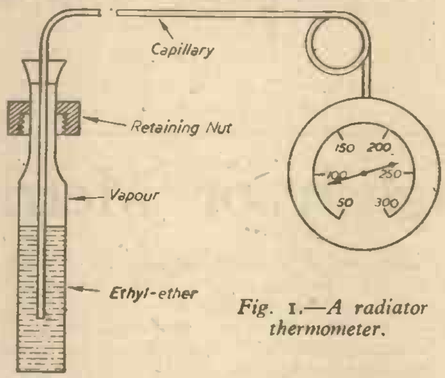
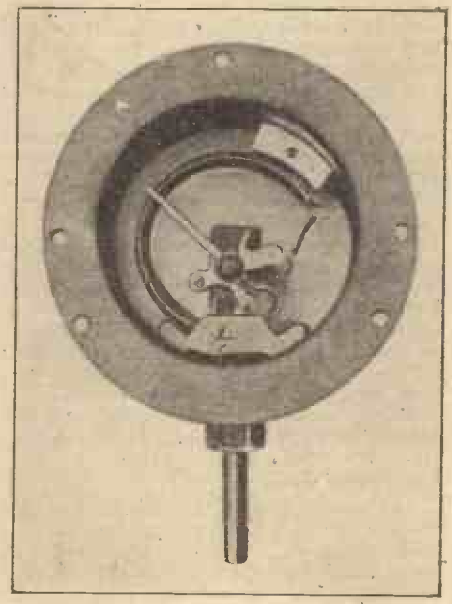


Fig. 1.—A radiator thermometer.

Oil Pressure Gauge.—This indicates the pressure at which the oil is being fed from the sump, through a pump to the engine. This pressure should change with temperature, and the scale is calibrated to show the pressure at given temperatures. It is installed primarily as a means of showing the driver that certain functions are taking place within the engine, and should these functions fail to operate it provides a danger signal to the observant driver, which, if taken heed of, will prevent any serious damage to the engine bearings.



Bourdon tube and link mechanism.

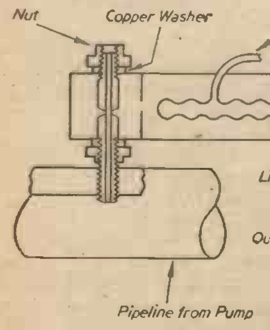


Fig. 2.—Banjo union to a transmitting type pressure gauge.

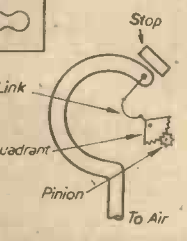


Fig. 3.—Bourdon tube as used on pressure gauges.

Radiator Temperature Thermometer.—This indicates the temperature of the water held in the car radiator, and in the jacket around the engine. Such water is provided for cooling, as a means of keeping the engine to a certain temperature. Should this temperature be exceeded it will show that the engine is running too hot, and further rise in temperature may result with damage to bearings. White metal bearings, for instance, will melt. The gauge will show the conditions ruling at the time. Should the gauge read a temperature above the normal or above the danger line this can be clearly seen, and an investigation is made in an endeavour to find the cause. (Fig. 1.)

Mileage Indicator.—This is generally incorporated in the speedometer, and indicates the length of the journey taken, at the same time adding up the number of miles the car has made since the indicator was installed or set at zero.

By combining the journey reading with the fuel consumption, it is possible to ascertain the miles per gallon performance of the engine.

Engine Speed Indicator.—This records the speed of the engine at various points of acceleration. Certain gear ratios will give certain speeds, and in order to prolong the life of the car it is required to observe the set speed or number of revolutions. For each gear this is different, and the indicator shows the speed of the engine as the throttle is opened.

Fuel Contents Gauge.—This shows the amount of fuel in the tank or tanks, giving notice of the impending necessity for replenishing the fuel used.

Ammeter.—This indicates the rate of charge of the accumulator in amperes, during the day or at fast speeds, or the rate of discharge when certain loads are put on the battery (starter motor, lights, etc.). It is already known that the car at normal running during the day should charge the battery at a certain amperage. Should this figure drop it is obvious that the battery is not charging sufficiently, and the cause can be remedied.

Directional Compass.—A comparatively new addition to the car instrument panel. This is a small compass fitted in an endeavour to give an indication of the direction in which the car is travelling.

Aircraft Instruments

Hydraulic Pressure Gauges.—Used to indicate the pressure of the hydraulic fluid in the braking system. Each brake is shown separately as having a certain pressure behind it. The pressure at the source is indicated.

Fuel Pressure Gauge.—A feed pump is generally fitted to aircraft engines, this feeds

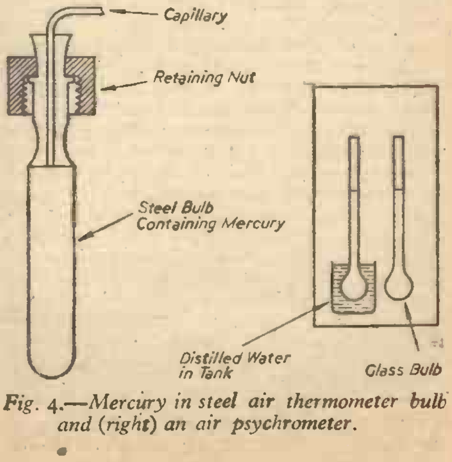


Fig. 4.—Mercury in steel air thermometer bulb and (right) an air psychrometer.

the fuel to the cylinder. For a definite result a certain pressure is required, and this instrument will indicate the pressure exerted upon the fuel.

Oil Pressure Gauge.—Used for the same purpose as that fitted to the car engine.

Thermometers :

Air-temperature Thermometer.—Fitted to the outside of the aircraft to ascertain the temperature of the air.

Air Psychrometer.—This is used for meteorological purposes, and is fitted to the outside of the aircraft.

Oil Thermometer.—This is fitted to ascertain the temperature of the oil in the engine, as an added precaution to ensure that the engine does not become overheated (Fig. 5).

Oil Volume Gauge.—Installed to determine the quantity of oil in the system.

Radiator Thermometer. — As with the automobile, this gives indication of the temperature of the water in the radiator.

Engine Speed Indicators.—These instruments give the speed of the engines at certain conditions.

Fuel Contents Gauge.—As with the motor-car, this gauge indicates the contents of the tanks, giving the pilot some slight indication of the remaining length of time during which he may stay in the air.

Position Indicators.—Used to indicate the position of the various working parts of the airframe. *Flap Indicators* show the position of the flaps, which control the lift of the aircraft and act as a brake. *Undercarriage Indicators* show the position of the wheels or retractable undercarriage. This is essen-

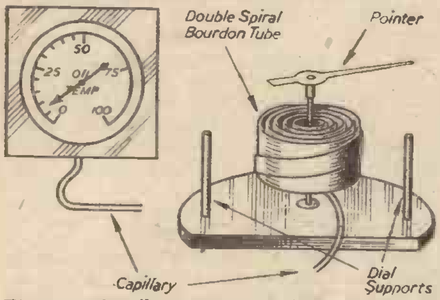


Fig. 5.—An oil temperature thermometer, and details of the double spiral tube mechanism.

tial information ensuring that the pilot actuates the controls, when necessary, for folding up the wheels when airborne, to avoid drag, and setting down the undercarriage when about to land. Failure to comply with the latter would incur especially serious results, and non-compliance with the former effects the performance of the aircraft.

Port/Starboard Level.—This shows whether the aircraft is flying on a purely level plane or whether either wing is lower than the other.

Airspeed Indicators.—These instruments give the speed of the aircraft relative to air.

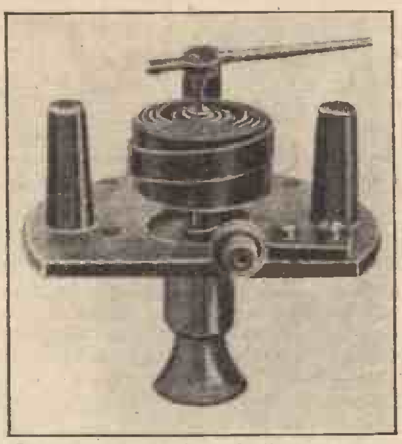
Altimeters.—Show the height of the aircraft, either relative to the sea level or to the height of the parent airfield.

Rate of Climb Indicators.—Give indication of the rate at which the aircraft is climbing or diving. Necessary in civil aircraft when, flying in bad weather, it is found necessary to rise quickly to avoid any obstacle at low altitudes. Worked in conjunction with the airspeed, it is possible to compute the desired climb in feet per second.

Turn and Bank Indicators.—Give the amount, in degrees, of turning and banking.

Boost Gauges.—With the introduction of supercharged engines into modern aircraft it is necessary to install an indicator showing the amount of "boost" developed in this supercharging. The pressure of the fuel mixture in the induction system is given on a calibrated scale.

Direction Indicator.—This is to all intents and purposes a compass, giving indication of the direction in which the aircraft is flying.



Operating mechanism of oil temperature thermometer.

Compasses.—Used to indicate the position of the aircraft in flight. Also for the setting of a predetermined course.

Oxygen Equipment. — Very necessary where, at high altitudes, the pressure of the atmosphere drops and the oxygen content is lower than that required by the human body.

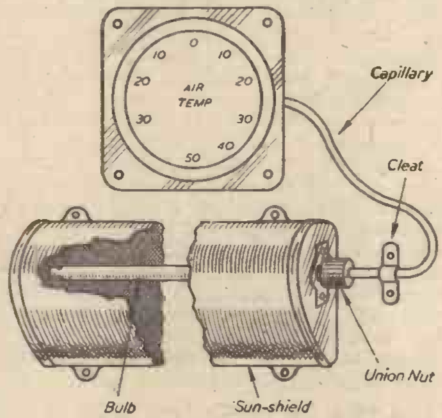


Fig. 6.—An air temperature thermometer.

PHYSICAL INSTRUMENTS

Direct-type Pressure Gauges

These instruments consist of a bourdon tube, which is directly connected to the source of supply, whether it be hydraulic fluid, compressed air or any medium. The pressure exerted upon the medium is transmitted through this bourdon tube, which is either in the form of a double spiral or what is known as the "C" type. The pressure within the tube tends to distort that tube, and in so doing a movement is recorded which is proportional to the amount of pressure exerted upon it. The end of the bourdon tube is connected to a quadrant and pinion. To the latter a pointer is attached which, with the movement, travels over a calibrated scale.

This type of instrument is used for brake pressure gauges.

Transmitting Type Pressure Gauges

Used for measuring the pressure of fuel or oil. The oil enters a chamber in which is suspended a small hollow (filled) container to which is attached a capillary tube. The capillary is fixed to a bourdon tube in the instrument. The varying pressure of the liquid in the chamber causes a similar amount of pressure to be exerted upon the outside of the container. This pressure causes a movement of the liquid in the capillary, and such movement is transmitted to the bourdon tube. By mechanism similar to that used in the direct type pressure gauge the indicator pointer is caused to move. (Figs. 2 and 3.)

The capillary is a drawn copper tube with an extremely fine bore, approximately .006in. The outside diameter varies with the use to which the tube is to be put. The filling in the tube will vary, but whether for oil or fuel measurement, this is alcohol. The capsule is made from any springy elastic metals, such as nickel-silver or steel. This is also filled.

Thermometers

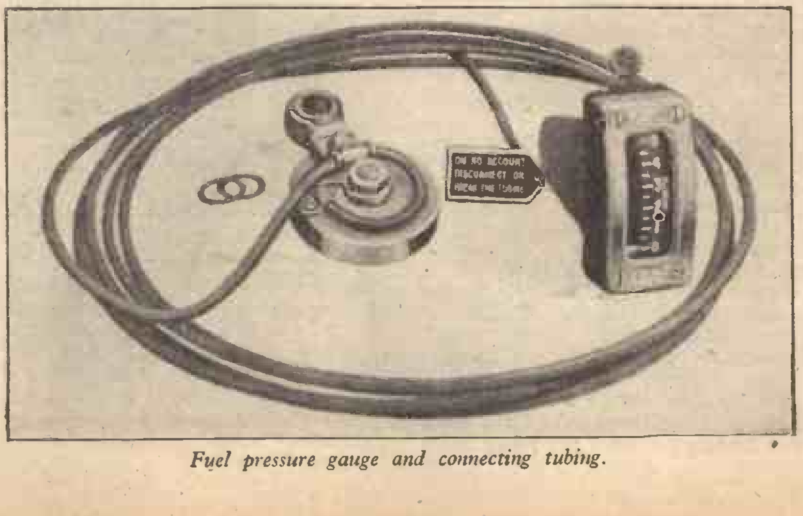
Various types of thermometers are produced, as outlined, each having a different use, the principle being the same in each case.

Thermometers for use in indicating the temperature of the air are normally of the alcohol in glass type. A thin glass tube or capillary is made with a bulb at one end into which is forced the fluid. The temperature is then raised, this expands the fluid, such expansion being proportionate to the increase in temperature. This forcing of the fluid up the capillary expels the air, the glass bulb and tube assuming the temperature of the surrounding air, and in consequence the change in temperature will give the change in indication. (Fig. 6.)

Another glass thermometer is called the Air Psychrometer and is used for measuring the humidity of the air. This is comprised of two ordinary alcohol in glass thermometers, the one dry and the other with the bulb steeped in a container filled with distilled water. The humidity of the air is measured by the difference between the readings of both thermometers.

A further type of air thermometer is the mercury in steel type. In this type both the bulb and the capillary are made from steel. The steel bulb is held in a housing or cover and through a slot in the cover the air surrounding the aircraft is directed on to the bulb. The capillary is led off to a double spiral bourdon-tube type instrument. (Fig. 4.)

(To be continued).



Fuel pressure gauge and connecting tubing.

Principles and Design of Transformers

Voltage Calculations and Working Conditions

By J. L. WATTS

TRANSFORMERS are now used for hundreds of purposes, from the tiny ones used in radio sets, for electric bells, and models, to the huge ones used on the "Grid" system which may operate at 132,000 volts on the high tension side. Transformers giving an output at 1,000,000 volts or so have also been constructed for special purposes, such as X-ray plants, and testing apparatus.

In order to understand fully the various features of the design and operation of transformers we can consider first what happens when a coil of wire, having no iron core, is connected to a D.C. supply of constant voltage. As soon as the supply is switched on a current starts to flow through the coil, this rising from the zero value to a certain maximum steady current, the value of which is controlled solely by the supply voltage, and the resistance of the coil circuit in accordance with Ohm's Law, which states

$$\text{Current (Amps.)} = \frac{\text{Voltage}}{\text{Resistance (Ohms.)}}$$

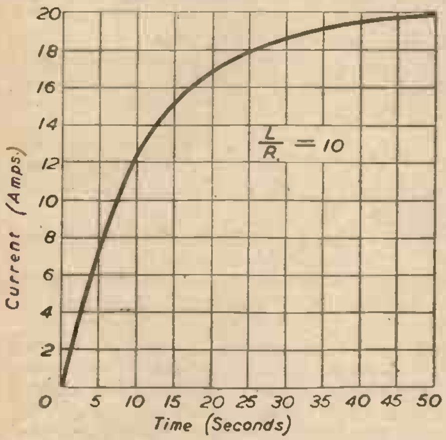


Fig. 1.—Growth of current in an electro-magnet coil.

Induced Voltage in D.C. Circuit

It should be noted that, as the current increases through the coil, a magnetic field of increasing strength is created in and around the coil, the strength of this field being proportional to the amp. turns, that is the product of the number of turns in the coil and the current flowing through. When any conductor is linked with a changing magnetic field a voltage is induced in that conductor. This is termed the induced voltage, and is proportional to the product of the number of turns in the conductor, which are linked with the flux, and the rate at which the flux is changing. In the case of an electromagnetic coil the self-induced voltage is in such a direction as to oppose the change of current which is responsible for the changing flux. The coefficient of self-induction L is used in such calculations and is measured in Henries. L has the same numerical value as the voltage induced in the conductor when its current changes at the rate of 1 amp. per second.

When a constant voltage is applied to a coil, therefore, the self-induced voltage tends to oppose the rising current and hence delay it so that it does not immediately reach the steady maximum value. Fig. 1 indicates the growth of current in a coil in which the coefficient of self-inductance is 10 times the resistance. The actual current (C) at any instant t seconds after applying a steady voltage E, can be found from the formula $C = \frac{E}{R}\left[1 - e^{-\frac{Rt}{L}}\right]$, where R is the resistance in ohms, L the coefficient of self-inductance in Henries, and e is the base of Naperian logarithms. The maximum steady current reached, that is when t is very large, is equal to $\frac{E}{R}$ as stated by Ohm's Law.

When the current is switched off the falling magnetic flux induces a reverse voltage in the coil which tends to maintain the current flow. This may cause the voltage across the coil to momentarily reach a value much higher than the mains voltage, and cause sparking at the contacts where the circuit is broken. The effect of adding an iron core to the coil is to increase the magnetic field obtained with a given current; hence the self-inductance is increased, the current takes longer to reach maximum value when switched on, and a higher voltage is induced when the circuit is broken. In fact, if an iron core is slid into a coil, which is carrying a steady current from a D.C. supply, the increasing magnetic flux induces a voltage which causes the current to fall momentarily, the current afterwards rising to its previous value.

Effect on a Secondary Coil

If a second and entirely separate coil is wound over the first, or indeed placed anywhere in the vicinity so that it embraces all or part of the magnetic flux produced by the first coil, any change in the magnetic flux will induce a voltage in the second coil also. The voltage induced in the second coil will be proportional to the number of turns in the coil, and to the rate of change of the magnetic flux which embraces this coil. When the current in the first or primary coil reaches its steady value the magnetic flux remains unchanged, so that no voltage is then induced in the second or secondary coil. This is why it is not possible to use a transformer for D.C. to D.C. conversion. It is possible to induce a continuously varying voltage and current in the secondary by continuously varying the primary coil current by means of a contact breaker, as in an

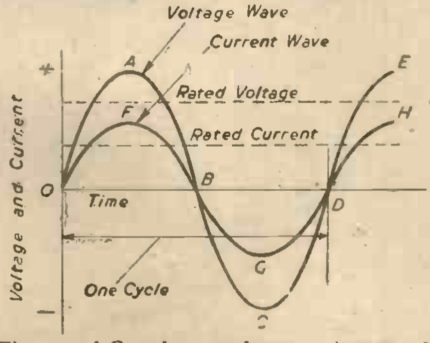


Fig. 2.—A.C. voltage and current in a purely resistance circuit.

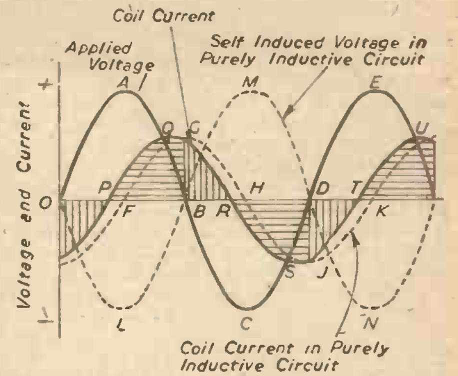


Fig. 3.—A.C. voltage and current in an electro-magnet.

induction coil, but the secondary voltage may vary considerably with variation in the rate of operation of the contact breaker. If the breaker operates comparatively slowly the rate of change of primary current and magnetic flux may be reduced, whilst if the contact breaker is too quick it may interrupt the primary circuit before the current has risen appreciably. It is interesting to note that the secondary voltage of the induction coil is alternating, since it is in one direction when the primary current and flux are increasing, and in the opposite direction when the primary current and flux are falling. In a telephone transformer, for example, the primary D.C. current is varied by the microphone, and the secondary sends alternating current along the line, although the frequency and strength of the A.C. are not constant.

Alternating Current Supply

In the case of an alternator or A.C. mains to supply from an alternator or A.C. mains to the primary coil the input voltage is closely controlled, as indicated in Fig. 2. Starting from the point O the voltage rises to a maximum at A, then falls to zero, reverses and rises to a maximum at C in the opposite direction, then falls to zero again; this constitutes one cycle and is repeated 50 times per second on the standard 50 cycle supply. It should be noted that on a supply which is rated at 230 volts the maximum or peak voltage reached at points such as A and C will be about 325 volts, 230 volts being the effective voltage or equivalent D.C. voltage. If such a supply is connected to a conductor having no inductance the current at any instant can be found by Ohm's Law and is equal to $\frac{\text{voltage}}{\text{resistance}}$. Maximum current therefore flows at the instants the voltage is at maximum, and zero current flows at points such as O, B, and D, where the voltage is zero. The cycle of current will be of the form indicated in Fig. 2 and the current is said to be in phase with the voltage, in other words the power factor of the circuit is unity. If the conductor has no inductance there must be no magnetic field created when the current flows through, and this is practically impossible to arrange. The nearest approach to such an arrangement is to have two conductors side by side, each carrying the same value of current but in opposite directions, so the magnetic field of one conductor is more or less neutralised by that of the other. That is why it is important to have the outgoing and return cables on an A.C. circuit contained in the same conduit. Similar conditions could be obtained by winding the parallel conductors side by side in a coil.

A.C. Electromagnets

We can now consider the case of a coil of no resistance but high inductance, which is fed from the A.C. supply. At two instants in each cycle (G and J in Fig. 3) the current is neither increasing nor decreasing and is, therefore, constant. At such instants the magnetic field can be considered to be constant, and there will be no voltage induced in the coil. The current and magnetic flux actually change at the maximum rate when the current is zero at the points F, H, and K, and at such times the induced voltage will be a maximum. If the dotted curve FGHJK represents the current wave, the induced voltage can be represented by the dotted curve OLBMDN, bearing in mind that the induced voltage is in such a direction as to oppose the change of current.

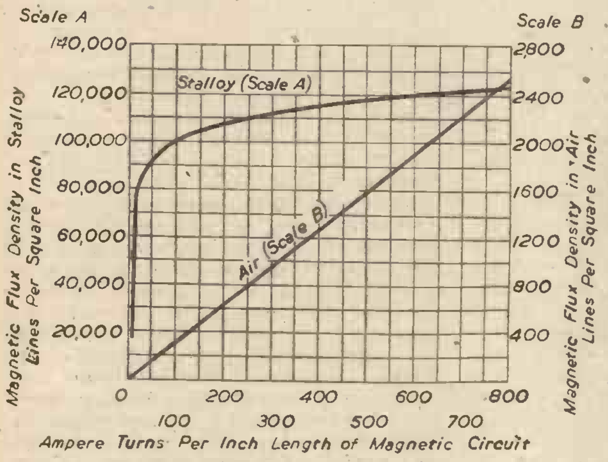


Fig. 4.—Magnetisation curve.

The applied voltage opposes the induced voltage and can be shown by the curve OABCDE. In a purely inductive circuit the current would thus lag by a quarter of a cycle behind the applied voltage wave, and the power factor would be zero. The electromagnet coil has the property of storing current during parts of the cycle and restoring it to the supply during other parts of the cycle.

In practice, of course, all conductors have some resistance, and the nearest approach to a purely inductive circuit is a coil of low resistance arranged to create a magnetic field which passes more or less completely through iron, such as the primary winding of a transformer. Even so, the effect of the coil resistance is very small compared with the inductance, and the current will lag considerably behind the applied voltage, as indicated by the curve PQRSTU. During the portion of the cycle from O to P the current is negative whilst the applied voltage is positive, and the area shaded with vertical lines represents current which the coil is feeding back to the supply. During the portion of the cycle from P to B the voltage and current are both positive, and the coil is taking current from the supply. The power consumption meter merely registers the portion of the current which is in phase with the voltage, which is equal to the excess of the horizontally shaded area over the vertically shaded area. This explains why a well-designed transformer takes very little power when there is no secondary load. The actual current taken by an A.C. circuit is equal to

$$\frac{\text{Applied volts}}{\sqrt{(R)^2 + (6.284 \times \text{Frequency} \times L)^2}}.$$

This is the primary magnetising current with no secondary load.

We now come to the important formula connecting the induced voltage with the magnetic flux and number of turns in the coil. Assuming the applied voltage follows a sine wave, as indicated in Figs. 2 and 3, the induced voltage V is equal to:

$$\frac{4.44 \times \text{Frequency} \times \text{No. of turns} \times \text{Total flux linked with the coil.}}{100,000,000}$$

The induced voltage per turn is thus equal to

$$\frac{4.44 \times \text{Frequency} \times \text{Flux}}{100,000,000}$$

this applying also to any secondary winding.

A.C. Choke Coil, or Magnet Coil

If we have a core of Stalloy 50in. long, free from air gaps, and wound with 500 turns carrying 10 amps., there will be 100 amp. turns per inch. Fig. 4 shows the magnetic flux density will be about 100,000 lines per sq. in. of cross sectional area of the core. If the area is 10 sq. in., the total flux will be 1,000,000 lines. From the formula we can calculate the induced voltage when 10 amps. A.C. at 50 cycles flows. Induced volts =

$$\frac{4.44 \times 50 \times 500 \times 1,000,000}{100,000,000}$$

and works out at 1,110 volts. If we neglect the resistance of the coil we can say that 10 amps. will flow if the coil is fed at 1,110 volts.

If we now remove the Stalloy so that the coil has an air core, we see from Fig. 4 that 100 amp. turns per inch will only create a magnetic flux density of 320 lines per sq. in. With 10 amps. at 50 cycles flowing through the coil the induced voltage will only be

$$\frac{4.44 \times 50 \times 500 \times 3,200,}{100,000.000}$$

that is 3.55 volts. Neglecting the coil resistance, we can say that 10 amps. would now flow when the coil was fed at 3.55 volts 50 cycles. If connected to a higher voltage a heavier current would flow, and this would increase the flux density and induced voltage. This is the principle of the choke coil with sliding core used to control the value of current flowing in certain A.C. circuits, and explains why it is necessary to have a sound magnetic circuit in a transformer to reduce the primary magnetising current. Owing to the bend in the magnetisation curve of the Stalloy it is most economical to work at a fairly low magnetic flux density, say, 65,000 lines per sq. in. for a small single-phase transformer and up to about 90,000 lines per square inch in a large transformer having oil cooling.

A voltage is also induced in any other conductor which is linked with the changing flux, such as the Stalloy core or any clamping devices. Such induced voltages are undesirable since they cause eddy currents to flow in these conductors, and heating; the efficiency of the transformer is also reduced. For this reason the core is built up of laminations which are lightly insulated from each other.

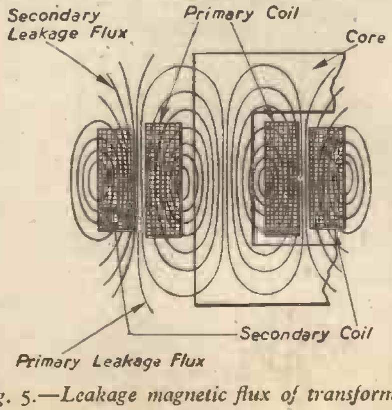


Fig. 5.—Leakage magnetic flux of transformer.

Size of Transformer Core and Number of Turns

For a given total magnetic flux in a transformer there is a certain cross-sectional area of core necessary to give the most economical flux density. On a given voltage, if the core is rather small the number of turns must be increased or the flux density must be increased. If the iron circuit is unduly long or has an air gap, there will be an abnormally high primary magnetising current, and there will be an increased tendency for the magnetic flux to leak through the air. It should be noted that the increase of magnetising current with a reduced iron area or air gap is automatic. For instance, if a few laminations are removed from a coil or a transformer whilst fed from the supply the total magnetic flux will fall. This reduces the induced voltage opposing the supply voltage, so an increased current will flow. This will automatically increase the flux density in the remaining core and increase the induced voltage so the conditions again become balanced; the flux density and magnetising current, however, will be more than normal.

The voltage induced in the secondary winding of a transformer follows the same law as the voltage induced in the primary. Induced volts =

$$\frac{4.44 \times \text{No. of turns} \times \text{frequency} \times \text{flux}}{100,000,000}$$

The turns required per volt for both primary and secondary are equal to

$$\frac{100,000,000}{4.44 \times \text{frequency} \times \text{total magnetic flux}}$$

It should be noted that, due to the resistance of the primary winding, the induced voltage thus calculated will be slightly less than the applied voltage. However, provided the magnetic circuit is well designed, this difference can be ignored.

Most of the magnetic flux created by the primary winding will pass through the iron core and will, therefore, be linked also with the secondary winding. As indicated in Fig. 5, however, some of the flux will leak or short circuit round the primary turns and will be ineffective so far as the secondary winding is concerned.

Effect of Secondary Load

We can now consider the effect of connecting the secondary winding to a load circuit such as a few lamps or other apparatus. The induced secondary voltage will cause a current to flow through the load circuit, the value of which will depend on the resistance and inductance of the circuit. The passage of this load current through the secondary winding magnetises the secondary, and this magnetism opposes and weakens that created by the primary. The immediate effect of this flux reduction is to reduce the inductance and induced voltage of the primary, so that a heavier current flows from the mains through the primary to restore the flux to practically its previous value. This is why the primary current of a transformer automatically increases with increased secondary load.

As shown in Fig. 5, some of the secondary magnetism does not pass through the primary but leaks back round the secondary turns. This flux does not affect the primary inductance and current but causes the secondary winding to be inductive to an extent which increases with the secondary load.

(To be continued).

Safety Devices for Machinery

Various Electrical and Mechanical Devices for Protecting Motors and Engines Against Overloading

By H. BOULTON

THERE is an almost infinite number of devices incorporated in modern machinery for the protection of operatives against accidents, a very common example being the safety device fitted to power presses to ensure that workers' hands are not under the punch when it descends.

The subject of this article however, is the protection of the machinery itself, both from the careless operative, and the inevitable introduction of faulty materials.

These devices may be broadly classified into two sections, namely mechanical and electrical. The electrical types are introduced either in the motor circuit or the motor itself to prevent electrical overloading, whilst the mechanical devices are nearly always fitted to the machine, or line shafting in the case of belt drives.

Protection of Electrical Motors

To protect motors from dangerous overloads, which may burn out the motor windings, a suitable type of contact breaker is usually fitted to the starter. One method is to install, in the circuit, a special strip, which is made up of two dissimilar metals firmly riveted together. Should any overload occur, the speed of the motor will obviously be reduced and the resulting excess of current flowing in the circuit will very rapidly heat the bi-metal strip. This strip is straight when cold, but when heated the different coefficients of expansion of the two metals cause one to expand more than the other, and since they are fixed together, the strip is forced to curve. This distortion is arranged to trip the starter and thus break the circuit. When the strip cools the starter is reset. Another method is to fuse a spring-loaded conductor into a horizontal container of low melting point metal. This apparatus is then fixed in the starter circuit; should there be an overload, the excessive current will heat up the apparatus and the metal in the container will become molten, thus releasing the spring-loaded conductor, and so breaking the circuit.

The Electrical Interlock

This is a type of switch, sometimes fitted to a motor-driven machine to obviate any possibilities of the motor being started whilst certain subsidiary gear is in use. For instance, a ball-mill used for grinding chemicals is often equipped with a hand-operated gear, designed so that an operative can crank the mill discharge opening to any desired position. This is simply a manually operated worm which can be engaged with a worm-wheel keyed to the mill counter-shaft. Whilst the mill is being driven by the motor, it would obviously cause serious damage if the worm and wheel were engaged; conversely, if the gear was already engaged when an attempt was made to start the mill, the consequences would be equally unfortunate. So an interlock is arranged to break the motor circuit when the worm and wheel are engaged, thereby isolating the motor, and so safeguarding the machine.

Electro-magnetic Brake

An appliance almost universally fitted to electrical lifts and overhead cranes is the electro-magnetic brake, illustrated in Fig. 1. Its purpose is to prevent the load from falling or "running back" after it has been raised, or in other words, the brake "holds" the load when the winch has lifted it. Should the electricity supply fail, the brake has the property of automatically sustaining the load. The operation of this simple and efficient device is as follows:

When the motor circuit is "dead," a spring-loaded band brake grips the winding-

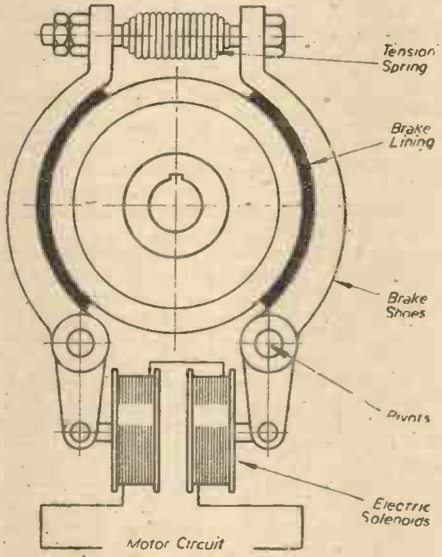


Fig. 1.—Magnetic brake.

drum; but when current is allowed to pass in the motor circuit it energises a pair of solenoids which hold the brake linings away from the winding-drum, thus releasing it, and allowing the motor to drive. Incidentally, all lifting mechanisms must be fitted with some form of self-sustaining appliance, to conform with legal specification.

Photo-electric Cell

The photo-electric cell is a device which has many uses in industry. This remarkable apparatus is used in power printing presses to stop the machine should the paper break or the supply suddenly fail. Damage would be done to the printing rollers, if they were

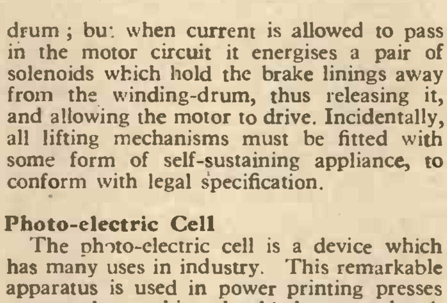


Fig. 2.—Shear-pin coupling.

allowed to run without paper. A ray of light is arranged to pass across the path of the paper and so on to the photo-cell. Now a photo-electric cell has the property of decreasing its resistance to electric current when light is allowed to fall on it; thus as the amount of light it receives increases, so the amount of current it will pass increases.

Naturally, when the paper is running correctly, the ray of light is broken, but should the supply of paper fail, the light can pass to the photo-cell; its resistance to electricity then falls, and the motor circuit is tripped by apparatus operated by the extra current being passed by the photo-cell.

In this way the printing press is stopped in a matter of a few seconds.

Mechanical Devices

Of the considerable number of mechanical devices designed to safeguard machinery, probably the simplest and most obvious is the shear-pin coupling shown in Fig. 2. If a machine "seizes," is jammed by faulty material, or overloaded in any way, it is clear that to continue to drive it under these circumstances would very rapidly cause some kind of breakdown. Now if a device were fitted (between the machine and its source of motive power) which would discontinue the drive, should the power required exceed a desired value, the plant would of course be safeguarded. The shear-pin coupling attains just this purpose; two discs A and B (Fig. 2) are keyed to the two shafts C and D as shown. A special pin E, weakened at its centre and designed to shear at a predetermined value, joins the coupling discs together so that shaft C transmits power through the pin to shaft D. Naturally any excessive "torque" in the driving-shaft shears the pin and discontinues the drive.

Although a friction clutch has the same effect as the shear coupling, it has several advantages over its cheaper and simpler counterpart. First, it is adjustable, and can therefore be set to slip within fairly accurate limits. It will continue the drive when conditions return to normal without first having to receive attention, and does not rely on the failure of one of its members for its effective working, therefore it needs no replacements. Finally, the friction surfaces commence and stop the drive smoothly.

The coupling, illustrated in Fig. 3, operates as follows: A disc A is keyed to the shaft B, and has two fibre discs C riveted or cemented to it. A housing D complete with compression springs E, pins F and annular ring G is keyed to the shaft H.

The compression springs E which are fitted to the pins F as shown, can be tightened down so as to cause a powerful grip between the annular ring and the housing D, thereby binding on to the fibre rings and so transmitting power from shaft B to shaft H. The drive is clearly due to friction, and can slip, should conditions become dangerous.

Centrifugal Clutch

The centrifugal clutch, Fig. 4, is similar to the friction clutch in so far as the drive is obtained by friction surfaces. It can be seen from the diagram that this appliance depends for its operation on two expanding "brake shoes," which bind on the inside of a housing. Thus the "shoes" (which must be fitted to the driving shaft) are able to drive the housing, which in this case is the driven pulley.

As the speed of the clutch is increased, the "shoes" are forced outwards, or expanded against two springs fitted to control their movement. The faster the rotation of the clutch the greater is the centrifugal force which causes the "shoes" to bind on the housing, in spite of the restraining springs. This means that the driving half must be running at a high speed before power can be transmitted. Should the speed of the motor or engine fall, due to overload, the clutch automatically ceases to drive; similarly, the prime mover must have attained a good speed before the clutch will operate. This makes it an ideal device for the electric motor.

Centrifugal force, a property of all rotating bodies, is used in many damage-preventing devices, since the fact that it increases with the speed of rotation, enables it to be made use of in many machines where excessive speeds are likely to become dangerous. It is also useful as a means of maintaining speeds within a definite tolerance, as in the case of steam engines driving alternators, cotton spinning machinery, and grinding mills.

Steam Engine Governor

A centrifugal governor is invariably fitted to a steam engine to achieve this uniformity of speed and also to prevent the engine "racing" on a light load and perhaps reach such speed as would cause damage. The essentials of the governor are two weights placed diametrically opposite to each other and free to move outwards when speed is increased. This outward movement is conveyed by a system of levers to the throttle valve, which controls the steam admitted to

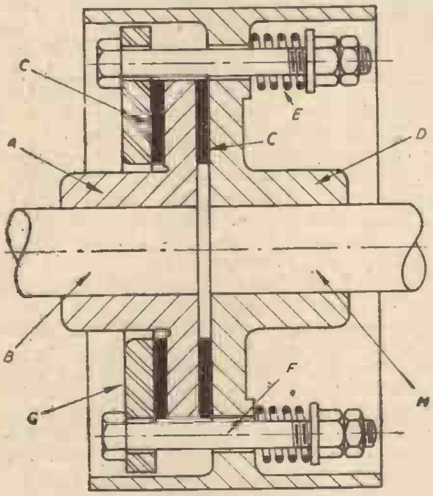


Fig. 3.—Slipping coupling.

the engine. Thus, more steam is allowed to pass when the engine speed falls, and less when the engine speed increases.

A centrifugal governor is also fitted to a clockwork gramophone motor to ensure a definite speed of the record.

A locomotive boiler provides us with some interesting ideas, incorporated in the general design to safeguard it from accidents. Of these the safety valve is the most widely known; its function being to open when the steam pressure in the boiler exceeds the safe maximum. Its principles are too well known to warrant any description here.

Fusible Plugs

Very dangerous indeed can be the conditions set up inside a loco-boiler if its water level drops below a certain point. A safety measure to cover this is the installa-

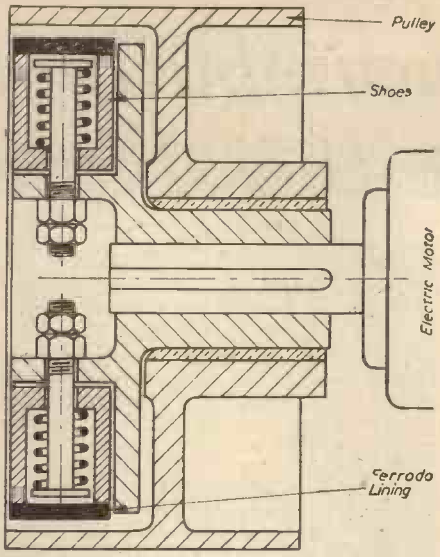


Fig. 4.—Section through a centrifugal clutch.

tion of several low melting-point metal plugs, set at such a height that if the water level dropped below these they would immediately melt. Steam would then issue through the holes left by the fused plugs, and the furnace would be extinguished.

In all steam installations, provision must be made for the collection and dispersal of steam condensate. In some instances the condensate does not constitute any great danger, but in a steam-engine cylinder the accumulation of condensate can result in a smashed cylinder cover. Obviously, if water is trapped between the piston and the cylinder cover something must give way, the water cannot be compressed, so the cylinder fails.

Usually, the cylinder cover is equipped with a drain-cock, and when the engine is started this cock is opened intermittently until sufficient steam has been blown through the cylinders to heat them to a temperature which will not condense the steam. The reader has probably noticed locomotives blowing steam from the cylinders just before starting. This is done by the driver to ensure that all is well inside the cylinders.

This idea of the drain-cock is all very well for locomotives and stationary engines situated near to a supply of steam; but in the case of steam engines used in large factories, where the boiler-house may be a good distance away, some further appliance is necessary, for long steam mains produce a considerable amount of condensate, due to the unavoidable loss of heat through the pipe lagging. Obviously, under these conditions, the drain-cock would be in almost constant use, and consequently quite inadequate.

Steam Trap

This condensate is drained from the steam mains by a device which will allow water to pass, but not steam. It is known as a "steam-trap." There are a great number of different types of steam trap, the one illustrated in Fig. 5 is quite a common variety. The sketch is only diagrammatic, but serves to illustrate the principle. It consists simply of a casing having an inlet and outlet as shown, inside which is fixed a special valve actuated by a ball-float. This float rises or falls according to the level of condensate in the trap. When the level of the water exceeds a certain height, the valve, opened by the float, allows condensate to escape. Water level is thus lowered and the valve closed by the float.

In actual practice, the condensate level is such that the valve is always slightly open, the discharge is therefore always a steady trickle. In conclusion, a device perhaps worth mentioning is the so-called "dead man's handle," a simple idea designed to stop an electric trolleybus or train should the driver meet with a sudden accident or illness. Briefly, it consists of a power control which must be held constantly by the driver to allow the vehicle or train to function. Should anything unfortunate happen, the driver, on falling or becoming in any

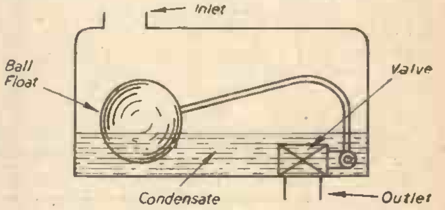


Fig. 5.—Diagrammatic sketch of a typical steam trap.

way incapable of doing his work, will naturally release the handle, thus stopping the vehicle.

The reader will doubtless be aware that the examples given in the foregoing are by no means exhaustive; but it is hoped that they at least cover this interesting branch of engineering in a general sort of way.

Books Received

Making Miniature Aircraft. By R. H. Warring. Published by Modelcraft, Ltd. 32 pages. Price 4s. 6d.

THIS is a new Modelcraft Planbook and deals with the making of solid scale model aircraft. Details of the simple tools and materials required are given, and there are nearly 60 illustrations, with plans for making three representative modern aircraft, viz., the Spitfire VB, Hawker Typhoon 1B, and the Thunderbolt. The hints and instructions contained in the book, whilst applying to all kinds of published plans, tie-up particularly with Modelcraft "Scaleline" plans, of which over 40 have been published to date.

Scenic Railway Modelling. By P. R. Wickham. Published by Modelcraft, Ltd. 52 pages. Price 5s. 6d.

THIS interesting book is another of the Modelcraft Planbook series and contains instructions for making and laying out various accessories for making model railways more realistic. In this handbook the scenic side of railway modelling is covered very fully, without making too big a demand on the technical skill and material resources of the reader. There are a large number of working designs and construction sketches, and several perspective drawings of various features incorporated in an O-gauge model railway built by the author. The book illustrates in a very effective manner how desired effects can often be obtained with the expenditure of only a few pence, and a few hours' fascinating work.

Engineer-built Houses of the Future—15

(Continued from page 236, April issue.)

Details of Flat Roofs : Flat Roofing Materials : Principles of Pitched Roofs

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

ONCE the main principles, as explained in the last article, are known, flat roofs require the most careful consideration in designing and detailing to ensure adherence to good structural and practical rules, and these must be blended with the need for economy.

As it will probably be found by designers of pre-built houses that the long-beam and the comparatively small and light weight roof panel system will be the best and most practical for most types of houses, I will limit descriptions to this system, and, a general construction, allowing for a sufficient fall for the various kinds of roofing materials which will be used, will be also described, as level roofs can be designed with little modifications to the details shown in this article. As previously explained, an appreciable economy may usually be effected by setting the main roof members and panels slightly out of level; a fall of about 3in. in a room is not necessarily offensive in appearance, and it does allow a uniform thickness of panels and makes firring up to falls unnecessary.

Solid timber beams and light timber framed panelled roof units are shown by Fig. 90. The beams, which are placed at distances apart to suit 4ft. wide roof units, require to be of the size shown to support safely the loads of and on the roof and to avoid excessive deflection. The beams may seem rather large, but by setting the roof panels between and in the depth of the beams, a not too heavy beamed effect is given to the ceiling. As timber is not always straight in its length, and it is not always practicable to straighten it, it is advisable to allow a reasonable amount of tolerance between the beams and units. Built-up beams may usually be relied upon to be reasonably straight and more easily adjusted to allignments than wide, solid timber beams. The roof units are supported, as shown, by flat steel bars which go through slots at suitable intervals near the neutral axis of the beam and project to form small, strong corbels. The beams would be wrought and have the cover fillets fixed at the manufacturers' works. The roofing material may be of any of the kinds described later in this article.

Single steel beams with light timber-framed roof units are depicted by Fig. 91. Steel beams of various sections will probably find much favour in pre-built housing work because of the following good reasons: (1) with structural essentials being equal for steel and timber, a steel beam may be of much less depth than one of timber; (2) there is very little difference in the weights of a steel and timber beam; in the example illustrated the steel weighs 12lb. and the timber 9lb. foot run; (3) the flange of the steel beam provides adequate support for the units and therefore obviates the necessity for using special formations as is necessary if timber is used; and (4) the ends of steel beams may be very strongly connected to stanchions or other structural parts of walls and partitions. Fig. 92 shows the use of steel angles and steel channels. Although these may not be so economical in steel as using the ordinary British Standard beam (H), there are certainly advantages which should not be overlooked, viz.: that angles or channels in twin formation may be set apart at reasonable variations to suit dimensional fluidity in the roof, an asset which can be valuable because it will allow the use of standard width roof units for variation in room width up to, say, 12ins. Of course, variations in the distances apart of

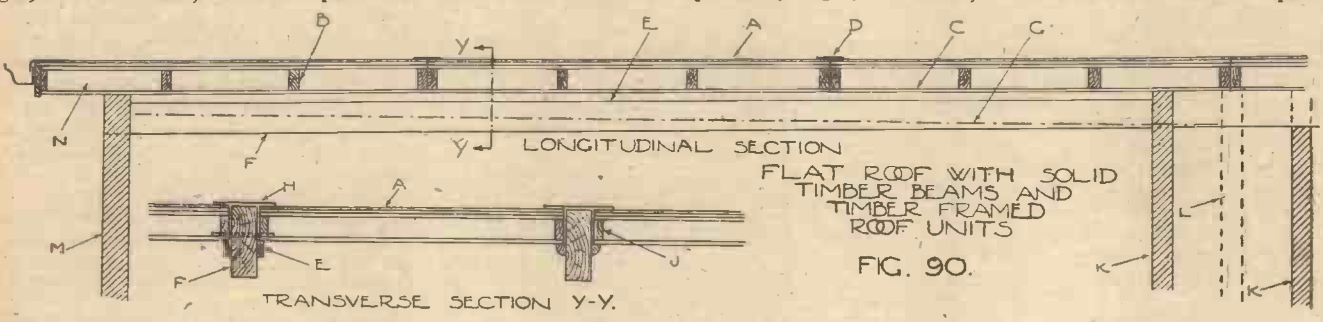


FIG. 90.

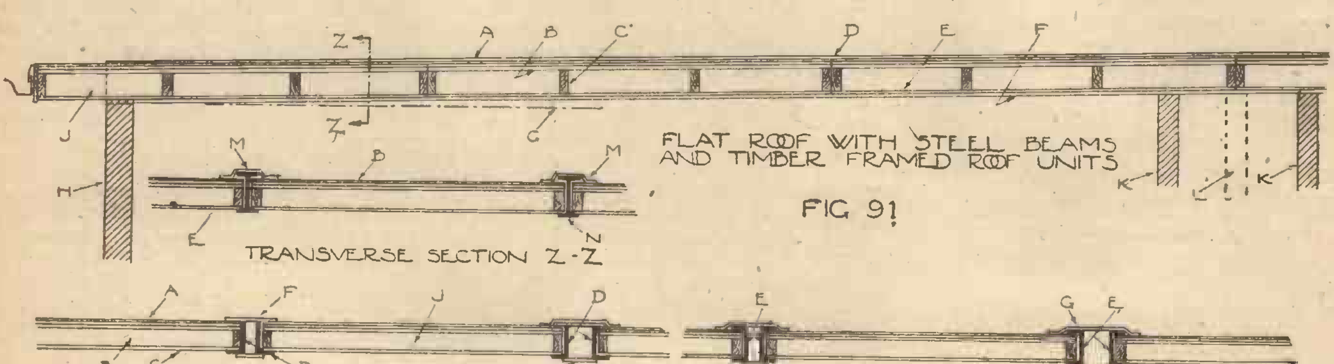


FIG 91

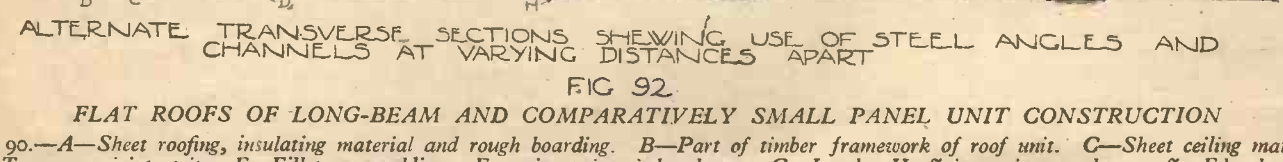


FIG 92

FLAT ROOFS OF LONG-BEAM AND COMPARATIVELY SMALL PANEL UNIT CONSTRUCTION

Fig. 90.—A—Sheet roofing, insulating material and rough boarding. B—Part of timber framework of roof unit. C—Sheet ceiling material. D—Transverse joint strip. E—Fillet or moulding. F—11in. × 4in. timber beam. G—Level. H—Joint strip over beam. J—Edge board of roof unit. K—Composite partition. L—Single partition. M—External wall. N—Overhanging eaves.

Fig. 91.—A—Top flange of steel beam. B—Rough boarding, on top of which is laid insulating material (if required) and then the roofing. C—Timber framework of roof unit. D—Joint between roof units. E—Ceiling material. F—Bottom flange of steel beam. G—Level. H—External wall. J—Overhanging eaves. K—Composite partition. L—Single partition. M—Capping forming rain-tight joint. N—Steel beam.

Fig. 92.—A—Roofing material on its sheet foundation. B—Roof units. C—Ceiling. D—Steel angles. E—Steel channels. F—Flat cover strip forming rain-tight joint. G—Capping. H—Soffit lining fixed to blocks between steel members or by hangers from top of beam. J—Roof unit of standard width and any dimensional fluidity being obtained by varying the distance apart of the steel beams which are in twin formation.

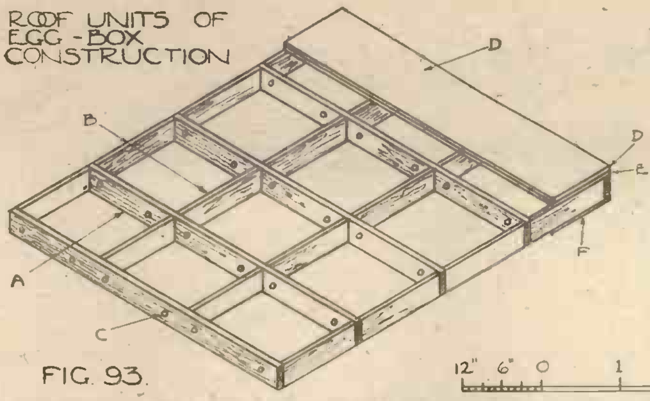


FIG. 93.

Fig. 93.—A—3in. × 1½in. main timber member. B—3in. × 1in. cross members. C—Vent holes to allow circulation of air through units. D—Sheet roofing material. E—Rough boarding. N.B.—Insulating material may be added if desired. F—Ceiling.

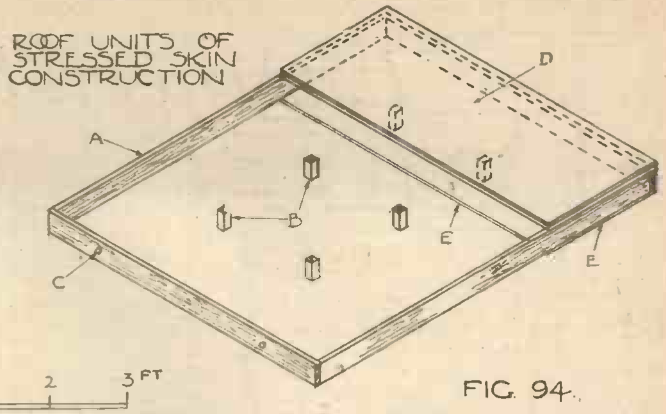


FIG. 94.

Fig. 94.—A—3in. × 1in. or 1½in. timber frame. B—1½in. × 1½in. or 2in × 2in. pegs. C—Vent holes. D—Roofing material laid on stressed section sheeting. E—Stressed section forming ceiling.

the steel members would cause a variation in the width of the cover strips to the roofing and the soffit of the beams, but this, I suggest, is not an important matter as such strips may be manufactured in, say, two widths to suit several variations in the spacing of the twin beams.

A study of the various kinds of beams will show that those of timber and steel angles will allow the roof units to be lowered into position without disturbing the beams; those of H and channel sections will necessitate moving the beams sideways to allow the units to be fixed.

The roof units may be designed and constructed as follows: (1) Of a light timber framework as Figs. 90 to 92, consisting of 3in. x 2in. or 1½in. members spanning in the 4ft. direction, and with 3in. x 1in. end boards framed in between or over the ends of the 2in. or 1½in. thick members. The joints in the framing must be framed and connected with proper joints or fastenings to resist all calculated stresses. (2) The egg-box principle, as shown by Fig. 93, formed with 3in. x 1½in. main members spanning without break in the 4ft. direction of the unit, and 3in. x 1in. cross pieces nailed between the main members. (3) The stressed-skin method, as Fig. 94, which consists of a framework around the four edges of the unit and 1½in. x 1½in. or 2in. x 2in. pegs in position where shown and fixed to the stressed skin upper and lower sheets.

Beams Projecting Above Roof Level

The best principles of pre-built roof and roofing work make it impracticable to avoid a little site work in connection with the actual roofing materials. Rain-tight strips, etc., over joints will have to be laid and bedded on site. Therefore on flat roofs there can be no reasonable objection to beams projecting above the roof level provided that the cost is reasonable compared with the advantages gained. The advantages may be that beams projecting below ceiling level are undesirable, which may be avoided by letting the beams project above the roof; and if steel beams are used it may be considered that it is better to let the roof units rest on the bottom flange of the beam thereby causing the top of the steel beam to be above the roof level. Whereas a little extra expense may be involved in covering the top of a beam where it projects above the roof, this extra may be balanced by a reduction of work in casing or covering the bottom of the beam where it projects below ceiling level. Fig. 95 depicts various methods of forming beams with their tops above roofing level. Although such tops, except their ends at eaves, will not be seen from street level, the appearance of them can hardly be deemed objectionable.

Steel Beams with Reinforced Concrete Roof Units

Fig. 96 shows this system of design and construction, and, although it may be favoured by some designers, it should be borne in mind that the reinforced concrete slabs which may be 2½in. to 3in. thick, are very heavy compared with timber-framed and stress-skinned units. It will be noticed that the slabs may be formed with reasonably fair-faced or smooth surfaces on the underside which would provide a fairly good appearance as a ceiling, but the joints between the slabs should be filled in or covered. Alternatively, the slabs could be made with a sheet ceiling material attached to them by the manufacturer; there are several ways by which the units can be made to provide a neat and good ceiling covering and to avoid site fixing of ceiling sheets, etc.

Sheet coverings to the roof units may now be described. They represent the material on which the roofing material is laid and that which forms the ceiling. The ordinary timber-framed units as shown by Figs. 90 to 92 may have their top surface covered with either of the following: (1) Full ½in. thick rough boarding. The thickness may be preferred to be not less than 1/24th of clear span between the small timber beams; (2) ⅜in. thick plywood, or of a thickness not less than about 1/32nd of clear span; (3) As (1) or (2) with a ½in. thick insulation building board laid on top of the rough boarding or plywood.

The egg-box type of unit, as Fig. 93, may be covered similarly to the timber-framed units.

The stressed-skin unit, as Fig. 94, must be primarily covered with plywood, usually ⅜in. thick, or of a thickness required by calculation of the stresses. An insulating material may be laid on top of the plywood if desired.

Ceiling coverings to the roof units of the timber-framed and egg-box types of construction may be of building boards, such as insulation boards or hardboards, or of plywood, asbestos-cement sheets, plaster boards, or any other suitable sheet material.

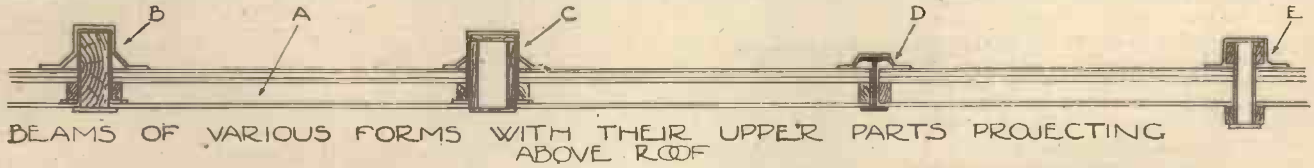
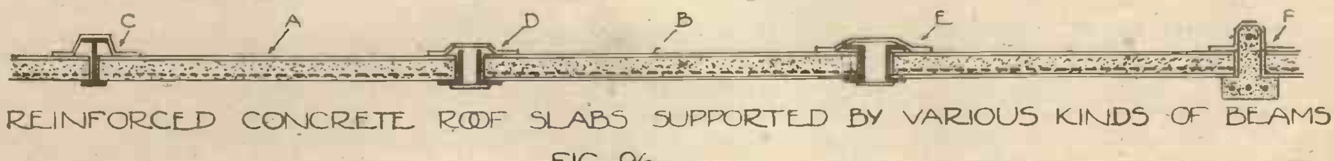


FIG. 95



REINFORCED CONCRETE ROOF SLABS SUPPORTED BY VARIOUS KINDS OF BEAMS

FIG. 96.

12" 9" 6" 3" 0 1 2 3 FT.

FLAT ROOFS WITH BEAMS PROJECTING ABOVE ROOF—AND FLAT ROOFS WITH REINFORCED CONCRETE UNITS

Fig. 95.—A—Timber framed roof unit. B—Solid timber beam. C—Built-up timber beam. D—Steel beam. E—Timber box beam.
Fig. 96.—A—Reinforced concrete units 4ft. long by about 1ft. 6in. wide with four faced soffit to form ceiling. B—As A but with building board bonded to soffit. C—D—E and F—Various kinds of capping to suit different beams.

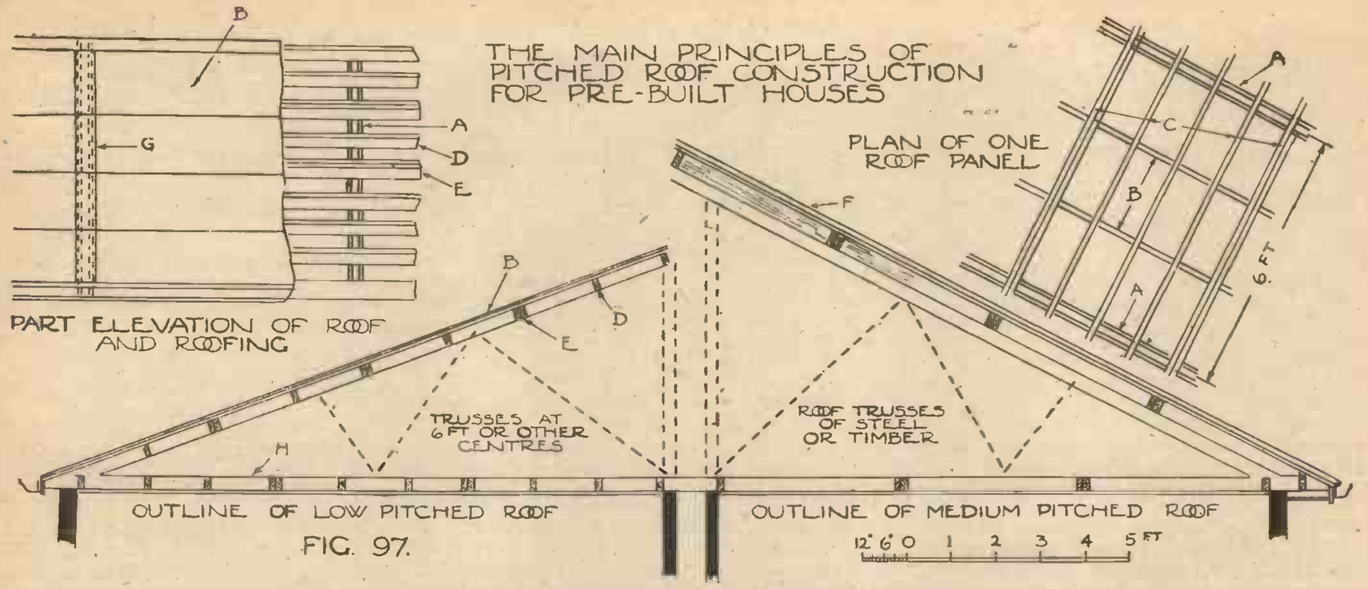


FIG. 97.

THE MAIN PRINCIPLES OF PITCHED ROOFS

Fig. 97.—A—Steel or timber pre-built roof trusses. B—Sheet roofing. C—Battens for Tiles. D—Timber framework of panelled roof units. E—Joint in units. F—Tiled roofing. G—Rain-tight cover strip over joint in roofing. H—Ceiling.

The units constructed on the stressed-skin principle must have a ceiling covering capable of resisting the tensile stresses which occur in the lower part of the units due to them bending when under load; plywood, usually of the structural kind, is suitable for this purpose. The reinforced concrete units may have building boards of the insulation type which are bonded to the concrete.

The joints between the units require rather particular attention. There should be no open joints in the ceiling covering which coincide with joints between the structural units. An easy method is to cover the joints with wood or other small fillets; but this must generally be done as site work.

Roofing Materials for Flat Roofs

There are many kinds of materials suitable for flat roofs, and care is necessary in choosing them to ensure suitability for various purposes. A flat roofing material must primarily be impervious to rain; it must be durable, and if a flat roof is used as a roof garden, as illustrated in the first article of this series, it must be capable of withstanding hard wear. It should be borne in mind that the surface of a flat roof is not seen from the road, and therefore æsthetics need not be considered very much except if the roof is used as a garden, when a pleasant coloured surface may be desirable in some cases. For ordinary flat roofs which are not subject to pedestrian traffic—except workmen doing repairs, etc.—there are many kinds of materials which are excellent. One of the most effective and economical is the built-up felt roofing, which is not of the kind used for huts and temporary buildings, but a scientifically constructed roofing consisting of two or three layers of good quality felt made in accordance with the British Standard Specification, each layer having between them a compound or mastic which binds the sheets together and makes the lapped joints between the sheets perfectly watertight. An advantage given by this type of roofing is that it does not easily crack or develop defects due to temperature and other movements which occur in roofs, and that its pliability allows it to be worked easily to upstands, turn-downs, and joints.

Zinc and other metals may be used for flat roofs; but I think their cost will prohibit their extensive use on housing work.

Roofings subject to pedestrian traffic require much care in their choice, and in my opinion it is very essential to bear in mind that many kinds of pre-built roof units are subject to temperature and other movements at the joints, and for this reason the joints must receive particular attention when such materials as asphalt and various kinds of tiles are used as a surface. Also, if the surface is to withstand traffic, it is even more important that the joints be also capable of resisting wear. With these essentials in mind I recommend that: (1) The units have a roofing consisting of two layers of built-up felt on which is laid a single coat of asphalt or other suitable pre-plastic material, or any of the various tiles which will be on the market. The built-up felt roofing would be in itself watertight, and it could be turned up at the sides of each unit to allow the capping at the joints to cover the turn-up and thereby make a good watertight joint. Or where no capping is used, but instead a flat strip to cover the joint, such strip could be bedded between the two layers of felt roofing. It is suggested that cappings or strips to the joints be formed of zinc or other suitable metal.

Pitched Roofs

There is no doubt that pitched roofs will be required to a great proportion of pre-built houses. There are three very good reasons for this: (1) Pitched roofs will be desired by architects and the public for æsthetic purposes; (2) they will permit the use of many kinds of roofing materials which are unsuitable for flat roofs, and (3) cause the good balance of use of various kinds of materials and labour which will be so essential in the national interests in the post-war years.

Fig. 97 depicts some of the principles of good pre-built pitched roof design, and as the next article will show in detail, light-framed steel or timber pre-built trusses of easily transportable size will form the foundation for roofing units, complete with sheet roofing materials, or units complete in all respects except for the laying of roofing tiles, which may be desired as an alternative to sheet materials.

Minimum pitches of the roofs should receive most particular attention, and for this purpose the tabular information below will be found useful.

TABLE OF MINIMUM PITCHES FOR VARIOUS ROOFING MATERIALS

Roofing materials. See Notes at foot	Lap in inches	Roofs in ordinary exposed position		Roofs in very exposed position	
		Degrees from horizontal	Ratio of rise to span	Degrees from horizontal	Ratio of rise to span
(1) Ordinary felt	—	14	1 : 8	—	—
(2) Built-up felt	—	A little fall to cause rain to drain off the surface and over any raised seams.			
(3) Corrugated steel with end laps	—	14	1 : 8	18½	1 : 6
(4) Asbestos-cement sheets, corrugated or other shape	6	26½	1 : 4	29¾	1 : 3½
(5) Ditto	9	18½	1 : 6	26½	1 : 4
(6) Roofings as (4) and (5) but in one length without end laps	—	11¼	1 : 10	—	—
(7) Courtrai du Nord	2½	29¾	1 : 3½	33¾	1 : 3
(8) Interlocking tiles: Pitches vary to a little extent with various makes, but generally allow	—	38½	1 : 2½	45	1 : 2
(9) Ditto with felt underlay...	—	29¾	1 : 3½	33¾	1 : 3
(10) Pantiles	3	33¾	1 : 3	38½	1 : 2½
(11) Interlocking pantiles	2½	29¾	1 : 3½	33¾	1 : 3
(12) Roman and Italian tiles	3	33¾	1 : 3	38½	1 : 2½
(13) Spanish tiles	2½	33¾	1 : 3	38½	1 : 2½
(14) Asbestos-cement tiles...	2½ to 3	29¾	1 : 3½	33¾	1 : 3
(15) Shingles	—	38½	1 : 2½	45	1 : 2
(16) Thatch	—	45	1 : 2	—	—
(17) Glass	—	18½	1 : 6	22	1 : 5
(18) Ordinary plain tiles 10½in. x 6½in. or	2½	38½	1 : 2½	45	1 : 2
11in. x 7in.	2¾	—	—	38½	1 : 2½
(19) Slates: small as 16in. x 8in.	3	33¾	1 : 3	38½	1 : 2½
(20) Ditto, medium size as 20in. x 10in. ...	3	26½	1 : 4	29¾	1 : 3½
(21) Ditto, large as 24in. x 12in.	3	22	1 : 5	26½	1 : 4

NOTES

Re (6). These may be laid flatter provided top edges and eaves are protected against driving rain.
Re (7). A felt underlay is advisable for roofs in very exposed positions.
Re (8) to (13). There are various types of these tiles and makers should be consulted as to minimum pitch if there is any doubt.
Re (10). A felt underlay is often advisable to ordinary pantiled roofing.
Re (19) to (21). If the slates are laid to 2½in. lap, which is sometimes done in poor quality work for roofs in ordinary exposed positions, then increase pitch to that stipulated for roofs in very exposed positions.

Small Wind-power Plants—5

Lamps, Fittings, etc., for Obtaining Best Results from the Windcharger Described in This Series

By W. H. SUTHERLAND

(Continued from page 229, April issue.)

RECENT years have seen a marked increase in the number of amateur lighting installations in use throughout the country. In particular, the influx of American-built "Winchargers" has aroused widespread interest in this source of free power, and many technical magazines have published designs of home-made wind-generating plants. Little attention has been given, however, to the layout of the lights and fittings, on which the ultimate success of the plant depends. A short account is given here of some dodges and devices found

A converted candle lamp.

effective when used in conjunction with the windcharger previously described in this series.

Lighting Problems

In windcharger lighting two main problems emerge: (a) The minimum working intensity of illumination necessary to supply to each part of the house; (b) to do this with the utmost economy of current consumption. For distribution purposes, the house is divided into three sections: (1) Two main rooms—living-room and kitchen—where comfortable reading and working light is necessary; (2) bedrooms and other rooms where a small light is sufficient for normal purposes, with provision for a more powerful light at strategic points when occasion demands it; (3) halls, stairways, coal-house, etc., where one or two candle-power is quite enough.

The requirements of the living-room are best satisfied by two separately switched bulbs, arranged (Fig. 1) to throw light on the two positions usually occupied on each side of the fire. When only one person is reading, the second bulb is idle. With both bulbs in use, good illumination is provided over the whole area in front of the fire, since the cones of light will overlap. In normal practice, 25-watt bulbs would be considered the minimum for such a job, but 12-watt lamps are sufficient if particular attention is given to the mounting. These lamps are made to fit standard 9/10 in. bayonet sockets, in any voltage from 6 to 100. Failing this, 12-watt, clear-glass car bulbs are just as good.

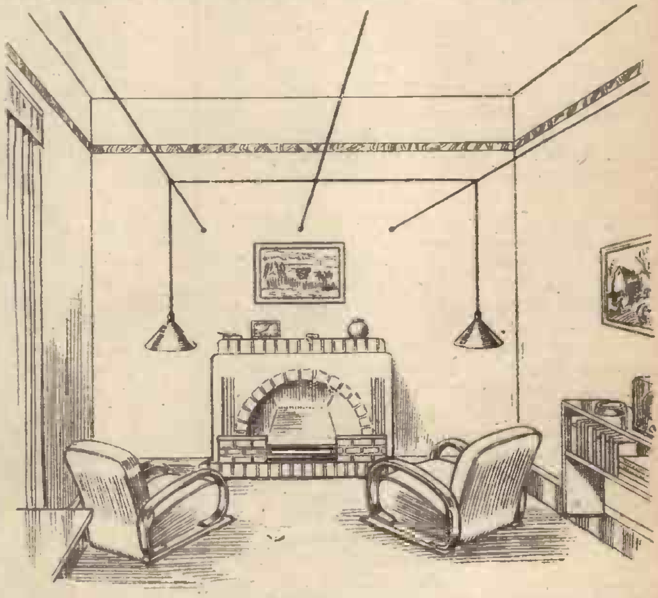


Fig. 1.—Arrangement of lights in living-room. Separately switched 12 or 18 watt bulbs suspended by flex from bare 7/22 aerial wire stretched from wall to wall at a height of about 9ft.

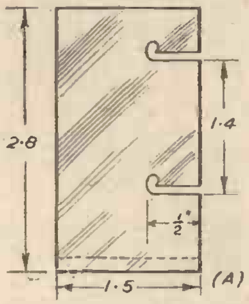


Fig. 4.—Bayonet grips cut in strip of tin.

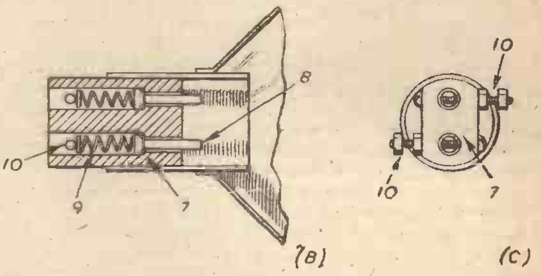


Fig. 5.—Section and end-view of bayonet socket for bulbs with standard sized bases.

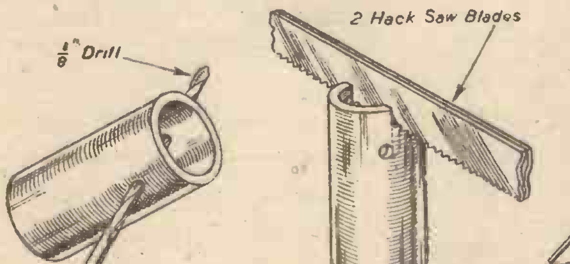


Fig. 2.—Two operations necessary to make a bayonet socket for car bulbs. (1) drill a ⅛in. hole, (2) make two cuts, using two hack-saw blades.

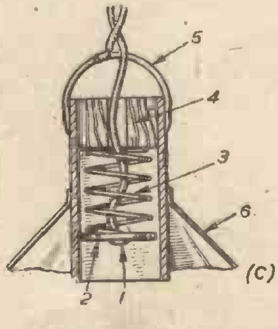


Fig. 3.—Section through finished bayonet socket for motor-car bulbs

Lamp Holders

Whatever the type of bulb used, a holder is necessary, and this is usually difficult to obtain. It can be made up easily and rapidly from odds and ends. For the car bulb, a piece of light tube is selected with a diameter about ⅝in., a loose fit for the base of the bulb. A piece of curtain rod is the most suitable source of material. Cut the tube into 1½in. lengths. The bayonet grip is made in two operations. First drill a ⅛in. hole right through the tube, accurately along a diameter, about ½in. from one end (Figs. 2 and 3). Then, using two blades in a hacksaw frame to give the necessary width, make a cut down to each hole, slightly to one side, so that the typical bayonet socket is produced (Figs. 4 and 5). It is best to make these cuts separately, by tilting the saw, so that each may be guided accurately to the correct position. The single contact stud consists of a brass paper-fastener (1) in the centre of a disc of fibre-insulating material (2). The legs of the fastener are passed through a slit made with a small, sharp screwdriver; cut off the legs about 1/16in. below the disc, open them out to secure the fastener, and solder on a length of heavy flex. Pressure between fastener and bulb contact is maintained by a spring (3), which is a close fit in the tube. A wooden plug (4), with a hole for the flex, keeps the spring in position. A "stirrup" of bare wire (5), is soldered to the end of the holder to support the weight of the lamp and shade evenly over the centre. The tin shade (6) is soldered directly to the holder at any suitable point.

It is not advisable to make holders for standard-sized bulbs on this system. A strip of tin (Fig. 4), is cut to the size shown and bent into a cylinder around the base of a bulb, a strip of thick paper between bulb and tin giving the necessary clearance. The cylinder is held temporarily with a loop of wire and soldered lightly along the joint. A piece of wooden rod (7), about 9/10in. diameter has two ⅛in. holes, separated by ½in., drilled along its length. These holes are then widened to within ½in. of one end by a ¼in. twist drill. Two circular section wire nails (8), are cut down to about 7/10in. length, and inserted to act as contact studs. The heads may need to be filed to pass freely into the ¼in. holes. Two small springs (9) preferably of brass or copper, press on the heads of the nails. The springs are best held in place by two 6 B.A. bolts (10, Fig. 5). The bolts act as terminals for the flex, and are arranged "back-to-front," as shown, to support the weight of the lamp evenly. Flat surfaces are obtained for the bolts by four hacksaw cuts. The tin is held in position on the timber by small screws or tacks, and the shade (11) is soldered to the holder, as before.

Shade Construction

The shades for these lamps are made from tin, polished well with a metal polish. A 12in. gramophone record is suitable for marking out the circle, but if a big enough sheet of clean tin is not to hand, open out two canisters, at least 6ins. long and 4ins. diameter, and mark two semicircles. Solder these together along one half of the common diameter, leaving the other half free for bending purposes. Shape the tin into whatever size cone is required, and, after cutting away the extra tin, solder lightly along the joint. Cut a hole at the apex to fit the holder in use, and enamel the back of the shade to suit the colour-scheme of the room. The angle of the cone may lie anywhere between 90 deg. and 135 deg. The shades are soldered directly to the home-made holders described.

Wiring Details

On low voltage system it is essential to use the largest possible diameter of wire, so that the voltage drop along it may remain small compared with the voltage of the battery. Heavy rubber-covered cable is expensive and scarce, and the best substitute is bare 7/22 aerial wire, which can be bought quite cheaply in rolls of 50ft. or 100ft. It should be nailed or stapled along walls so that opposite polarity wires are separated by at least two or three inches. To save material and power, the wires should be stretched directly from one point to another on their journey from battery to lights, rather than follow neatly the contours of the building. Fig. 1 shows this plan adopted in the wiring of the living-room. Three lengths of 7/22 wire are stretched tightly from hooks across the

A useful reading lamp which can be tilted at any angle.

room, and the bulbs are suspended by heavy flex soldered to the bare cross-wires. The two outside wires are positive, coming from the two switches inside the door, and the inside wire is a common negative for both bulbs. Any one 7/22 wire may feed bulbs totalling 24 watts on 6-volt circuits, where the drop in voltage will be 0.045 volts per yard. Small 6-watt bulbs can be supplied through 18 S.W.G. wire taken from an old dynamo field coil or ignition coil, provided the distance from battery to bulb is not too great.

In the bedroom, a 6-watt car-bulb, with a small tin shade about 6ins. diameter, gives a satisfactory light, but a socket should be provided for a bedside reading-lamp containing a 12 or 18-watt bulb. The bases of old plug-in coils form very useful sockets, which can be placed at suitable points throughout the house where a good intensity of illumination is needed occasionally. Fig. 6, and the illustration above, explain the construction of a very useful and versatile lamp, which can be arranged, by a readjustment of the clamps, to throw intense light on the most awkward positions. The shade is semi-cylindrical, and is easily made from tin canisters, soldered at the joints. It should be large enough to surround the bulb completely. A bulb-holder with a built-in switch is used. Retort clamps (11), of the type used to hold school laboratory apparatus, make an ideal stand, which can be attached to any support. When used as a bedside reading lamp, it clamps neatly to the top rail of the bed, throwing the light just where it is needed.

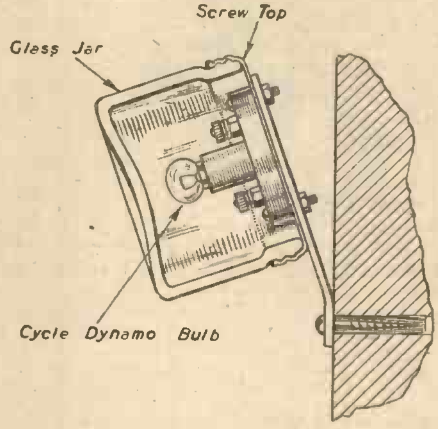


Fig. 9.—Partial section of hall or stairway light using a cycle dynamo bulb in a clear glass screw-top jar.

Converting Old Lamps

Old candle or oil lamps, with good silvered reflectors, can often be converted into ideal reading lamps. The illustration on page 267 shows a typical conversion, using an old parabolic reflector candle lamp. A small toggle panel-mounting switch is fitted into the base. The best type of bulb for these lamps is a double filament double contact car bulb, rated usually at 6/8 volts, 18/3 watts. The appropriate filament is selected by a small change-over switch, made from the wiper of an old wire-wound rheostat or volume control, moving over small round-headed brass 6 B.A. bolts arranged on a piece of fibre or paxolin (12). The wiper (13) moves in its original bush (14), and just touches a pair of the bolt heads, giving a pleasant "snap-action" as it crosses the central bolt. Two small bolts (15) act as

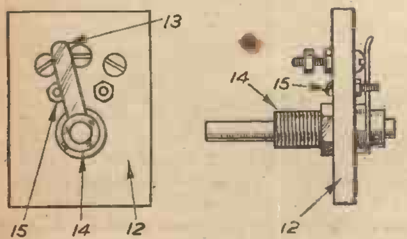


Fig. 7.—Back and side views of "snap-action" change-over switch for use with double filament 6-8v. 18/3 watt bulbs for use in reading lamps.

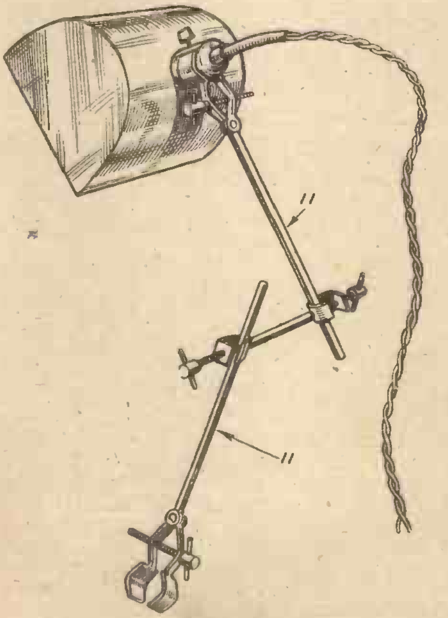


Fig. 6.—Details of the adjustable reading lamp, showing the retort clamps.

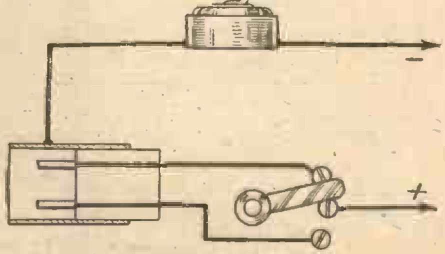


Fig. 8.—Connections for double-filament 18/3 bulb, using the switch shown in Fig. 7.

stops. Fig. 7 shows details of the construction of this switch, while it can clearly be seen on the base of the reading lamp shown on page 267. Fig. 8 gives the connections necessary when using the switch to control a double filament bulb. From this it is obvious that the holder could be wired up with only one contact-stud in use, the second wire being attached to the metal of the holder. Changing from one filament to the other would then be effected merely by reversing the bulb in the holder, so that the "live" contact stud of the holder would touch the other contact of the bulb. This would eliminate the change-over switch, and is particularly useful for positions where a strong light is needed only now and again (e.g., a shaving light for the bathroom).

For passages, stairways, etc., screw-base 6- or 8-volt cycle dynamo bulbs are ideal. These can be mounted very artistically under clear glass ointment or cosmetic jars with screw lids, attached either flat against the wall or roof, or by a small aluminium bracket. Fig. 9 gives an idea of the way in which it is made.

Total Load

With an installation consisting of 12 6-volt lights, arranged on the lines suggested, the total load will rarely exceed 6 amps., while the average nightly load over a period will be about 3 amps., provided reasonable care is exercised in switching off unnecessary lights. Allowing five hours for each night, the average consumption would therefore be about ½ kilowatt hour per week. Allowing a battery efficiency of 80 per cent., and an average charging rate of 8 amps., this would need about 16 hours charging in every week of 168 hours, or one hour in every 10. Wind surveys reveal that we get about 2,000 hours of 10 m.p.h. winds over most of the country during the year, which works out at about one windy hour in every five, or more than sufficient to supply the load mentioned. The weak point in this reasoning depends on the fact that many of the 2,000 hours of wind will come in the form of sustained gales, lasting up to 24 or more hours, with hardly a break. To make good use of such windy periods, large storage capacity is necessary.

Accumulators

The single car accumulator, with a top capacity of 100 amp-hours, is obviously insufficient. Several accumulators in parallel go a long way to solve the problem, but large glass house-lighting 2-volt cells are the ideal solution. These cells have correct charging rates of about 20 amps., and can be fitted with visual charge indicators, taken from old Exide radio batteries.

Useful Workshop Devices

Two Home-made Appliances for the Amateur. By B. T. MACTAVISH

THE following constructional details of two useful home-made devices may prove of value to other readers.

Combined Bench Grinder and Circular Saw

Mr. R. C. Bolton's (Liverpool) letter in the January issue gave me the idea for what is considered an improvement on his model. I used the *rear* hub of a cycle instead of a front one, but this, I think, is optional. A general view of the finished tool is shown in Fig. 1. The following parts are required, which cost roughly the amount stated:

	s.	d.
1 Rear cycle hub	3	6
1 (5in.) emery wheel	9	0
1 (6in.) circular saw	7	0
¼in. sheet metal (mild steel or iron) bent and welded, as shown, plus fitting, turning, etc.	20	0
1 1½in. diameter pulley wheel		6
1 3ft. length circular leather belt		3
Bolts, washers, bushes, etc.		—
TOTAL	40	3

The sheet metal is first bent to form the letter "E" less centre "bar," thus forming the saw table and base. A sheet, 8in. by 4in. by ¼in. is then welded about ⅜in. from saw slot, towards vertical support (see Fig. 1). This forms the suspension for the saw end of the spindle. The upright forms the suspension for the grinder end of the spindle. The cycle hub was then dismantled, and a ⅜in. piece removed from the outer casing. The pulley wheel, obtained from a window sash pulley, was then welded to the centre of the spindle, taking care not to bend the spindle (as happened in my case). The hub was then reassembled after fitting to its suspension. The ball-bearings were grease packed. It is necessary to decide on the direction of rotation (i.e., towards one) in relation to the spindle, which must be fitted so that the bearing retaining nuts tend to *loosen* in use *against* the grinder and saw. Alternatively, these nuts may be locked with split pins, fitted through the drilled spindle.

A tool grinding rest was fitted in a slot, to compensate for wear on wheel, as shown in Fig. 1. The whole is driven by a ⅛ h.p. electromotor, with pulley wheel of approximately 2½in. diameter. This gives a machine speed of approximately 2,000 r.p.h., which causes no play or noise if carefully assembled. The length of saw slot is variable, but I allowed about two-thirds of the saw to be above the table. This, of course, determines the height of the spindle mounting above the base plate.

The motor for this machine is foot controlled, using an easily-made *pedal switch* on the following lines:

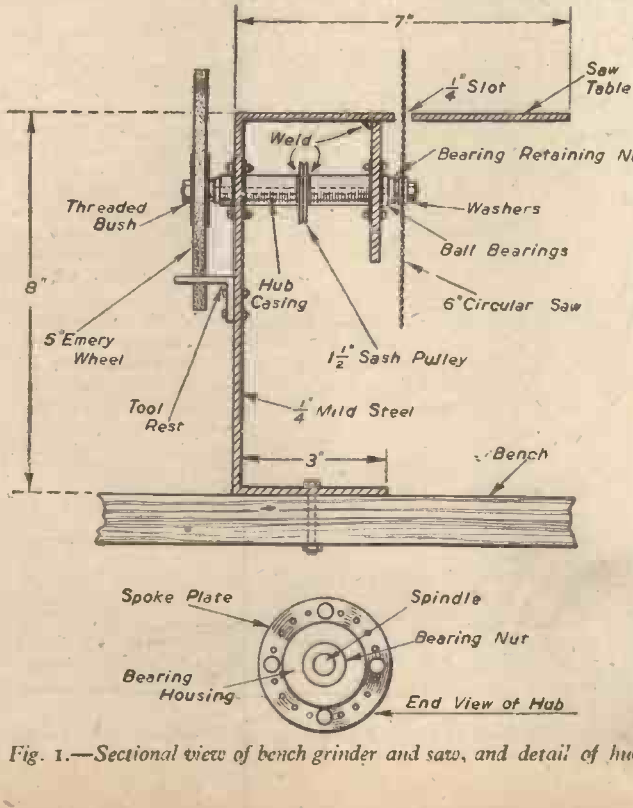


Fig. 1.—Sectional view of bench grinder and saw, and detail of hub.

Pedal Swit.h

Obtain a bakelite-clad switch of the Crabtree pattern with a long and square-sided lever. The spring action should be firm and of the Q.M.B. type. The lever was drilled 1/16in. to take a] fine brass bolt and nut about ½in. long. Two strips of aluminium were cut, 3½in. by ½in. by ⅛in., one end being drilled 1/16in. to fix one each side of the switch lever via the small brass bolt (see Fig. 2). The other ends of these strips were drilled ⅛in. to take suitable 1½in. bolt and spacers. The pedal was made of wood, 7in. by 1¼in. by ⅜in., hinged to baseboard with 1in. butt hinge. The free end was drilled through its width to take the ⅛in. bolt and spacers, the latter being made from indiarubber. The return action is comprised of the inner spring from a car valve spring assembly, fitted with adjustable tension to suit the switch mechanism. The baseboard was mounted with 4 rubber feet, and should be sufficiently large to keep the pedal upright when in use. The pedal switch was connected in parallel (with detachable 2-pin 5 amp. plug and socket) with the "static" motor switch, mounted on a board along with its "cross-arm" reversing switch and bench light switch.

A Q.M.B. action switch, with square section lever.

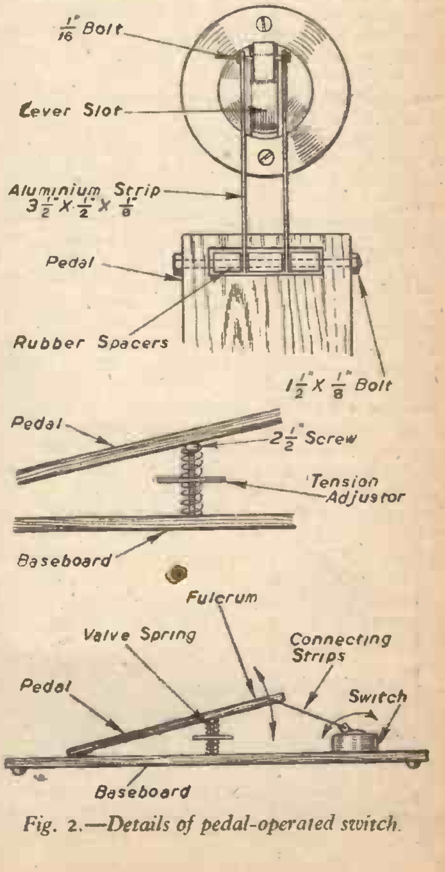


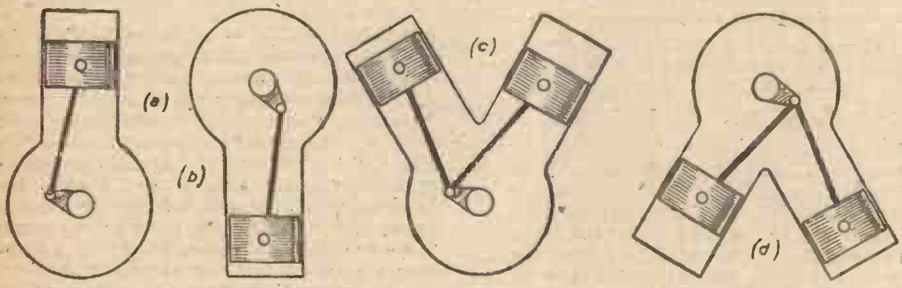
Fig. 2.—Details of pedal-operated switch.

Types of Aircraft Engines

Their Development and Uses in Modern Machines

By T. E. G. BOWDEN, Grad.R.Ae.S., M.I.E.T.

AERO-ENGINES have developed from those used by the pioneers of aircraft construction developing under 20 h.p. to the present-day engines developing over 2,000 h.p., with a possibility of even higher outputs. In the earlier stages steam engines were utilised, e.g., the aircraft designed by Sir Hiram Maxim in 1890 was fitted with a boiler and two steam engines. The disadvantage of this type of engine was the high weight per horsepower, and when the



Vertical in-line. Inverted in-line. Vee. Inverted Vee.

Fig. 1.—Various engine types.

petrol engine was developed, the steam type faded into the background.

Although they suffer from the weight disadvantage, steam engines possess important advantages, e.g., no carburettor, lower revolutions, thus not requiring a reduction gear, and the fact that power is maintained at high altitudes. There have been experiments to try and produce a light steam engine, but so far it has not proved a practical proposition. The possibility of steam engines being used in the future must not be overlooked as their advantages are well worth trying to utilise.

Petrol Engine Development

The first petrol engines were extremely heavy, and if a light and efficient engine had been developed earlier the first free flights would have taken place several years before they actually occurred. The engine used by the Wright brothers developed 15 h.p. at 1,300 r.p.m. for a weight of approximately 250lb. Two airscrews were driven from this engine by means of chain drives.

A great deal of development took place during the 1914-18 war, a typical engine being the Rolls-Royce Falcon (250 h.p.). Both in-line and radial types were built, the rotary design being used for a period. The Gnome air-cooled rotary engine was one of the most successful of its type, developing 1 h.p. for every 4lb. weight. In this design the crankshaft was fixed and cylinders rotated around it with the airscrew attached. One of the main disadvantages was the amount of lubricating oil used. Also the detail components required careful manufacturing to enable the whole assembly to balance correctly.

Cylinder Arrangement

The types of aero-engines in present-day use may be generally classified by their cylinder arrangement and whether they are liquid or air cooled. Types of cylinder arrangement are illustrated in Fig. 1. The two main classes are: in-line engines with the cylinders arranged behind each other, and radial engines with the cylinders arranged radially.

Fig. 1 (a) illustrates the vertical in-line type and, as will be seen, the cylinders are arranged vertically above the crankshaft. This design is used mainly for the smaller type of engine fitted to training or sporting aircraft and developing approximately 100 h.p.

An inverted in-line engine arrangement is illustrated in Fig. 1 (b) and this design has proved extremely popular. One of the main advantages is the fact that the view from the pilot's cockpit is improved as compared

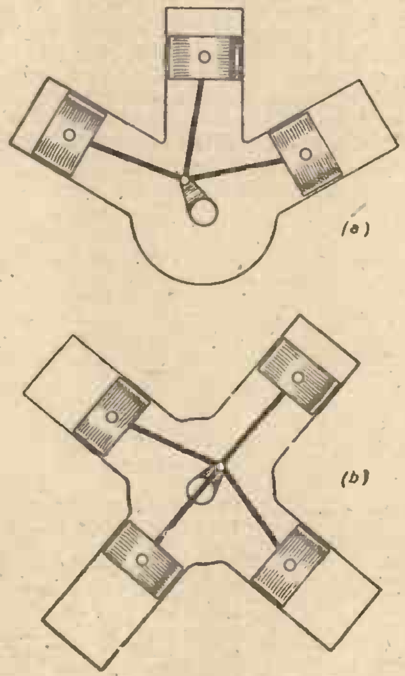


Fig. 2.—" W " engine, and " X " arrangement.

with that obtained when a vertical in-line engine in fitted. The cylinders being arranged underneath the crankshaft enable the profile of the nose portion of the aircraft to be arranged to give excellent vision for the pilot. The number of cylinders for this type (and also for the vertical in-line) is usually four or six, and the maximum horsepower approximately 200 to 300 h.p.

An additional advantage is the fact that due to the cylinders being in a lower position the engine is more accessible from the ground for maintenance purposes. In a typical light aircraft no trestles are required and the minimum of equipment is needed.

The cross-section area of the vertical and inverted in-line designs is small and the drag incurred is not excessive. A typical inverted in-line engine is the Cirrus Minor, a four-cylinder design developing a maximum of 90 b.h.p. at 2,600 r.p.m. The bore and stroke are 3.74in. and 5.00in. respectively. A medium compression ratio of 5.8 : 1 is used.

The Menasco Buccaneer is a six-cylinder inverted in-line design developing a maximum of about 300 b.h.p at 2,400 r.p.m. This engine has a weight of 1.9lb. per horsepower. The compression ratio in this engine is 5 5 : 1 and it is fitted with a centrifugal supercharger.

Vee Arrangements

The Vee arrangement has been adopted almost universally for the more powerful liquid-cooled in-line engines. The majority of these engines possess 12 cylinders arranged in two rows of six. It would be impracticable to arrange all the cylinders one behind the other due to the length of engine required. A common crankshaft is utilised, resulting in a compact unit. The frontal area is small and the profile allows an efficient streamline form to be designed when fitting this type of engine to an aircraft.

An additional advantage is the fact that when fitted to military aircraft, machine-gun bullets will tend to glance off the cowling rather than penetrate due to the profile. This allows a lighter weight of armour to be fitted.

This design of engine is shown in Fig. 1 (c) and is fitted to the majority of present-day high-speed British aircraft. The weight per horsepower has dropped from 3lb. to approximately 1lb., with an increase in horsepower from 400 to 2,000 during the last 25 years.

The angle between the two sets of cylinders is important and is usually 60 deg. The reason for this value is as follows. In the case of a 12-cylinder engine the number of power strokes per one revolution of the crankshaft is six. By arranging the cylinders at 60 deg. to each other the power strokes follow each other at regular intervals, i.e., at 60 deg

A typical engine of the above design is the Rolls-Royce Merlin which is manufactured under various mark numbers for different purposes. The cylinder blocks are separate aluminium alloy castings incor-

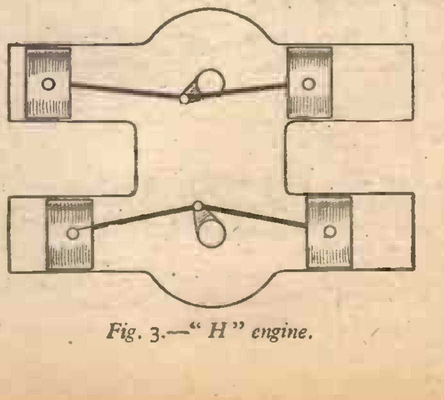


Fig. 3.—" H " engine.

porating the cylinder heads. These blocks are attached to the cast aluminium crankcase which is in two halves. The lower half incorporates the oil pumps, hydraulic pump drive and forms the sump. In the upper half are mounted the reduction gear and main bearings. Steel liners are fitted to the cylinders and incorporate rubber jointing rings to prevent loss of coolant and to provide good joints. The supercharger is mounted at the rear end, and is of the centrifugal type

Inverted Vee

The inverted Vee design, illustrated in Fig. 1 (d), has been developed mainly in Germany. The Junkers firm have produced many inverted 12-cylinder, liquid-cooled engines. The general design does not differ from the other Vee type except that in these engines the fuel is injected direct into the cylinders, this method being described later.

Air-cooled inverted Vee types are also used and have proved extremely efficient. The problem of cooling these engines has developed several novel ideas, and the method adopted for the Gypsy 12 is extremely interesting. Instead of taking cooling air from the engine cowling it is taken from two inlets in the wing leading edge, one each side of the engine. The air then flows forward to the engine and passes round the cylinder fins. After performing its duty the air is vented out underneath the engine by means of an adjustable gill.

By adopting the above method an efficient profile giving a very small amount of drag may be designed. To control the amount of air passing through to the engine the adjustable gill may be opened or closed. For cruising conditions the gill is practically fully shut, as the amount of air passing through is sufficient at these speeds.

W Arrangement

An alternative arrangement to the V is the W design illustrated in Fig. 2 (a). An alternative name is the "Broad Arrow" arrangement. In this case there are three banks of cylinders arranged at 60 deg. to each other. By this means the engine can be made shorter in length, which is a definite advantage. The main reason why this arrangement has not been adopted is the fact that the frontal area is greater than the Vee engine.

However, this design was used for a period when aircraft speeds were not high and drag was not so important as it is now. A successful engine of this type was the Napier Lion. This engine had three banks of four cylinders and developed about 500 b.h.p. at 2,000 r.p.m. The bore and stroke were 5.5in. and 5.125in. respectively.

X Arrangement

Fig. 2 (b) illustrates the X arrangement, which is in effect a Vee and an inverted V placed one on top of the other By this means 24 cylinders can be accommodated for an extremely small frontal area. The horsepower developed by this type of engine is extremely high, at least 2,000, and probably with more development up to 3,000 b.h.p.

The Rolls-Royce company developed an engine of this type named the Vulture and which was fitted to the Avro Manchester bomber. A 24-cylinder German design is the Mercedes-Benz engine. These engines are still being developed and even higher horsepowers may be expected.

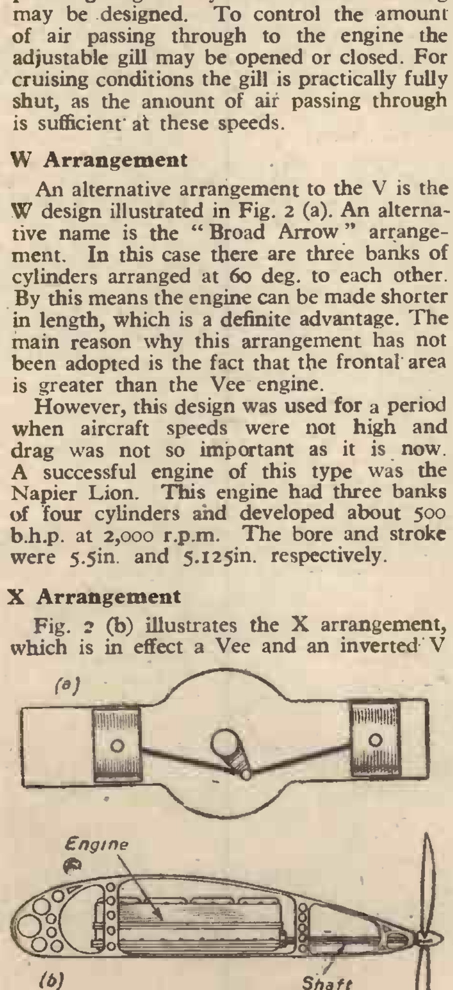


Fig. 5.—Opposed engine, and wing installation.

H Arrangement

This arrangement of the cylinders has been in use for some considerable time. As will be seen from the diagram (Fig. 3) two crankshafts are required with a consequent increase in the number of parts. The advantages of this arrangement are as follows. When high-powered engines are required it is more efficient to increase the number of cylinders rather than increase the size of the cylinders above a certain limit. Higher engine speeds are also obtainable and the cooling is easier than when larger cylinders are fitted.

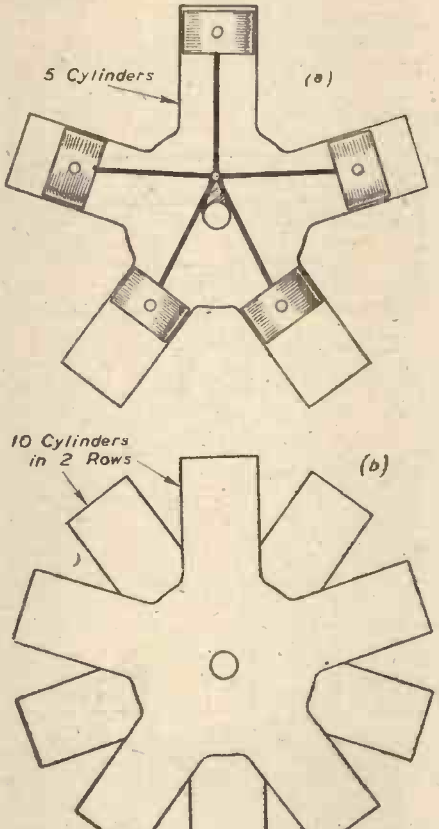


Fig. 4.—Single row and double row radial engines.

The Napier Dagger was an H-type engine with 24 cylinders developing 1,000 h.p. at 4,000 r.p.m. This engine was air-cooled and weighed approximately 1.5lb. per horsepower. Further developments of the H engine have taken place, but full details have not yet been released.

Radial Engines

As shown in Fig. 4 (a) the cylinders in a radial engine are fitted radially around the crankcase Due to the position of the cylinders the problem of cooling is not so difficult as that for in-line air-cooled engines. At one time it appeared as though the radial engine was being superseded for all the faster aircraft, but recently, due to careful cowling and increased output, they have been used to the same extent as have the in-line liquid-cooled engines.

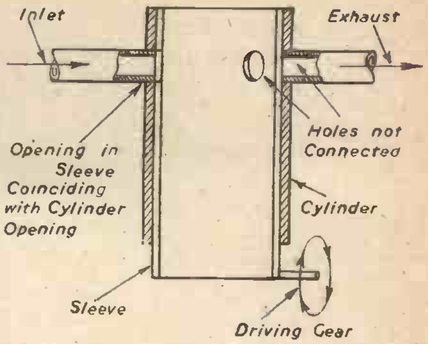


Fig. 6.—Section of sleeve valve.

The number of cylinders varies from five to 18, a normal maximum of nine being arranged in one row. Above this figure the cylinders are arranged in two rows as shown in Fig 4 (b). An interesting point is the fact that odd numbers are always used for each set of cylinders, and fire, in the case of a seven-cylinder engine, 1-3-5-7-2-4-6. The reason for this is to obtain evenly spaced power stroke impulsion, 1-3-5-7 for the first revolution of the crankshaft and 2-4-6 for the second revolution.

An advantage of the two-row design is the fact that the frontal area is reasonably small and allows a considerable increase in power without increase in drag. If desired, the same output may be obtained from a two-row engine with more cylinders than a single row and at the same time possess a smaller frontal area. In the future, no doubt, three-row radials are a possibility.

Radial engines vary from the light seven-cylinder Pobjoy type developing a maximum of 95 b.h.p. at 3,650 r.p.m. to the Wright Cyclone which develops 2,000 b.h.p.

Horizontally Opposed

Fig. 5 (a) illustrates the horizontally opposed design in which the cylinders are mounted above and below the crankcase. The main advantage and probable future use of this type is the fact that it may be fitted within the profile of a wing, thus reducing drag to an absolute minimum. The airscrew shaft may protrude either from the leading or trailing edge to form an extremely compact assembly. By careful designing of the mountings and access panels, the maintenance difficulties should not be any worse than those of many present-day aircraft. Fig. 5 (b) shows such an engine driving a pusher airscrew.

A small opposed engine is the Continental (American) four-cylinder design which develops 50 h.p. at approximately 2,000 r.p.m. A larger engine is the Lycoming, also American, which has 12 cylinders and develops 1,200 b.h.p. at 3,400 r.p.m.

Sleeve-valve Engines

Sleeve-valve engines are now firmly established, and are being used in ever increasing numbers. One of the main advantages of this type is the reduction in the number of working parts, as there are no tappets, push rods, etc. The principle of operation is as follows. From Fig. 6 it will be seen that the cylinder contains a sleeve with apertures at the upper end. The sleeve is rotated by gears from the engine crankshaft and moves up and down as well as partly rotating. The apertures, or ports, as they are termed, line up at the correct times with the inlet and outlet connections of the cylinders. The cycle is the same as

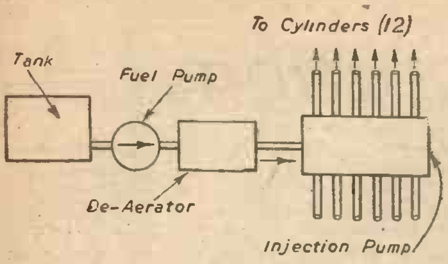


Fig. 7.—Injection system.

that for the poppet valve engines, i.e., all the ports are shut in the compression stroke, etc.

There are many other advantages, apart from the reduction in the number of parts, and several of them follow. Firstly, the sleeve-valve engine is comparatively silent in operation due to the elimination of the usual valves. Secondly, it is possible to use higher compression ratios with higher boost pressures. Thirdly, the volumetric efficiency is high, due to the large port openings which allow the mixture to flow into the cylinder very easily.

The Bristol Hercules is a typical modern high-powered sleeve-valve engine. It is a 14-cylinder, two-row radial, developing 1,400 h.p. at 2,800 r.p.m.

Petrol Injection Engines

The method of delivering fuel to the engine by the direct injection system has now been developed to a high degree of efficiency. Germany has been the main country for this type, and a typical engine is the B.M.W.801. The carburettor is not required, and in its place there is a fuel metering unit. Fig. 7 illustrates the system diagrammatically.

The fuel may be directed to the cylinders themselves or to the induction system. In the first case the fuel is delivered at intervals during the compression strokes. This is known as direct injection. In the second method, or continuous injection, the fuel is fed into the induction pipes so that the usual petrol-air mixture is drawn into the cylinders.

A more detailed description of the direct injection system is as follows. The fuel injection pump unit is fitted between the Vee arrangement of the cylinders and receives petrol from the tanks via a normal pump. Before passing to the injection pump the fuel is de-aerated.

The pump unit consists of a series of plungers, one for each cylinder. These plungers are operated by means of cams which give a quick delivery movement and allow the plungers to be returned by means of springs. The fuel is then fed to the cylinders via the injectors which are screwed into the cylinder heads. To obtain an efficient jet of fuel, the injector is designed to produce a hollow, conical-shaped jet of approximately 60 deg. The amount of fuel injected can be varied by rotating the plungers.

An automatic control to give the required mixture strength is connected to the plungers. The control is a capsule and operates under the varying air densities occurring in the supercharger diffuser. Manual operation by the pilot is also catered for by the necessary linkage.

By doing away with the carburettor icing problems are non-existent, provided the air intake is guarded correctly. The danger of fire occurring is also lessened, and the mixture delivered is more uniform than that delivered by the normal carburettor.

C. I. Engines

Compression ignition engines function as follows. By compressing a gas the tempera-

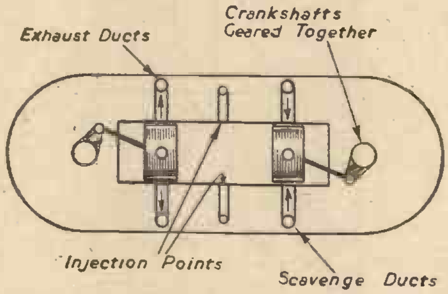


Fig. 8.—Diagrammatic section of a Junkers Jumo.

ture increases until it reaches a point at which self-ignition takes place. Thus, no ignition system is required, an important advantage. The actual fuel is injected into the cylinder almost at the end of the compression stroke and ignites immediately.

To obtain the high temperatures required, the compression ratios of C.I. engines are extremely high, an average figure being 18 : 1. Instead of petrol, oil is used as the fuel, and thus the danger of fire is greatly reduced. Unfortunately, due to these high compression ratios, the engine has to be strengthened considerably, thus adding to the weight. This disadvantage outweighs the advantages of cheap fuel and low consumption, otherwise C.I. engines would be used in far greater numbers than they are at the present time.

An interesting C.I. engine is the Junkers Jumo, of which several versions have been constructed. They are of the opposed piston two-cycle type, developing a maximum of 800 b.h.p. at 1,850 r.p.m. Six double cylinders are incorporated as illustrated in Fig. 8. The engines are water-cooled, and have proved quite efficient.

Aspin Engine

The unusual feature of the Aspin engine is the fitting of an unorthodox cylinder head valve assembly. A rotary valve fits into a conical head, which opens and closes the inlet and exhaust ports at the correct intervals. The advantage of this design is the elimination of the usual hot-spots which occur in the poppet valve engines. This makes possible the use of a higher compression ratio without the dangers of detonation.

Barrel Engine

Another unusual engine is that in which the cylinders are positioned parallel to the main shaft. To rotate this shaft a swashplate is attached and operated by piston rods from the pistons. The main advantage of this engine is the small frontal area, approximately one half of the normal radial design. Viewed from the front, the main shaft is central and the cylinders are arranged radially with their axes running parallel with the shaft.

Conclusion

Of the various types of engines described, the sleeve valve appears to be the one to be used chiefly in the next few years. Development of the flat type of engine is likely, as in the future they must be housed within the wing profile to reduce the drag to a minimum. Compression ignition engines with a reduced weight per horsepower may rival the other types, and by using oil should prove attractive for post-war transport aircraft.

Typhoons in the Making

THE production of the Hawker Typhoon single seat fighter is now approaching that of the Hurricane, a great number of which were supplied to the R.A.F.

The Typhoon fighter-bomber has already shown itself more than a match for any of its German "opposite numbers." This 'plane carries two 500lb. bombs with thin casings which have the blasting power of ordinary bombs twice their weight. With this 1,000lb. bomb load it can fly at 400 m.p.h., nearly twice the speed at which our 1939 medium bombers carried the same weight. The new fighter-bomber is superior to the F.W.190, in that the German machine can stay over a particular target for only a few seconds, whereas our 'plane can make deep inroads over enemy territory.

The illustration shows many Typhoons being assembled at a Hawker factory. The Typhoon is reputed to be one of the most formidable fighter aircraft yet in service.

Refrigeration Applications

Its Uses and Method of Operation

By A. S. PASCOE

REFRIGERATION is taking a very active part in the war effort, the extent of which is not generally realised. Apart from the preservation of food, it is concerned with the manufacture of synthetic rubber, oil refining, explosives, photography, fuse loading, plastics, petroleum, lens grinding, welding, and other processes too numerous to mention. Air conditioning alone has made possible the amazing accuracy of the modern bombsight, various firing devices, and any process where a very close degree of tolerance is required.

In the Aircraft Industry

It is in the aircraft industry that refrigeration has made the greatest contribution. The testing of engines, instruments, carburettors, investigation into ice formation on lifting surfaces and airscrews, production of stratosphere conditions, and the fitting of bearings by shrinkage, necessitated the production of low temperatures in the region of -70 deg. F. to -100 deg. F. Low temperatures were usually produced by means of CO_2 machines, or solid CO_2. The production of these special machines would cause delay, so several of the fractional and small horsepower manufacturers decided to use their existing products, with the added advantage that service and spares were available in all parts of the country. This, of course, entailed the use of existing refrigerants in use, particularly Dichlorodifluoromethane, known in the trade as Freon. Doubts were expressed as to whether the low temperatures involved could be produced with these refrigerants.

Evaporation Temperatures

Evaporation temperatures in the region of -100 deg. F. meant that the compressor had to be able to handle large volumes of refrigerant, at low pressures in the region of 28" vac. At a standard evaporation temperature of 5 deg. F. Freon has a volume of 1.485 cu. ft. per lb.; at -70 deg. to -100 deg. F. the volume is increased 20 to 25 times (see Fig. 1.). The refrigerating effect is dependent upon the weight of gas circulated, and to produce 1 ton or 200 B.T.U.s of refrigeration per minute at 5' F. requires the removal of 5.81 cu. ft. per minute, volumes 20 to 25 times as great necessitated large cylinder displacement. This was overcome by fitting a boost or first stage compressor, which enables the second stage to work on a back pressure of 0lb. to 17lb. per sq. in., which also increases efficiency by reducing the ratio of evaporation to condensing temperatures. It was also necessary to cool the condensate to as low a temperature as possible, otherwise the size of the condensing unit would be prohibitive, due to low efficiency. The refrigerating effect per lb. of refrigerant is found by subtracting the heat content of the liquid from the total heat content of the gas coming off the evaporator. If the heat content of the liquid can be reduced, the refrigerating effect can be increased (see Fig. 2.) To quote an example, a condensing unit of 1 ton capacity working at 5 deg. F. evaporation, and 86 deg. F. condensing is required to circulate 3.92 lb. of refrigerant per minute. If the condensing temperature can be reduced to -40 deg. F. it would be only necessary to circulate 2.538lb. per minute. Theoretically, the volumetric capacity of the compressor could be reduced from 5.81 cu. ft. to 3.77 cu. ft. It is thus possible to keep compressor sizes within reasonable limits. In actual practice the head-laden gas from the second stage is cooled by water, part of the condensate then being used to cool the remainder in the liquid receiver. The heated gas from the precooler is then carried back to the second stage for recompression, as shown in Fig. 3. Another method is to expand the condensate coming off the condenser, through an expansion valve into the liquid receiver.

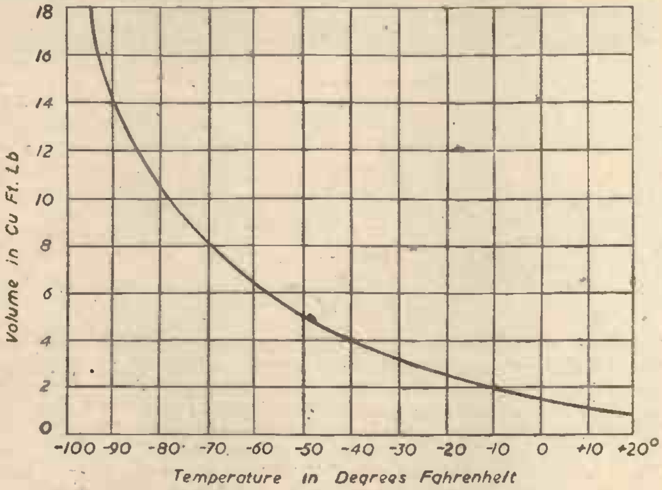


Fig. 1.—Volume and evaporation temperature curve.

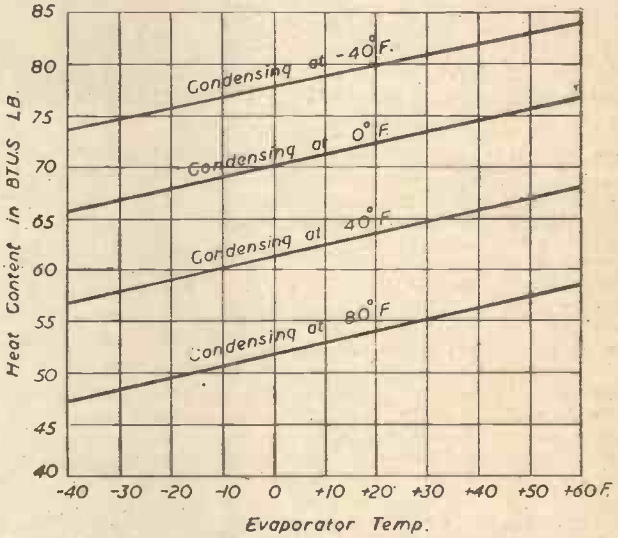


Fig. 2.—Refrigerating effect in relation to heat content.

Two-stage Unit

One manufacturer has used a standard twin-cylinder compressor, to act as a two-stage unit, by means of suitable alteration to the cylinder head. Another has used a separate condensing unit, to cool the condenser of the main unit. This, of course, obviates the use of stage compression and simplifies design (see Fig. 4). Oil separation must be used, otherwise any oil carried into the evaporator will solidify, and either choke the system or considerably reduce the rate of heat transfer.

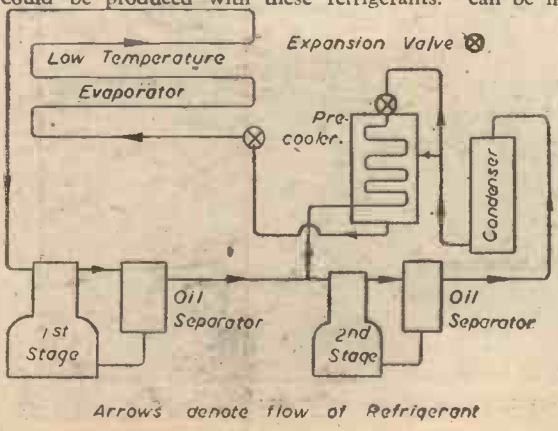
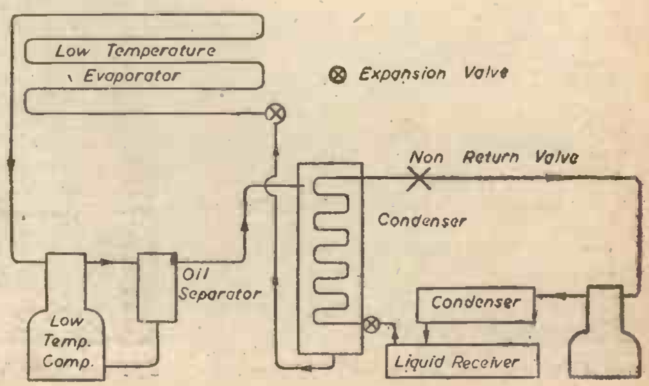


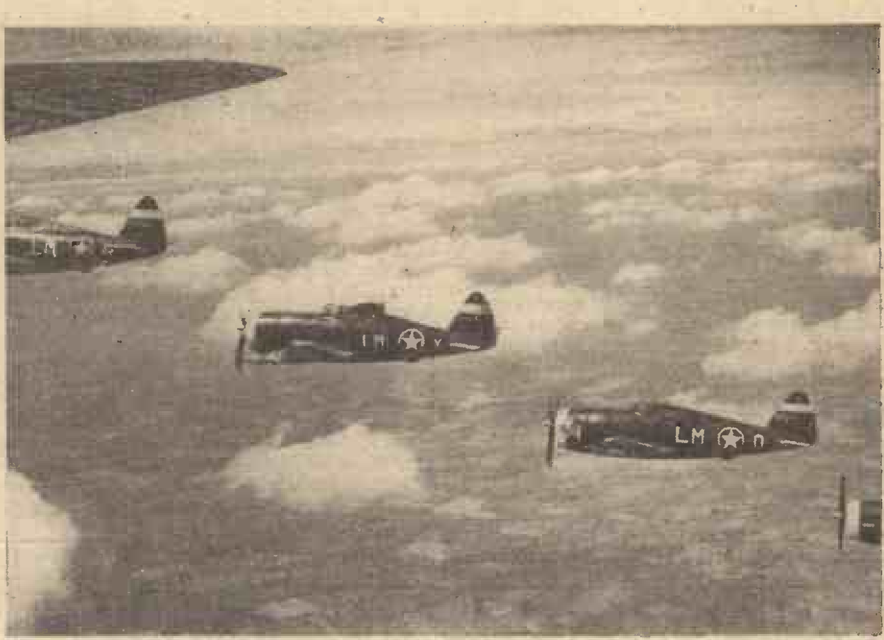
Fig. 3 (Left) and Fig. 4.—Diagrams showing the cycle of operations of two methods of refrigeration.



Half-inch or Three-o-three?

The Possibilities of Heavier Armament for Aircraft

By RAY GORDON



Aerial view of American "Thunderbolts" flying over the clouds. One of the heaviest single-seat fighters in service, the machine is designed for high altitude flying—around 40,000 ft., and has a top speed of 400 m.p.h. The armament consists of eight .5in. calibre machine guns, giving a total rate of fire of 6,400 rounds a minute.

AMERICAN claims to have destroyed such large numbers of enemy fighters in the course of bombing raids over northern France (and, to a lesser degree, over Germany), while indisputable, are still accepted with, shall we say, considerable reserve by those who have not yet realised the terrific weight of defensive armament carried by the American bombers. Pride in the exploits of our own aerial gunners, and highly justifiable pride it is, too, tends to blind us to the fact that the Americans have been quicker than the British to learn the lessons of aerial combat, and that, in consequence, their heavy bombers are now streets ahead of ours in so far as defence against enemy fighters is concerned.

As bombers, the Flying Fortresses may not be quite so efficient as our own Stirlings and Lancasters, carrying as they do a smaller bomb load. But it is an essential for bombing raids that the bombers get through, and return, without an undue number of losses. True, our bomber crews have always achieved their objective, and wrought terrific destruction, but that is no reason why we should overlook any means of cutting down our losses.

The German Policy

In the Battle of Britain our fighters proved that German policy, which relied on the speed of its bombing 'planes rather than defensive armament, was fundamentally wrong. Our fighters shot down the enemy to such an extent that the Luftwaffe had to call off large-scale daylight bombing raids.

The Germans were not alone in thinking that the high-flying and comparatively fast bomber did not need heavy defensive armament. The American Flying Fortress, most boosted of all big bombers, was, in its earlier versions, almost completely unarmed. Its sponsors claimed that its ceiling and speed were such that no enemy fighter could get within attacking range . . . but long before it could be put to a real test American designers were profiting by the lesson which the R.A.F. had learned, at the enemy's expense, in the Battle of Britain. R.A.F. policy was to install power-operated gun turrets on its heavy bombers. U.S.A. designers, looking one step further ahead, paid less attention to power-operated turrets, and concentrated on increasing the weight of defensive armament . . . the famous "half-inch" gun against our .303 inch.

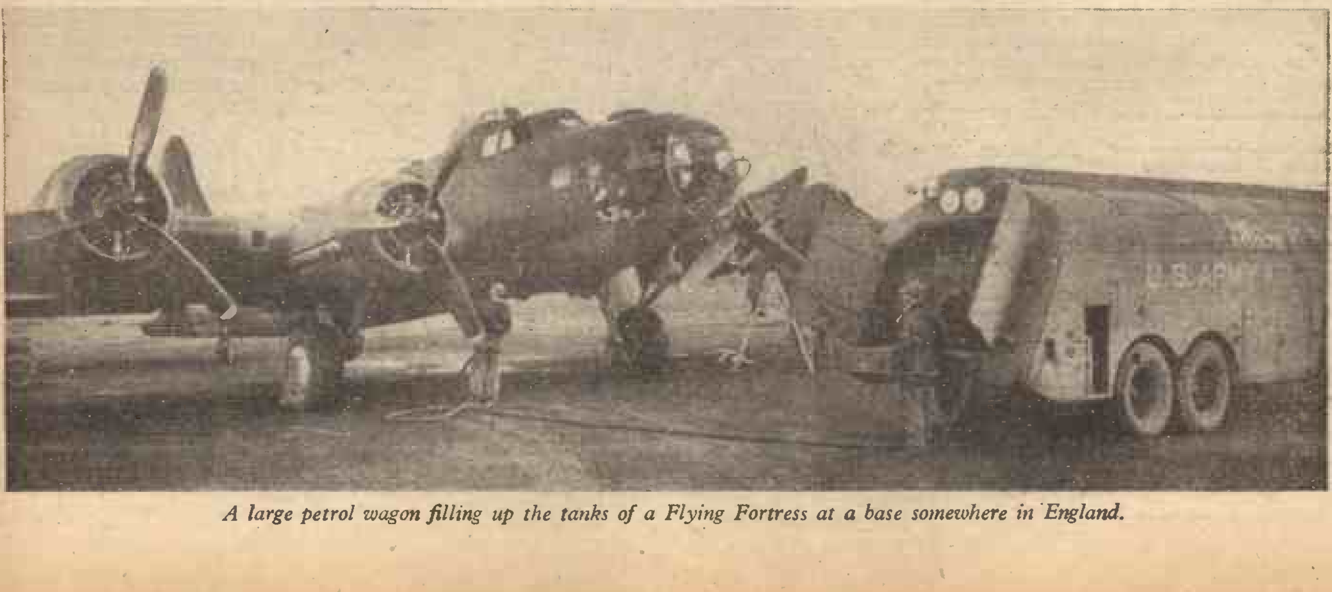
The Fortress

Are we lagging behind the Americans? The Fortress II is now a Fortress in more than name, and has proved its ability to carry out deadly bombing raids while shooting down the attacking enemy fighters by the score. Our bombers, admittedly handicapped by the fact that they are principally used on night operations (the bulk of the American raids having been carried out in daylight) not only fail to reach the impressive American scores, but are themselves all too frequently shot down. (The exact figures are known only to the Germans, naturally, but, taking a line through announced figures of German bombers brought down over this country by our fighters as against by our ground defences, it is fair to assume that a large proportion of our losses over Germany are occasioned by attacking night fighters.)

Turrets

Our bombers may be equipped with impressive power-operated turrets which enable the gunner to train and fire his guns quickly and accurately, but are those guns themselves capable of the task demanded? A turret fitted with four .303in. machine-guns can pump out over 4,000 bullets per minute to an effective range of 400 yards. The obvious defence to this is to equip the attacking fighter with armour which, while light enough not to interfere with the 'plane's performance, is yet heavy enough to resist a .303in. bullet at normal range, and, further, to equip the fighter with armament which has a greater range than the .303in. gun, so that the attack can be delivered from beyond the effective range of the bomber's gunners.

And this is what the Germans have done. A cannon-armed fighter can "tail" one of



A large petrol wagon filling up the tanks of a Flying Fortress at a base somewhere in England.

the bombers, keeping out of range, and pick off the bomber at leisure.

At first sight the American bomber would appear inferior in defensive armament. It can bring fewer guns to bear on an attacking fighter, most of the guns are manually trained, and are slower in coming to bear on the target, and the .5in. machine-gun has an appreciably lower rate of fire, something over 600 bullets per minute as compared with the 1,000 plus of the .303in. gun.

Bombing up a Typhoon fighter bomber. This single-seater day and night fighter is powered by a 2,400 h.p. Napier Sabre engine. Two types of Typhoon are now in service, MK1A, equipped with twelve .303 machine guns, and MK1B, with four 20 mm. cannon. The muzzles of two of these formidable weapons can be clearly seen in the illustration.

Facts about Bullets

But, outweighing all these apparent defects, are two vital factors . . . the .5in. bullet reaches out to an effective range of 800 yards, and the combination of higher muzzle velocity and very much increased weight give it a penetrating power far in excess of the .303in.

An enemy fighter attacking a bomber armed with .5in. guns has to keep at least 800 yards away, instead of 400 yards with the .303, and its own effective fire is accordingly reduced. It would, of course, have its protecting armour plate stepped up in weight to resist the .5in. bullet (which goes through .303 armour like cardboard), but the increase in weight would be such that the performance of the fighter would be materially affected.

For the time being, at any rate, the .5in. armed bomber can hold its own against fighter attack.

A Change Necessary ?

Unless, for reasons known only to the higher authorities, there is some as yet undisclosed advantage to be obtained from the faster-firing .303in. guns, then it would appear that the time is overdue for a change in our defensive armament. Although the substitution of .5in. guns for .303 would involve considerable manufacturing changes, the basic design and principles of our power-operated gun turrets would not be affected, and there are no really difficult design problems to be solved before effecting the change.

True, it might not be possible to cram four .5in. guns into a turret originally holding four .303in. guns (for the guns, and their accompanying ammunition, bulk very much larger) without enlarging the turret structure, and, in consequence, altering the airframe to accommodate it. But it does not seem to be necessary to carry four .5in. guns in a turret . . . two .5in. guns would be more effective than four .303's.

It might even be possible to go one step further and fit 20 mm. cannons to the turrets, thus securing an even heavier weight of fire, but the greatly increased size and weight of the cannon, as against the machine-gun, introduces many difficulties.

If warfare teaches us anything, it is that we must always be one jump ahead of the enemy if we are to win. We gained a terrific advantage over the Luftwaffe when we fitted the power-operated turret. The enemy countered with increased range and armour. The next move is up to us.

Bomb Load

It may be that our strategy demands that prior consideration be given to the bomb load, and that it has been decided that increased weight of defensive armament cuts too deeply into the "payload" of bombs carried, but there is a way round this. One bomber of each squadron could be fitted with .5in. guns, to the exclusion of part of its bomb load. It would then shepherd the squadron on its flight out and back, and, as far as present information on enemy fighters goes, it at least should be able to keep such fighters out of effective range, and, at most, be able to shoot them down.

The famous "dam raids" on Germany, when 19 of our heavy bombers between them wrecked three dams vital to the enemy's war industry, and wrought damage to an extent which we are even now only just beginning to appreciate, will serve as a very useful example of the value of heavier defensive armament. An attack on such selected targets calls for absolute accuracy on the part of the bomb-aimer . . . near enough will not do, his bombs have to be dead on. The bomb-aimer, in turn, calls for a smooth approach from the pilot. The 'plane has to run in on the target in a straight line, what time the bomb-aimer adjusts his sights and prepares to "press the teat" to release the payload at the exact split second.

If the 'plane is being harried by enemy fighters, the pilot has to choose between (1) ignoring the attack and sticking to his bombing run, (2) taking avoiding action or (3) relying on the gunners to keep the fighters at bay while he completes the bombing run.

Alternative (1) may result in the attainment of the objective, but the loss of the 'plane and crew. Alternative (2) may save the 'plane and crew, but the raid will be wasted if the objective is not hit. Alternative (3) will give us both the objective and the chance of the safe return of 'plane and crew, provided the 'plane's defensive armament is sufficient to keep the fighters at bay.

For pin-point raiding such as this, surely the case for the .5in. gun is unanswerable ?

Mosquitoes and their pilots standing by in readiness for a take-off for a raid. This twin-engined R.A.F. reconnaissance bomber is of wooden construction, and has two Rolls Royce engines. Its armament consists of four 20 mm. cannon, and four .303 machine guns.

The Story of Chemical Discovery

Poisons from Plants

About the Alkaloids, Nature's Most Potent Poisons and Deadliest Drugs

IT is a curious fact that many of the most powerful poisons known to chemical science are of plant or vegetable origin.

Take, for example, nicotine, the active principle of the tobacco leaf. Nicotine, in its pure state, is an almost colourless, oily liquid, and it is so intensely poisonous that the swallowing of only two or three drops of it will lead to almost certain death within a few minutes.

Strychnine is another of these ultra-poisonous plant products. So, also, are hyoscine, morphine, brucine, coniine, atropine, cocaine, and many other similar products.

In all, there are about 400 of these excessively poisonous plant substances, but of these only a relatively small number, not more, in fact, than about two dozen of them, are made use of by present-day medical science, by far the greater number of them still remaining more or less obscure substances and mere chemical curiosities.

At the commencement of the last century, when, chiefly through the multifarious activities of the renowned Swedish pioneer chemical worker and apothecary, Carl William Scheele, numbers of natural substances were beginning to be extracted from plant, vegetable and animal sources, it was observed that all these extracted materials were either acidic or neutral in chemical character. They were never alkaline in

The source of opium and morphia—Oriental poppy heads.

reaction. Hence, the theory grew that no natural substance could possess alkaline properties.

When, however, in later years, the intensely potent plant-obtained drug substances, such as morphine and strychnine, came to be examined chemically, it was discovered that they were all definitely alkaline or, as the chemical term is, "basic," in nature, so much so that they were able to combine with acidic substances to form well defined chemical salts.

Thus, morphine, the active principle of

Joseph Pelletier (1788-1842), *the discoverer of strychnine.*

opium, can react with sulphuric acid to form a chemical salt, morphine sulphate. Likewise strychnine, in combination with nitric acid, forms strychnine nitrate.

In view of the "basic" or alkali-like character of these plant poisons, they were given the generic name of "alkaloids," which term has ever since been reserved exclusively for their designation.

Nitrogen in Alkaloids

It is often the case that alkaline substances contain nitrogen, and the alkaloids are no exception to this rule, for, in nearly every case, they contain nitrogen combined in a very complex manner with carbon, hydrogen and oxygen. Indeed, the precise chemical constitution of many of the alkaloids is so complicated and obscure that chemical science is still in doubt as to their exact nature.

Although some alkaloids, such as cocaine, coniine and nicotine, can be synthesised, that is to say, made artificially in the laboratory, many important alkaloids, notably morphine, strychnine and quinine, cannot be made artificially, since their exact chemical make-up is not yet thoroughly understood.

Many have been the attempts to synthesise quinine, one of the most important and the least poisonous of the alkaloids, but without success. Young William Perkin, a lad of eighteen years of age, was endeavouring to synthesise quinine when, quite by chance, he hit upon *mauve*, the first of the aniline dyes. This coloured compound was not what Perkin had hoped for. Nevertheless, it enabled him to set up a new industry and, before long, to retire on the profits.

Indeed, if anyone could synthesise quinine he would confer a great benefit on humanity, particularly at the present time, whilst, by synthesising morphia, or morphine, he would also rid the modern medical world of its dependence upon the ubiquitous opium poppy, although, no doubt, he might be severely called over the coals by the Home Office for having in his possession a dangerous drug!

Laudanum and Morphia

Opium has long been the friend, the last refuge, and, alas, the confirmed enemy of suffering man. It is, essentially, the dried juice of certain kinds of poppy heads. When dissolved in alcohol or rectified spirit to the extent of about 1 grain of opium in 15 minims of spirit it is known as *laudanum*.

The use of opium dates back at least to the third century before Christ, yet it was not until the beginning of the nineteenth century that some serious attempt was made to ferret out the elusive, active and narcotic principle of opium. The first lasting success in this direction came to a 21-year-old apprentice, Friedrich Wilhelm Sertürner by name who, working in a Westphalian pharmacy, separated from crude opium an acid

Modern extraction plant for the manufacture of strychnine.

"Enough to kill a regiment!" A quantity of strychnine sulphate, *one of the most violent of known poisons.*

which he termed meconic acid, and, also, an active principle which he found to possess in an intensified degree all the physiological activity of native opium and of opium extracts.

This active principle he named "Morphium" (from *Morpheus*, the Greek god of dreams and of sleep). Gay-Lussac, the French chemist, shortly afterwards altered the name to "Morphine," whilst, in this country, this exceedingly potent material is nowadays commonly known as "morphia."

Now, morphia, or morphine, is so excessively poisonous that less than a single grain of it may well prove to be a fatal dose to a strong man in robust health. Yet, in doses of a quarter or a fifth of this amount morphia constitutes one of the most valuable and indispensable adjuncts of modern medicine in virtue of the certain and speedy manner in which it relieves and nullifies intense pain.

Morphine is the most reliable pain-killer which we know of. It is, perhaps, the alkaloid of alkaloids, so far as its humane uses are concerned. Yet, chemically speaking, its composition is still more or less unknown. Since 1920, the year of the first of the "Dangerous Drugs" Acts, morphine has been placed on the prohibited list of chemicals which are only obtainable and usable by medical men and others under the most stringent legal restrictions.

When morphine is heated with hydrochloric acid it is converted into apomorphine, which is less poisonous than morphine, and which acts as a powerful emetic when taken internally.

Coniine is one of the simplest of alkaloids. Its composition is known and it can be synthesised. It occurs naturally in the seeds of the spotted hemlock from which it can be extracted by simple distillation with caustic soda solution.

Coniine is a colourless oil when fresh, but it rapidly oxidises and turns brown. It is exceedingly poisonous, its effect being obtained by its power of almost instantly paralysing the respiratory muscle, so that a man poisoned by coniine dies the death of asphyxiation.

Nicotine—Poison No. 1!

Like coniine, nicotine, which is, perhaps, one of the most poisonous of all known substances, is, in its pure state, an oil which turns brown through oxidation on exposure to air. The fact that smokers of tobacco and cigarettes do not usually suffer ill effects is attributable to the very small amount of active nicotine which is present in commercial tobaccos and, also, to a considerable proportion of this substance being destroyed by the slow combustion of the tobacco during the act of smoking. In its pure state, nicotine smells like a rank and foul tobacco pipe. Apart from its presence in tobacco and its employment in the form of its various extracts as insecticides, nicotine has no scientific use in the modern world.

In the seventeenth and eighteenth centuries the Spanish Jesuits introduced into Europe from Peru various kinds of tree barks (cinchona barks) which, when infused with water, were found to have a powerful effect in reducing fevers. "Jesuits' bark," as this valuable commodity was termed, was responsible for the cure of countless thousands of fever patients in Europe. It was not, however, until 1820 that the alkaloids, quinine and cinchonine were first extracted from the Peruvian bark by a pair of French chemists, Peter Joseph Pelletier and Joseph Cabentou, both of whom were quite young men at the time.

From Pelletier's discovery of pure quinine a new industry quickly arose. In 1823 Luke Howard set up the first quinine factory at Stratford, London, whilst in Holland, France

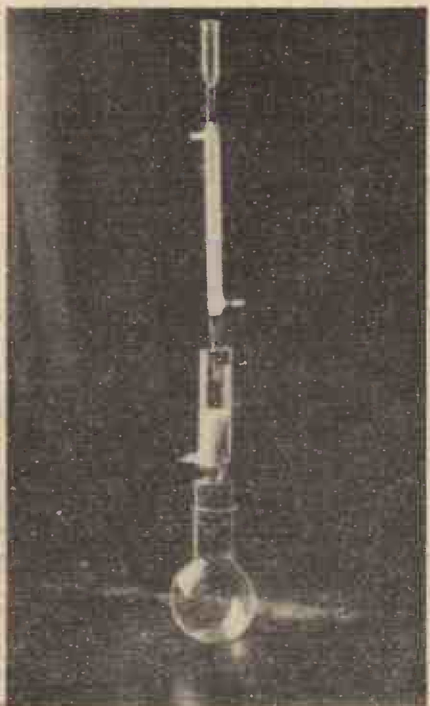
Friedrich Wilhelm Sertürner, the discoverer of morphia (from a bronze plaque).

and Germany similar quinine-extraction plants were put into operation. Next to morphine, perhaps, quinine might be considered to be the most important alkaloid, although, apparently, there are now substitutes for it.

Before he had discovered quinine and cinchonine, Pelletier had experimented on the active principle of ipecacuanha, and in 1817 he had discovered in that natural substance a powerful emetic, an alkaloid which he termed "emetin."

Discovery of Strychnine

The year after followed Pelletier's discovery of strychnine, which he extracted



Laboratory apparatus for the extraction and analytical estimates of belladonna.

from the Ignatius bean and from the seeds of the plant, *Strychnos nux vomica.* Pelletier did not experiment much with strychnine. It was too poisonous for his liking! Subsequent workers, however, showed that, when pure, this alkaloid takes the form of white rhombic crystals which are only very slightly soluble in water.

Strychnine has the distinction of being the bitterest thing known. Even at the dilution of 1 part in 10,000 parts of water, its solution is intensely bitter. The pure alkaloid is, of course, a terrible poison, being, if anything, even more poisonous than morphine. Less than half a grain of strychnine sulphate has been known to cause death in a quarter of an hour. Death by strychnine poisoning is a very painful and, indeed, an agonising process, the victim being involuntarily contorted and twisted about under the influence of the most violent spasms. No wonder, therefore, it is that the most recent Poisons Regulations have placed much restriction on the sale and use of strychnine and its preparations.

Despite its formidable characteristics, strychnine, in minute quantities, is a most useful alkaloidal drug. In exceedingly small doses it acts as a general tonic to the body. In slightly larger doses it tones up the heart powerfully. Indeed, when hypodermically injected in such doses into the body it has often showed itself to be capable of reviving an almost dead person.

Brucine is a near alkaloidal relative of strychnine. It occurs along with strychnine in the *nux vomica* seeds and in the Ignatius bean, and it was first isolated by Peter Joseph Pelletier in 1819, shortly after the discovery of strychnine by this worker.

Cocaine, the Local Anæsthetic

Perhaps the alkaloid which has received the most publicity is cocaine, which is contained in coca leaves. Cocaine was first isolated from this source in 1860 by a German worker, Niemann. In a sense, it comprised the "last of the alkaloids," for no really "big" and industrially important alkaloids have been given to the world since that time.

It had long been known by travellers that South American natives derived remarkable powers of endurance by the simple act of chewing certain leaves of the coca plant, but it was only after a consignment of these leaves had been sent over to Europe that the secret of the coca plant was wrested from it.

It was shown that the active principle of the plant—cocaine—comprised a solid crystalline material which, when injected under the skin in minute amounts, has the valuable property of rendering the area completely anæsthetic, so that a minor surgical operation could take place in that area without the patient feeling any pain.

Unfortunately, cocaine proved to be almost as poisonous as morphine. More than that, it showed itself to be extremely habit-forming, so that an individual who had accustomed himself to taking small doses of cocaine in order to relieve painful feelings, or to brace up a dejected system, found himself compelled to continue with his doses of this deadly material until eventually complete physical (and mental) ruin assailed him.

Cocaine is nowadays much less used as a local anæsthetic than it used to be, in view of the many excellent "cocaine substitutes" which have been made synthetically and which have shown themselves to be non-habit-forming. Cocaine therefore is now on the official "Dangerous Drugs" list, along with morphine and a few other similar poisons of high potency. It is, however, one of the important alkaloids which have been synthesised, and its chemical constitution is well known, cocaine being the methyl ester of benzoyl-tropine-carboxylic acid.

The "Deadly Nightshade" and Atropine

One of the summer plants of the English countryside, the "Deadly Nightshade," contains an exceedingly potent and poisonous alkaloid, to which the name *atropine* is given.

Atropine ranges itself along with strychnine and nicotine in regard to its intensely poisonous nature. It takes the form of white crystals, which are soluble in spirit but not so in water. As small a dose as 0.05 of a gram has been known to cause death.

Atropine has a most remarkable property. Used in very minute doses, it has, when instilled into the eye, the power of dilating the pupil. This fact is made great use of by ophthalmic surgeons during their examination of various conditions of the eye.

A closely related alkaloid to atropine is *hyoscyanine*, which is extracted from the seeds and leaves of the henbane plant. With atropine and traces of other alkaloids, it is present in the medicinal extract known as "belladonna."

There is an interesting alkaloid present in pepper. It is known as *piperine*. It is one of the least poisonous of alkaloids, and it is easily extractable from pepper (particularly from black pepper) by warming the material with approximately double its weight of milk of lime for a quarter of an hour. The mixture is then evaporated to dryness on a water-bath and the residue extracted with ether. After evaporation of the ether extract, crude piperine remains. It is then purified by crystallisation from alcohol. It is a white, crystalline material, melting at 128 degrees C., soluble in ether and alcohol, but almost insoluble in water. It has been used as a blistering agent in view of its skin-irritant nature.

Corpse Alkaloids

Although the term "alkaloids" is normally used to describe these physiologically active products of plant metabolism, it is nevertheless a fact that a number of alkaloidal substances are derived from animal sources. These latter are the so-called "corpse alkaloids," so styled on account of the fact that they are generated in decaying flesh. The "corpse alkaloids" include the *ptomaines*, which latter constitute a class of alkaloid-like compounds, all of which are characterised by their exceptionally intense poisonous nature. Like the true plant alkaloids, the ptomaines are "basic" substances containing nitrogen. They are the chemical compounds which are, in the main, responsible for ptomaine poisoning.

Two clearly defined ptomaines have been isolated and studied. They are "putrescine" (*tetra-methylene-diamine*) and "cadaverine" (*penta-methylene-diamine*). There are many other similar substances, however, known and unknown, but, in view of the fact that they are useless, nauseating compounds, their further study and isolation has not been given very much attention.

The highly poisonous nature and the extreme physiological activity of the more important alkaloids proceeds from unknown causes.

We do not know precisely why strychnine should be so excessively poisonous, and, for that matter, we are still unaware exactly how quinine derives its valuable anti-malarial properties. It is true that physiological activity is dependent upon some particular configuration of the atoms of a substance, as witness, for instance, the fact that the intensely toxic cocaine has proved the "model" for numerous less-poisonous and habit-forming artificial imitations, many of which have had much success in clinical use. Nevertheless, the real reason why the alkaloid compounds prove to be such terrible poisons is, as yet, one of Nature's secrets, the final and successful elucidation of which has yet to be accomplished.

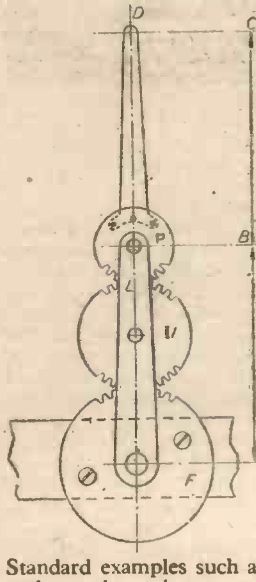
An Epicyclic Cycle Gear

Notes on an Experimental Driving Gear.

By H. F. KING, A.F.R.Ae.S.

As many people have no doubt attempted at one time or another to devise alternative methods of transmitting motion to the ordinary bicycle, it is felt that while the following notes will be of general interest, the conclusion that the best ideas are usually the simplest is well emphasised.

The subject cropped up while discussing straight line mechanisms with a friend.



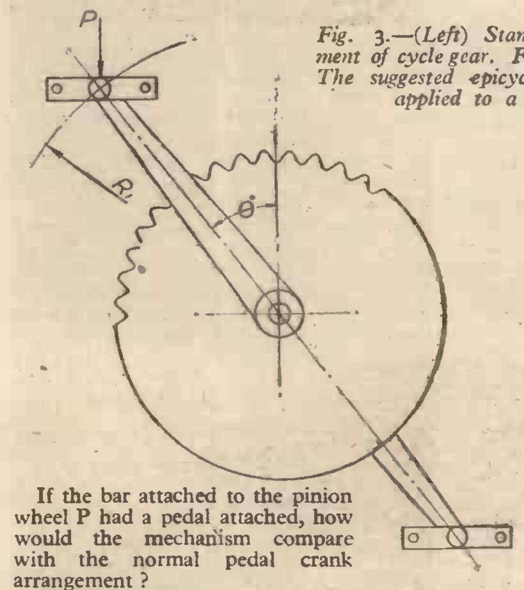
Figs. 1 and 2.—The component parts of epicyclic mechanism.

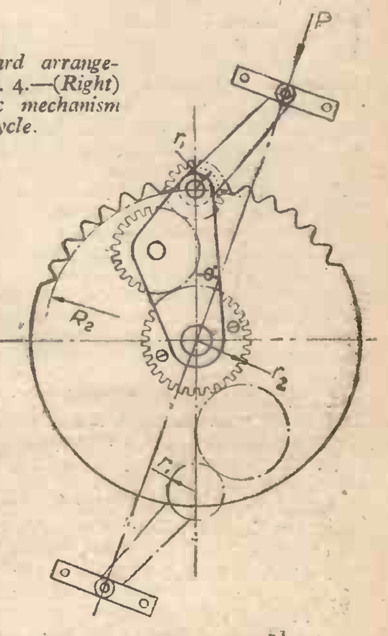
Standard examples such as link combinations and crank and connecting rod are well known. Many approximations have been evolved by special purpose machinery designers on the cam and lever principle, but a less widely-known example consists of an epicyclic arrangement of three gears, and in order to render the subject matter simpler to follow, it will be expedient to describe the arrangement clearly.

Epicyclic Mechanism

Reference to Fig. 1 shows a fixed gear, F, connected by an idler or intermediate gear, I, to a pinion wheel, P, by means of links, L. Now if a bar is fixed to the pinion wheel, such that centres AB = BC, then on rotating the links the point D will trace out a straight line through the centre of the fixed wheel. It has been mentioned to the author that this arrangement was evolved by Watt as a means of circumventing proprietary rights on the crank connecting-rod mechanism, and that the matter was eventually settled without recourse to such means. Whilst the writer cannot vouch for the accuracy of this statement, it would appear feasible enough.

Fig. 3.—(Left) Standard arrangement of cycle gear. Fig. 4.—(Right) The suggested epicyclic mechanism applied to a cycle.





If the bar attached to the pinion wheel P had a pedal attached, how would the mechanism compare with the normal pedal crank arrangement?

Comparative Torque

Figures 2 and 3 show the epicyclic mechanism arranged as adapted for the suggested purpose, whilst Figure 3 shows the standard arrangement for comparative purposes. A torque analysis of both methods shows:

In both cases the applied force is taken to be the resultant P (Fig. 3).

Pedal Crank Arrangement.

Torque = PR_1, $\sin\theta$.

Epicyclic Arrangement.

In a scale layout the fixed gear was $2\frac{1}{2}$in. pitch diameter, the intermediate wheel 2in. pitch diameter, and the pinion $1\frac{1}{4}$in. pitch diameter.

R_2 = Links centre to pinion pivot.
r_1 = Pitch radius of pinion.
r_2 = Pitch radius of fixed wheel.

Then Torque $= PR_2 \sin\theta \times \frac{r_2}{r_1}$

Then Torque $= PR_2 \sin\theta \times \frac{1\frac{1}{4}}{\frac{5}{8}}$

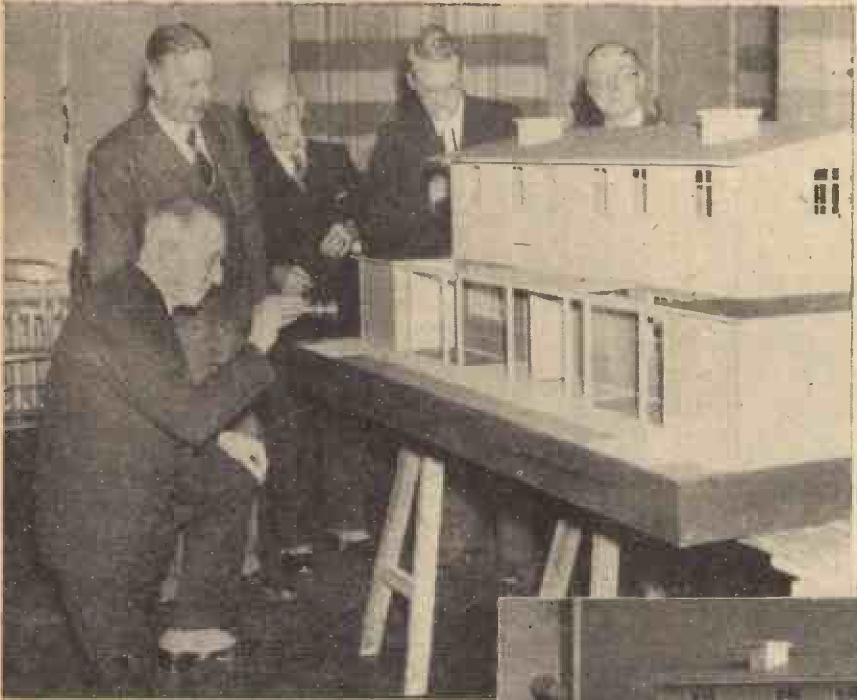
Then Torque $= 2PR_2 \sin\theta$.

Since, however, R_2 in the epicyclic arrangement is $\frac{1}{2}R_1$ in the pedal crank layout the two expressions for the torques are equal in magnitude. The travel of the pedal along the straight line is simple harmonic motion, and thus it is seen that no advantages are to be gained.

THE WORLD OF MODELS

By "MOTILUS"

The Part That Models Will Play in the Post-war World . . . a Model Pre-fabricated House



Viewing the model houses in the Northampton Council Chamber. Left to right: Councillor W. J. Bassett-Lowke (Deputy Chairman of the Town Planning Committee), Alderman A. L. Lyne (Chairman of the Housing Committee), The Mayor (Alderman A. Weston), Mr. D. E. E. Gibson, M.A., A.R.I.B.A., A.M.T.P.I. (City Architect of Coventry), and Alderman R. A. Glenn (Chairman of the Town Planning Committee).

IN a recent statement in Parliament the Prime Minister promised the people of this country three things—*work, food and homes.* We cannot obtain homes without work and food. What better inducement can there be for a people to work than to have an ideal home in view in which to live? Here is something practical in the shape of a model of one of the houses proposed for post-war England.

The view of those appointed to deal with the economic and financial aspects of this large problem of housing appears to be that, in order to realise Mr. Churchill's statement within a reasonable period, it will be necessary for a large percentage of new houses to be pre-fabricated, i.e., partly factory built and assembled on site. In this respect several experiments have already been made, and the Government itself is already building six specimen houses of different types at Northolt, and some local authorities are planning in a similar manner.

I am confident that models are destined to play a very important part in planning the post-war world. There is a psychological reason for this, especially where the object to be modelled only exists in the mind of the artist, on the drawing board of the architect, or in the brain of the inventor or engineer.

Very few people can easily read a blue print, and that is where the scale model makes it possible, in the minimum of space and time, to weigh up the advantages or disadvantages of any proposed scheme. The construction of models for this purpose is no new thing. Sir Christopher Wren had a great regard for the use of models in designing his magnificent buildings.

Apart from bringing the idea before the notice of those who have to make decisions, it is also a great help to the architect himself, when he is designing the layout of a new city or the replanning of a blitzed area, if he can prepare a model side by side with his drawings, in the same way as a sculptor makes a model in clay before proceeding to the lasting stone or bronze.

Front view of the model pair of Gibson pre-fabricated houses.

Houses for Post-war Coventry

The new plan for the centre of Coventry, which is the work of the City Architect, D. E. E. Gibson, M.A., A.R.I.B.A., A.M.T.P.I., is now being prepared in model form for presentation by Lord Iliffe (director of the *Midland Daily Telegraph*) to the Coventry authorities, to enable them to visualise what is proposed for this busy centre of the light engineering and motor-car industry of England.

In addition to the city itself, Mr. Gibson has also designed houses for the post-war Coventry, to be built on a pre-fabricated basis, and a large model of a pair of these houses, to the scale of one inch to the foot, has been built by Bassett-Lowke, Ltd. I have recently had the opportunity of examining this model at Northampton, when it was shown to the Housing and Town Planning Committees of the Northampton Town Council and borough officials interested in this sphere of work.

One of the pair of houses was modelled with both interior and exterior fittings—the other only the exterior, so that both a view of the amenities planned for the housewife, and the appearance of the houses from the outside, were available.

Back view showing small covered play space adjoining garage.

Utility Unit

The main feature of each house, apart from the fact that it is to be pre-fabricated, is the incorporation in it of a utility unit, which is the work of Messrs. Radiation Ltd., and several well-known manufacturers of household equipment, in collaboration with Coventry's City Architect, Mr. Gibson.

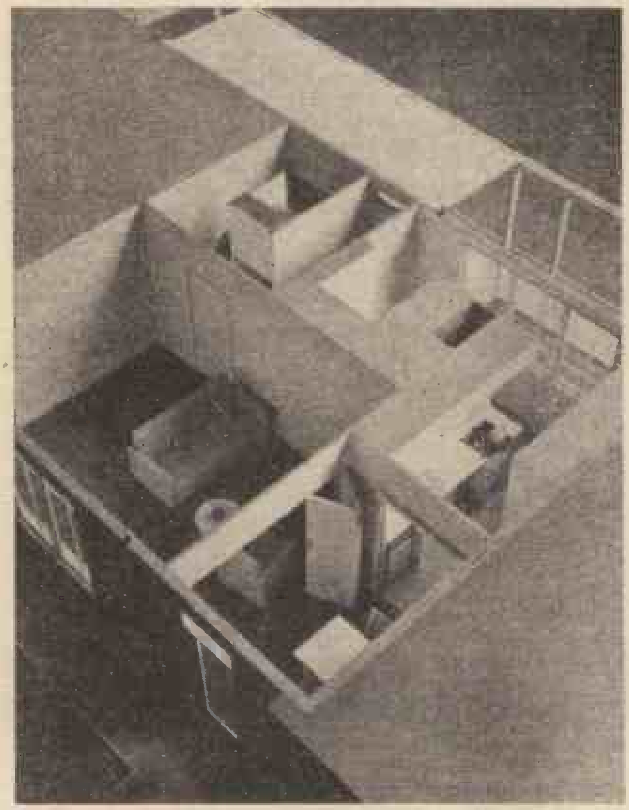
This unit, which is housed in a central position, provides the amenities for the kitchen and food storage, including gas cooker, refrigerator, hot and cold water, heated towel rail, plate and utensil racks, refuse container, and also in another part of the U-shaped kitchen, the accessories for clothes washing—the sink, clothes boiler and wringer, heated airing cupboard, and ironing and drying equipment. Upstairs the same unit provides hot and cold water for the bath, wash-basins and w.c., and, if necessary, for radiators.

This unit has a central duct where all the pipes and plumbing are housed. This is easy of access and free from the danger of frost in cold weather. In winter the unit is heated from a stove in the corner of the lounge, burning either coke, anthracite or coal. This stove only requires refuelling every twelve hours, and in the summer, when this is not in use, the domestic hot water is provided by a thermostat-controlled gas circulation in the kitchen.

The general plan of the house is simple and effective. On the ground floor there are two rooms and the hall, with staircase to the next floor, which is composed of four rooms—three bedrooms and bathroom.

An Attractive Model

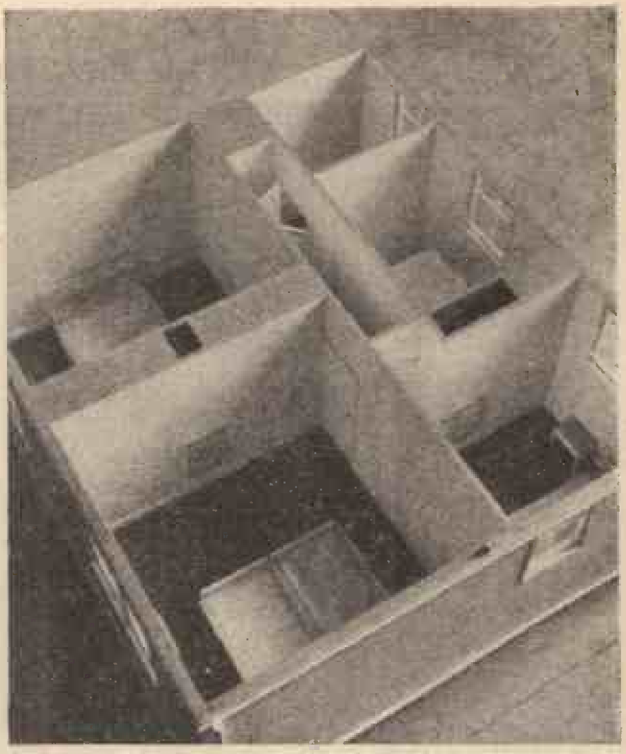
Let us examine the model. The ground floor is finished in concrete tile faced slabs of a russet colour facing material from the ground to the heads of the windows, with turquoise painted doors and garage sliding doors. The upper portion is of reeded asbestos cement sheets. The roof will be of zinc, copper or asbestos sheets on a suitable insulating material. The veranda is painted cream to represent concrete (reinforced with tubular steel inside).



Ground floor with first floor removed showing large lounge with dining recess leading off kitchen.

The model makers were given a free hand with the interior colour scheme, and also with the loose furniture. The latter was simple and distinctive in line and made in sycamore, polished natural colour, and, where necessary, the armchairs, settee, etc., were upholstered in cloth. The main colour of the rooms was pale biscuit, with accessories in shades of buff, and mandarin red handles on cupboard doors. The bathroom was carried out in sunshine yellow. The door fittings were either turned from metal and plated or cellulose coated. All windows were shown metal-framed. The stairs and floors were dark brown.

Now to describe the ground floor rooms. There is a small dining recess, directly accessible from the kitchen with a door to the garden, and also approached from the lounge by means of a folding door, which can be folded up to make the lounge and dining annexe one room. The lounge is large and spacious, and is entered from the hall. Upstairs there is a large bedroom with two beds, a medium-sized one with double bed and a small bedroom with single bed, which could be used either as a workroom or nursery. Then there is the bathroom with all modern fitments. Each of the houses has a garage which can be used as a store room, if the owner is not car minded. There are also outside sheds for coal and wood, an outside w.c. and covered tiled play space.



First floor with roof removed showing three bedrooms and bath room.

In the model such items as wash basins, sinks, ovens, etc., were carved from wood and specially finished with porcelain enamel. The small utensils, such as cups, saucers, plates, milk bottles, rolling-pins, kettles, saucepans, etc., were all turned by hand.

Among the sensible ideas associated with this house are such items as a porch at the front door—a useful asset in wet weather, and at the side of the door is a tradesman's delivery cupboard to receive milk, bread, meat, laundry and other parcels. A letter-

Close-up of the utility kitchen unit.

box is also incorporated, so that there is no need for the door to be opened to deliver goods. In the hall, too, a radiator is fitted underneath a special drying space for wet clothes. The bathroom and kitchen have floors of granulated cork, or other similar material.

Mr. Gibson has planned to maintain an average temperature in the bedrooms of 55 degrees Fahr., and in very cold weather additional warmth can be provided by gas or electric fires. The fires fitted in the bedrooms represent the modern panel gas fires, and either these or electric fires will be a standard fitment in every house.

Another modern method planned is to have built-in cupboards all over the house, and built-in wardrobes in the bedrooms.

The two house unit, as designed by Mr. Gibson, would compare favourably in cost with a pre-war house of similar size.

It is estimated that the cost of heating and lighting per week will be just under 7s.

Letters from Readers

A Mystery Explained

SIR,—I was very interested in the article, "A Mystery Explained," in the February issue of PRACTICAL MECHANICS. Has not your contributor overlooked the fact that as the load on the rear wheel increases the load on the front wheel would decrease by the same amount?

If F_F = Force required to turn front wheel,
and F_R = Force required to turn rear wheel,
Then $F_F = P_F u$
and $F_R = P_R u$
where P_F = Vertical pressure on front wheel,
and P_R = Vertical pressure on rear wheel.

Then total force F needed to propel bicycle $= F_R + F_F$
$= P_F u + P_R u$
$= u\ (P_F + P_R)$

and as $Pu + P_R$ is always equal to the total load (w) it will be seen that F will be always equal to *uw*, and will therefore not be affected by altering the position of the c. of g.

Unless, of course, the value of *u* is much larger for the rear wheel, but I see no reason why it should be.—D. DAWSON (Ashbourne).

[*Our contributor agrees.*—EDITOR.]

Sir,—I was interested in the article "A Mystery Explained" in the February issue. I would like to say that I am not an expert on this mode of progression, but to me it is obvious that there can be no mechanical explanation why it is that a tandem can be more easily propelled up a hill by one rider than by two, provided the rider at the back plays the game.

We must, of course, assume that each rider is of equal weight and capable of equal physical exertion. If we assume that the weight of each rider is 150lb., and the weight of the tandem 50lb. (in racing trim), then it cannot be denied that, neglecting friction, the solo effort will require 10 (150 + 50) = 2,000 ft. lbs. of work to raise the machine through 10ft., and the dual effort will require $\frac{10\ (150+150+50)}{2} = 1{,}750$ ft. lb. from each man.

On a modern tandem on a good surface the question of friction can practically be neglected, but even if we regard it as considerable your writer's argument still does not hold. The total friction remains the same, irrespective of the angle of the tandem and, after all, the front wheel has to be pushed up the hill just the same as the back one. If we reduce the weight on the back wheel by moving the centre of gravity, we increase the weight on the front wheel, and so increase the friction. The writer has regarded the front wheel as a fulcrum, but the summation of the reactions at each wheel is equal and opposite to the summation of the weight of the tandem and rider, or riders.

I did not know, but we will assume that it is common knowledge among tandem riders that your writer's assertion is correct.

The first thing that strikes me is that a vigorous 11-stone man would rather ride the tandem up the hill alone than with his 15-stone wife behind him. That, I think, will be obvious, but consider again the equal men; they will be perforce moving slowly up the hill, exerting their energy, and will have a tendency to get out of rhythm, and as soon as this occurs the efficiency of their united effort will be impaired, and they decide to dismount.

The reason why a cyclist instinctively moves forward when ascending a hill is not to reduce the weight at the back, but to bring his centre of gravity vertically over the crank-axle and so enable him to exert his full weight on the pedals.

MORLEY HEDLEY (West Ardsley).

Probes and Problems

SIR,—Recently I picked up a copy of the March issue of PRACTICAL MECHANICS, and proceeded to work out the "Probes and Problems" on page 201, and I submit that there is a further valid solution to the one entitled "Services' Dinner Party," which is not mentioned, one which still makes Adams the H.G., and is not invalidated by his beard!

Here is a perfectly possible position of the diners based on the problem as far as the words "opposite the Home Guard":

1. Adams	Liverpool	Home Guard
2. Evans	?	Soldier
3. Clark	?	?
4. Brown	Glasgow	Sailor
5. Frazer	?	Fire-watcher
6. Davies	?	Warden

Do you agree that this conforms to all the conditions? Well, then, the Leeds man who sat on the right of a fellow from Birmingham might be either Evans or Frazer. Your solution says he was Frazer; but, if he was Evans, then Clark comes from Birmingham and Frazer is the Mancunian, which leaves only *Davies* as the Londoner, and he is the warden!

I agree with you in rejecting the solution which depends on Adams being a soldier, but I think you must acknowledge that the alternative I have outlined conforms to all the data, and is a solution which cannot be rejected. I should be glad to know that you concur.—IAN C. GILCHRIST (Catterick).

[*Our contributor agrees.*—EDITOR.]

A Miniature Hand Loom

Details of the Beams and Shuttle

(*Continued from page 240, April issue*)

THE wires at the back of the reed and frame are cut, thus leaving 65 single wires, all parallel and stretched across the frame. Screw the frame on to its wooden support and fix the hinges on to the baseboard halfway between the main frame and the supports for the cloth beam. The screw eyes are for use as handles.

The "beams" are made from four pieces of broomstick, 1⅛in. diameter, as shown in Fig. 10 (April issue). The spindles are made from nails with the heads cut off. You will find it very difficult to get the wood true on the spindle if you drive the nail in without special precautions. A good method is to mark off the centre carefully and drill a hole of the same diameter as the nail about 1in. deep. Ask an assistant to watch the drill to make sure you are holding it upright. The drilled hole then forms an effective guide for the nail, which should be driven in about ½in. Further to fix it firmly.

For the cloth beam drive in eight small brads and cut off the heads, leaving ¼in. projecting as shown in Fig. 10. This provides a simple form of ratchet arrangement, the brads engaging a hole in a flat brass spring, which can be seen in Fig. 1. A small block of wood holds the bottom end of this spring

A piece of strong tape, ½in. wide, is tacked along one edge only to the round wood, as shown in Fig. 10.

The warp beam is the same as the cloth beam, except that the tape is tacked along the other edge, and instead of the eight brads, a single round-head screw is fitted.

A rubber band is hooked over the screw on the warp beam, wrapped once round the beam, and hooked on to a screw-eye in the baseboard to provide tension on the threads.

The only item now to be made is the shuttle, which is illustrated in Fig. 11. This is best cut out of a piece of bone about 1/16in. thick, though ⅛in. fretwood will do quite well; all the edges and corners should be well rounded, smoothed off and polished, so that the shuttle shows no tendency to catch any of the warp threads.

Ordinary darning wool is good material to weave on this loom. The warp beam is fixed, temporarily, about a yard behind the machine and the wool is stitched on to the piece of tape of the cloth beam, threaded through the reed, then through the central eye in one of the twisted wires of the front heald and stitched on to the tape of the warp beam. The second thread passes through the next space in the reed, but is threaded through an eye in the back heald instead of the front one. Alternate threads go through an eye on the front heald and the threads between go through an eye on the back heald.

The warp threads are then all rolled on to the beam at once and the beam fitted in to its supports, a small nail being pushed into the 1/16in. hole in each support to hold it in place

The shuttle is wound in the slots with as much wool as it will carry easily. Press one of the heald levers to raise and lower the warp and pass the shuttle through the resulting "shed," then pull the reed towards the front to push the weft into position. Now depress the other lever to reverse the position of the healds and pass the shuttle through the shed again in the opposite direction. press the weft up close to the previous thread with the reed, and you will find the cloth grow as these operations are repeated.

Inventions of Interest

By "Dynamo"

To Warn and to Wipe

TWO interesting inventions relating to motor vehicles have recently been submitted to the British Patent Office.

The first of these is an improved arrangement to warn a driver immediately his rear or other light fails. The device is electrically operated and incorporated in the electric lighting system of the vehicle. There is a warning lamp or an audible warning signal, or both, which at once notifies the driver of the fact that a light has ceased to function.

The second invention is an improvement in the means of keeping a clear vision through the windscreen. The device comprises a conduit which delivers air, vapour or liquid to a movable distributing member. This conduit is connected to a hollow body of the wiper mounted on a shaft to move the wiper over the screen. And there is a distributing tube or tubes passing from the hollow body.

Automatic Gas Lighter

MATCHES are not plentiful at the present time. Therefore a convenient and effective means of lighting a gas fire is sure of a welcome.

There has been devised an automatic gas lighter which can be operated from any electric circuit. This lighter includes a striker metal contacting piece which is entirely shrouded and disconnected from the circuit when the lighter is not in use. But it is momentarily connected when in use by means of an automatically operated, normally open switch to a current-limiting device connected to the positive or live electric point.

This is designed to control or dissipate the current in the lighter to minute ampere value when the striker point is brought into contact with a gas jet of negative or earth potential, and the small spark generated at contact ignites the gas.

Joystick Button

IN order to fire the guns it is necessary for the pilot or other operator only to press a button, without exerting any considerable force. The button is mounted on the control level or joystick of the aeroplane, or on the gas lever.

A highly important characteristic of the invention consists in the employment of control relays affecting the firing circuits, and located in such a manner in relation to the control or selective devices that the expansion of the compressed air, during firing, affects merely a small volume of air.

The risk of hoar frost, it appears, frequently accompanies pneumatic control devices, especially at high altitudes, and is increased by the cooling effect produced by the expansion of air. The use of relays restricts this expansion to the vicinity of the machine gun—that is, to a locality which is heated by the gun.

Iodine Liberator

OF considerable interest to the medical faculty and the nursing world is a rubber hydrochloric film, which liberates iodine.

The film is designed for wrapping surgical gauze or the like, or for wet dressings, and may be used for iodine therapy.

The invention consists of a composite laminated sheet of rubber hydrochloric film, in which one of the plies has been treated to absorb and gradually release iodine. The other ply contains no iodine, and it is preferably non-elastic.

Swaddled Torch

SPEAKING of elastic moves me to mention, in parenthesis, that elastic sticking plaster is useful for purposes other than that of applying it to a cut or wound. I myself have found it effective to reinforce a cracked bakelite torch, which, bound round with this plaster, I have even dropped with impunity.

It is also useful for stretching over the pad of a truss when the chamois leather becomes worn.

Unfortunately, at the present juncture, when rubber is scarce, it may not be possible to obtain this stretchable plaster in large quantities.

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

To Control Ropes

AN inventor has conceived an improved method of paying-out ropes. His aim has been to produce a simple, cheap, and reliable foot or manually operable apparatus by means of which the travel or paying-out of a rope may automatically be checked or stopped, in the event of the appliance being unattended.

While the device may be adapted to the control of the ropes of derricks, cranes, and warehouse hoists, it is particularly concerned with the ropes in connection with launching a ship's lifeboat.

The inventor points out that it is customary to control the lowering of such a lifeboat by means of rope falls. However, in the hurry of lowering the boat in an emergency, it may happen that one of the men on duty loses control of his fall. The result is that the unrestrained rope runs out without check or hindrance. As a consequence, one end of the boat suddenly inclines downwards, and the occupants are thrown into the water. This may involve loss of life as well as damage to the boat.

To prevent such a disaster is the principle object of this new device. The apparatus comprises spaced parallel members through which a fall rope may pass, readily removable rope-supporting means, and a spring-influenced plate carrying a brake block normally bearing on the rope. And there is an arrangement whereby the plate may be moved by foot or hand, or both, to remove pressure on the rope.

Accessible Racks

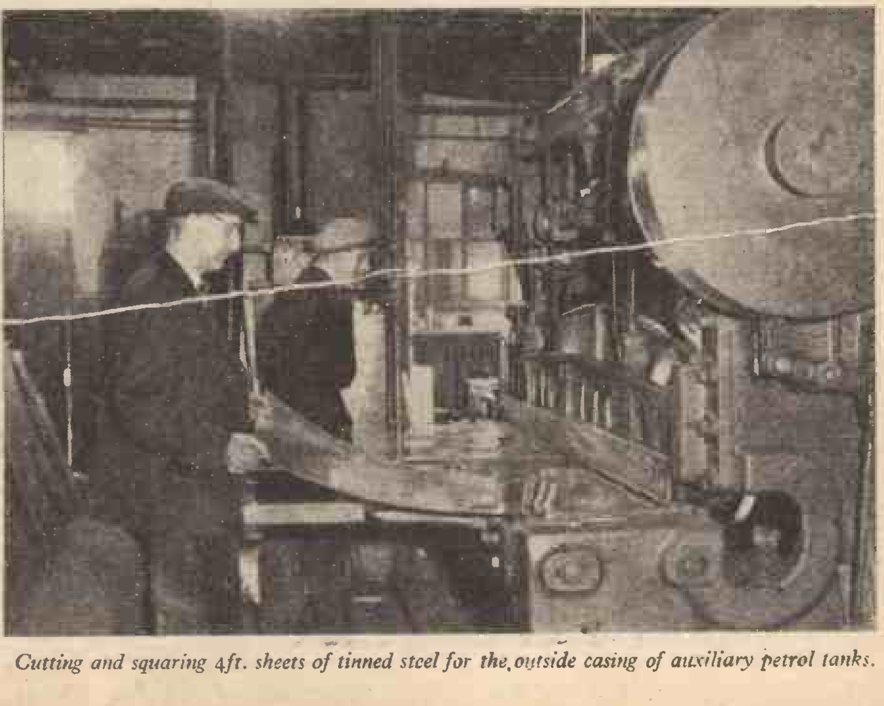
RACKS for the storage of articles in a limited space is the subject of a recent application for a patent in this country. A feature of the device is that it permits easy access to any desired rack with a minimum of effort.

The invention consists of square-sectioned storage racks, each provided with a pivot, and a supporting arrangement to enable it to rotate easily, about a vertical axis through one corner. These racks are situated in front of a wall of fixed racks, so that any section of this wall which happens to be blanked by one of the rotatable racks can be brought into view by rotating that particular rack through 90 degrees.

Petrol Tanks for Fighter 'Planes

FOR the purpose of increasing the range of fighter aircraft, auxiliary petrol tanks are being fitted to enable them to escort the heavy bombers through the defended coast areas of the Continent. They have been fitted to the famous "Thunderbolt" fighters, and can be jettisoned when empty.

To increase the strength of the tanks without adding weight, the whole of the tanks are soldered and welded.



Cutting and squaring 4ft. sheets of tinned steel for the outside casing of auxiliary petrol tanks.

Masters of Mechanics—95

Sir George Cayley

Founder of Aeronautical Science

LEONARDO DA VINCI, the fifteenth-century Italian genius, was chiefly famous as an artist, but he was an engineer and a student of science as well, in which latter capacity much credit is due to him on account of his being the first man to consider the manifold problems of human flight from a definitely scientific point of view.

To obtain exact knowledge of his subject, da Vinci studied bird flight. He came to the conclusion that "a bird is an instrument which works in accordance with mathematical principles, which instrument it is within the capacity of man to reproduce."

Here we have the first reasoned and scientific prophecy of the ultimate practicability of human flight. However, as we have already mentioned, the famous Leonardo was much more in demand as an artist than as a scientist. Perhaps, also, his artistic nature was stronger than his scientific and mathematical inclinations. At any rate, da Vinci's attempts to put the theory of mechanical flight on a workable basis quickly became forgotten, and a couple of centuries, or even more, had to elapse before their true significance came to be realised.

Towards the end of the seventeenth century, interest in the possibility of mechanical flight reawakened. Through the ensuing century, the entire problem of human flight was attacked by various isolated theorists and from a number of different angles. Although the aggregate results of these observations and deductions did not, in any way, throw much light on the *practical* problems of flight, they at least concurred in establishing the essential practicability of flight.

It was into such an age of theoretical speculation that Sir George Cayley was born at Brompton, about eight miles south-west of Scarborough, on December 27th, 1773. Cayley had a tremendous influence upon the establishment of the fundamental principles of flight, yet, for some strange reason, he has become wellnigh forgotten by the present world. Few, indeed, are the usual books of reference and biography which include a notice of Sir George Cayley. Yet, so fundamental were his labours in the subject of artificial flight that the modern historians of aviation have felt honoured to call him "The Father of British Aeronautics."

Cayley, let it be stressed, was never successful in making a practical flying machine; the mechanical and scientific resources of his day were altogether against him in that respect. None the less, the forthright nature of his investigations, coupled with the permanent principles of flight which he deduced from them, gave to other workers at a later date the foundation knowledge upon which much of their success was based.

A Yorkshire Baronet

Sir George Cayley was the sixth baronet of that name, and unlike the other members of his circle, he was a thoughtful and a studious man. At school he had been brilliant at mathematics, and the rising chemical and physical science of the day had engaged his earnest attention from his sixteenth year.

Ten years after his birth, the noted Montgolfier brothers invented their celebrated fire-balloons by means of which human beings were, for the first time in history, able to ascend from the earth's surface. The exploits of these famous brothers excited young Cayley's boyish imagination, and there is little doubt that they constituted the factor which gave to

One of the many early suggestions for a hand-operated flying machine—which principle Sir George Cayley showed to be impossible.

his mind that decided bent towards aeronautics which showed itself so strongly during his mature years.

Cayley's first practical devices were not concerned with aviation. They took the guise of certain systems of land drainage which he put successfully into operation on his own estates at Brompton, Yorks. This was before he had attained his twentieth year.

The world's first balloon ascent, made by the Montgolfier brothers in the presence of the French Royal Family, on September 9th, 1783. It was such balloon ascents which first drew Cayley's attention to aeronautics.

Shortly afterwards he began in real earnest that series of practical observations and experiments into the whole question of human flight which have, although somewhat belatedly, imparted so much celebrity to his name.

Cayley's first writings on mechanical flight and its problems did not appear until 1809, by which time he had many years of patient observation and theoretical deduction to support him. It was in the *Journal of Natural Philosophy* that he first published his foundation-essay entitled "On Aerial Navigation." The essay is a veritable classic of aeronautical science, a thesis which, even in these days, is well worth reading by the student of aviation.

Flight of Birds

In his paper "On Aerial Navigation," Cayley begins by describing his prolonged series of observations on the flight of birds. He has two very important things to say about bird flight. The first of these is that bird flight takes up considerably less mechanical energy than had been supposed. The second is that the bird "rests" on the air in virtue of the resistance which the air offers to its wings, and, therefore, that most of the bird's energy in flight is employed merely for the purpose of propelling it through the air. Birds, reasons Sir George Cayley, are merely natural gliders which are endowed with an auxilliary propulsive mechanism.

More than a century before Cayley's time there had lived in Italy an early experimentor, Giovanni Alfonso Borelli, who, among other things, had invented a diving bell, and had, additionally, interested himself in the possibilities of human flight. Borelli (1608-1679) studied bird flight and came to the logical conclusion that, contrary to the opinions of many thinkers, it would ever be impossible for a man to achieve flight merely by strapping a pair of artificial wings on himself and flapping them by means of his own muscular power. His arguments were convincing, for they were based upon the fact that the contraction of human muscles cannot give out sufficient power to carry up the heavy weight of a human body.

Sir George Cayley came precisely to the same conclusions as Borelli had done before him. However, unlike Borelli, he did not remain satisfied with enunciating what could not be done. His work was of a much more positive nature, so much so that it enabled him to point towards the direction in which the solution of the problem of practical flight lay.

All that one has to do to achieve successful flight, announced Sir George Cayley, is to "make a surface support a given weight by the application of power to the resistance of air."

It was a pregnant utterance, for that sentence of Cayley's contained within it the true prescription for the achievement of all mechanical flight.

Theoretics of the Aeroplane

If we take a stiff sheet of cardboard and allow it to drop to the ground, it will fall under the influence of gravity and will readily overcome the air's resistance to it in so doing. But if, by means of a flick of the wrist, we fling the sheet of cardboard away from us in a horizontal direction it will travel a surprising distance before it reaches the ground. This is because the resistance which the air offers to it in motion is very much increased. By tilting the cardboard sheet before it is thrown so that the front edge is slightly raised above the back edge, the sheet will actually rise in the air until its momentum is lost, after which it will fall to the ground.

Here we have the theoretics of the aeroplane in a nutshell. In the cardboard experiment just described we have "made a surface support a given weight [its own weight] by the application of power to the resistance of air."

"Surface" and "Power"

Such was the problem as Sir George Cayley saw it. He had reduced it to two fundamentals or elements, to wit, "surface" and "power." To achieve flight in any practical sense with a heavier-than-air machine, he saw clearly that he needed a suitable "surface" and a suitable "power." But exactly what form the "surface" was to take, he had, naturally, no clear-cut views. Nevertheless, he foresaw that the precise shape of his surface-device would be of extreme importance. He went so far as to suggest that a slightly convex surface would be more effective than a perfectly flat one, a deduction of astounding accuracy, for it is nowadays well known that the "cambered" wing surface of an aeroplane enables the machine to derive a greater "lift" from the air than does a perfectly flat wing surface. Cayley even predicted that it would, under some conditions, be possible to arrange one surface over another, a prediction which, years afterwards, took practical form in the design of the first bi-planes.

To Cayley the necessary motive power for his flying "surface" proved an insurmountable difficulty. As we have just seen, he proved that no human muscular exertions could ever power a flying machine. He perceived, also, that the heavy, slow-working steam engines of his day could never be utilised for generating the power necessary to retain an aerial machine in flight. Rejecting, therefore, the steam engine for this purpose, Cayley, with a brilliance and an accuracy of imagination which is truly surprising, considering the times in which he lived, goes on to suggest that the only means of providing aerial power would constitute some type of engine "firing inflammable air with a due proportion of common air under a piston."

In plain English, Cayley prescribed the internal-combustion engine as the power-provider for his hypothetical aeroplane long before the practical internal-combustion engine was ever invented! Such was the mind of the man who has rightly been called "the Father of Aeronautical Science."

Sir George Cayley was a practical man, besides being an imaginative theorist. About 1803 he constructed a number of gliders, which were based on his observations of bird flight and the principles which he had deduced from them. These were made mainly for the purpose of formulating his notions concerning the resistance of air to plane surfaces travelling through it. At first the Cayley gliders were miniature affairs, but gradually they increased in size until at last this inventor constructed a glider which developed sufficient lift to carry a medium-sized man.

The Airship

Alongside his interest in the practical possibilities of a heavier-than-air flying machine, Cayley involved himself in the numerous problems connected with the propulsion of balloons through the air. In this subject, too, he had a fair amount of success. Indeed, in 1810, he announced that it would be possible for him to design and construct a balloon that would "carry its passengers at twenty miles an hour." Owing, however, to general lack of interest, this constructional feat did not materialise.

The fact was that the populace of those days, and even the reasonably intelligent section of the populace, seemed to have firmly ingrained in their minds the notion that any type of speculation on the practicability of a flying machine was to be regarded more or less as a symptom of enfeebling lunacy. Sir George Cayley was never called a lunatic, but it seems certain that many people thought him one, despite the conclusive nature of his reasonings.

In many respects Cayley was the father

An airship designed for the relief of Paris at the time of the Franco-Prussian war in 1870-73. It was based on some of Cayley's assumptions, but it was never actually constructed.

of the airship. He seems to have grasped the essential features of a steerable balloon or lighter-than-air machine. He made the suggestion that the gas bag of the balloon should be sectionalised, and the gas contained in a number of separate compartments. He also suggested the structural bracing of the gas-bag assembly in order to enable it to retain its predetermined shape. He made accurate calculations of the amount of power which would be required to set the airship into horizontal motion. And, finally, he considered the possible methods of powering the airship, coming to the conclusion, once again, that the gas-engine was the only ideal device for this purpose, although, perhaps, there might exist possibilities for the utilisation of an ultra-light steam engine as the aerial power-provider.

Sir George Cayley, of course, was a man of wealth as well as of leisure. He utilised both these factors well in his endeavours to establish a practical science of aviation. As he grew older his interest in the possibilities of aviation increased until eventually the invention of a successful flying machine became almost the main theme of his active life.

Proposed Aeronautical Society

In 1837, the year of Queen Victoria's coming to the English throne, Sir George Cayley put forward proposals for the establishment of an aeronautical society in London. But he might as well have tried to set up an inter-planetary society in those days, for during the 'thirties of the last century interest in the possibilities of aviation was at one of its lowest ebbs. Even the few enterprising balloonists of the period were usually dubbed "bal-lunatics!"

Half a dozen years afterwards, in 1843, W. S. Henson (1805-1888), a Leicestershire man and one of the pioneers of practical aviation, brought out a design for a man-carrying flying machine which was steam-driven. Sir George Cayley was at once enthusiastically interested in the design. He did not, however, hesitate to criticise it and to emphasise its many defects. In the same year Cayley himself published a design for what he termed an "aerial carriage," which was based upon a light steam-engine propulsion. But the "aerial carriage" of Cayley never materialised, while, on the contrary, the flying machine of Henson did achieve some minor practical success in conjunction with the work of his friend, John Stringfellow.

Beginnings of Streamlining

By no means dismayed at the failure of his plan for an "aerial carriage," Sir George Cayley went on year after year with his studies into the mechanics of gliders. He experimented, also, with a whirling arm in order accurately to ascertain the air-resistance of a flat sheet. To him also is due the honour of being the first individual to consider the practical bearing of that important factor which we nowadays designate as "streamlining." In a word, it was Sir George Cayley who brought into being the little nucleus of aerodynamical knowledge which the mid-nineteenth-century flying-machine inventors were only too glad to avail themselves of during the course of their experiments.

Almost to the time of his death, which occurred on December 15th, 1857, Sir George Cayley went on with his experiments on glider construction. The principles and design of what we now call the "air frame" seem to have attracted his attention mainly during the last years of his life.

Blazing the Trail

Such, in brief, was the life career of Sir George Cayley, "the father of aeronautical science." As a practical aircraft constructor he was at least the equal of any of his few contemporaries. As a theorist, however, he towered above his fellows. Needless to say, his theories and, in particular, the practical applications of them, were necessarily incomplete, for Cayley was only the prophet of the successful aeroplane, not the actual constructor or designer of it.

It was the thoroughness and the essential soundness of its basic principles which lifted Cayley's pioneering work far above that of the others of his day. That is the reason why he is now accorded so considerable a degree of honour in the annals of aviation. Sir George Cayley blazed the trail at least a little way into the unknown jungle of aeronautical possibilities, and the narrow path which he cleared therein, through his own innate perceptive instinct, was essentially a sound and reliable one, for it led others, after his time, to the first solutions of the problem of mechanical flight.

QUERIES and ENQUIRIES

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

Enamelling Iron Ware

I SHALL be very thankful for any information that you could give me on vitrifying or enamelling ironware. What I require is the type of salts used, and the type (if any) of dip used for the colouring. The colours which I am desirous of obtaining are black, grey, white and green mottled.—S. A. Snifall (Thorpe Bay).

UNLESS you have a gas or electrically heated furnace capable of giving a temperature around 1,200 deg. C., you will find it impossible to carry out vitreous enamelling of ironware. Colours and glazes for this purpose may be obtained from Messrs. Cowan Brothers, Ltd., Stratford, London, E., but unless you can obtain the necessary high-temperature furnace you will not succeed in any attempt at vitreous enamelling, which, without these appliances, is an impossible job.

Vitreous enamelling consists in cleaning the metal surface by chemical or mechanical treatment, then in painting it over with properly applied liquid "glaze." The ironware articles so treated are then fired in a high temperature furnace at approximately 1,150 deg. C. for a period between 16 and 36 hours, according to the type of glaze required. They are then cooled down slowly in order to anneal the glaze. Vitreous enamelling is a highly specialised and a mass-production job, and it cannot be really successfully imitated on the small scale.

Fillings for Etchings

I HAVE been doing some ornamental etching on brass sheet and should be pleased if you could tell me of a suitable filling for the depressions. I might mention that I have used oil colours, but as they dry they sink below the surface. I should like to use brilliant colours, such as prussian blue, crimson, etc., and to be able to make them myself.

What I had in mind was a sort of synthetic porcelain, such as dentists use for stoppings. The depressions can be undercut, if necessary. The ideal, of course, would be a fired enamel, but this would be too expensive and complicated. —J. L. Prendergast (E. Dulwich).

OIL colours are quite useless for the purpose which you name, since they always tend to remain soft and because they shrink on drying. A good method is to fill up the engraved lines by dusting finely powdered sealing wax (of any colour) over the surface of the engraved plate. After carefully "packing" the plate in this manner, the latter is then slowly warmed in an oven until the wax melts and becomes fluid. The plate is then allowed to cool. Any wax remaining on the surface of the plate is scraped away, and finally the surface of the plate is gently polished.

Alternatively, the sealing wax may be ground up with a little gold size and applied to the engraved lines in that form. Strong solutions of sealing wax in methylated spirit are sometimes used.

"Porcelain" fillings are of the zinc or magnesium oxychloride type. A good filling of this variety can be made as follows: Dissolve 40 parts (by weight) of magnesium chloride in 60 parts of water. This makes a 40 per cent. solution of magnesium chloride. Use this solution (which keeps indefinitely) to slake finely powdered calcined magnesite or magnesium carbonate to a stiff paste. This paste is used for filling in the engraved lines, any surplus being very carefully wiped away. The paste sets hard in 36 hours to a white-porcelain-like surface. If coloured effects are desired, these are readily obtained by mixing up to 25 per cent. of any dry pigment colour with the magnesite or magnesium carbonate. It is absolutely essential that perfectly smooth and gritless powders are used, otherwise a smooth surface will never be obtained when the "fillings" have set hard. Using this type of filling, there should be no necessity to go to the trouble of undercutting the engraved lines, since the paste expands very slightly on setting, and, therefore, it should be quite secure in the engraved lines, provided that the engraved article does not suffer any unreasonable handling. These magnesium oxychloride "mixes" dry out to a matt effect. The surface of the hard filling may, of course, be given a coating of clear varnish, if desired, in order to impart a glossy effect to it.

Concrete "Mixes"

I WOULD be much obliged if you could give me the following information:

(1) The correct proportions of sand and cement for cement making for various jobs, such as bricklaying, surfacing of floors and walls, pointing etc., and the proportions for making concrete.

(2) When I use a certain soldering fluid it makes the articles go rusty, however well I clean them. Could you tell me how to stop this happening, and is there any fluid sold that will remove rust, and if so, where can I obtain it? I do not want to use paraffin.—D. Corser (Wellington).

I. A good deal of variation in the composition of concrete "mixes" is permissible. For flooring concrete take 1 part Portland cement, 1 part sharp sand and 2 parts of brick, stone or other rubble, which latter must be clean and of a particle size of about 1in.

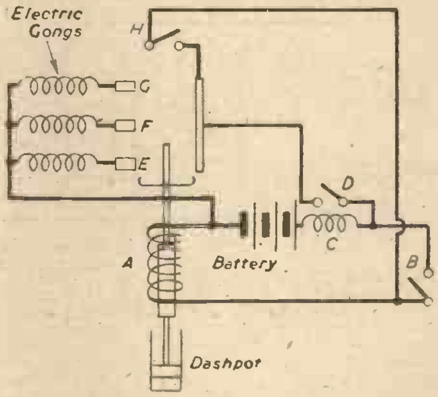
For indoor floors, increase the sand to 2 parts and decrease the rubble to one part.

Mortar concretes are best made from cement 1 part, sand 3 parts. You should note that there is no real difference between "cement" and "concrete." Both are basically the same, being made from dry Portland cement, but the "concrete" usually incorporates coarse "aggregates" such as rubble (above mentioned) whilst the "cement" is finer in texture, frequently having in its composition merely sand and Portland cement.

2. Soldering fluids of the type you mention do sometimes cause rusting or corrosion in view of the acid nature of the fluid. This can only be minimised by carefully washing away all traces of the fluid after soldering, or, better still, by swabbing a little weak ammonia over the soldered area. But, for your work, it would appear to be better always to use a resinous soldering flux, which latter will definitely not cause any corrosion. So far as we are aware, there are no rust-removers available commercially nowadays.

Electric Gong

I WISH to make an electric gong to take the place of my front door bell—something on the tubular type, sounding perhaps three different



Circuit diagram of an electrically-operated gong.

notes. This would be very much more pleasant to hear than the present harsh bell.

Could you advise me, and perhaps let me have a sketch of how to go about this, and the name of a firm who might supply me with the necessary materials? Could you also give me the name and address of any firm who manufacture this type of door signal in this country?—J. W. McDougall (Dunoon).

IT is not practicable in these columns to give full details for constructing the device you mention, but we are giving a suitable circuit diagram which may assist you. A is a solenoid coil, the plunger of which is attached to a piston working in a dashpot. The dashpot may be closed at the bottom end with the exception of a very fine hole; or may be completely closed at the bottom and contain oil, the piston then having a very fine hole. The function of the dashpot is to slow down the rising of the plunger when the coil is energised by pressure on the door push B. The push B also energises a small coil C which closes spring mounted contacts D (this part may be taken from a trembler bell, with the make and break removed) so the coil A remains energised when B is released. The plunger of A continues to move upwards and the moving contact closes contacts E, F, and G in turn to energise the coils of the electric gongs. The gong mechanism may be the mechanism of a trembler bell with the make and break removed. When the plunger reaches the top of its stroke it opens the contacts H which de-energises the coils A and C, the contacts D then fly open and the plunger returns to the bottom position until B is again pressed.

We do not know of any firm who manufacture this type of door bell but you could probably obtain any insulated wire you may need to wind the coils from Ormiston & Sons, Ltd., 79, Clerkenwell Road, E.C.1.

"Anglo-Helvitium"

WILL you please forward me any informati n concerning the recently discovered element of Atomic Number 85, which I think is called "Anglo-Helvetium"?—J. H. Briggs (Carnforth).

"ANGLO-HELVITIUM" is merely a name at present. Nothing is known about it, and its existence has not been confirmed. It is supposed to constitute the missing Element No. 85 and to have been discovered and isolated by two physicists working in the Radium Institute at Berne, Dr. Walter Minder and Mrs. Alice Leigh-Smith, the latter being a former pupil of Mme. Curie, of radium fame.

Nearly 12 years ago, Element No. 85 was claimed to have been discovered by a group of American workers who named it "Alabamine" and who extracted it from monazite sand residues. Both "Alabamine" and the more recent "Anglo-Helvetium" are hypothetical entities. Neither has been isolated in mass form, and until this has been done it is impossible to determine the properties of these suspected elements. The whole position regarding element No. 85 is still very unsatisfactory. When, however, the matter is finally clarified, it will be found that the missing element will be a member of the "Halogen" or Chlorine-Bromine-Iodine family and possibly that it is radioactive and unstable.

Slow-speed Dynamo

I HAVE a dynamotor that I want to wind into a wind-charger giving, say, 25 or 32 volts at approximately 10 amps. at about a cut in speed of 200 r.p.m. If it is not possible to get this output at the volts mentioned please tell me what is the nearest I can get to it.

I would prefer to hand-wind this machine instead of former winding, and would be much obliged if you could tell me if there is much advantage to former winding against hand winding.

I have a Rotax dynamo DM6S and the following are the dimensions of same. Pole shoes 6 in all. 3 starter coils and 3 shunt coils. Armature has 29 winding slots measuring 6in. long, 9/16in. deep and 7/32in. wide and was originally wound with 3 strips and one turn per coil. Winding pitch 1-5 and the commutator had 86 segments. The brushgear consists of 5 brushes, 4 large and 1 small. I want to cut this down to, say, 2 main brushes, and 1 field, and maybe I would get down to a lower speed if I had only 2 brushes, and connected a field into each of them.

I had an idea that if I got the armature slots cut down a bit deeper it would be an advantage, or would I need all the iron that it has at present (if making the slots deeper was necessary)? Would each lamination (4in. diameter) have to be done separately, or would putting the whole armature in a milling machine and cutting all out at same time do?—Mr. Taggart (Belfast).

THIS is not a type of machine that can be recommended as a slow-speed wind-charger, and will be difficult to wind, especially as you are not prepared to use "former-wound" coils. A speed of 200 r.p.m. is impossible to obtain with anything like reasonable efficiency, and you would need to gear up from wind-motor to dynamo in the ratio of at least two to one. Do not attempt to deepen the slots in the armature, this will lead to no improvement and would make the winding still more difficult. There will have to be 87 separate armature coils, one of which needs the ends cut off short and insulated so as to form a "dummy" coil to preserve the mechanical balance of the winding, leaving 86 active coils to connect to the 86-part commutator. The coils will be grouped three per slot in the 29-slot armature, and for the output you want No. 18 s.w.g. will be the most suitable gauge. With great care in winding you may get 24 wires in each slot, so that each coil will consist of 4 turns spanning from slot 1 to slot 5 inclusive, and wave connected from bar 1 to bar 12 of the commutator, resulting in a 2-circuit series-winding. The six field coils require 1 lb. each of No. 20 s.w.g. connected in series to give alternate north and south polarity, one end to the positive main brush, and the other end to the small intermediate third brush. The main brushes will be set at 60 degrees apart.

Regulating Resistance

I SHALL be obliged if you will give me details required to construct a resistance for use on the mains (210 volts).

I wish to run one, two or three lamps of the motor-car headlamp type, i.e., 6 volt × 24 watts, or 12 volt × 36 watts from the mains through a resistance, giving some means of reducing or increasing the resistance in circuit, so as to bring the lamp or lamps from dim to the point where they are slightly overloaded.

The type usually supplied with sub-standard cine projectors would suit my purpose, but they are practically unobtainable at the present time.—J. Senior (Sheffield).

IN order to construct a single resistance capable of meeting all your requirements from the 210 volt supply you would need about 100 yards of 22 s.w.g. nickel-chrome resistance wire. This could be wound on a ventilated former, the wire being supported on mica or vitreous material capable of withstanding about 500 deg. C. One end of the resistance wire would be connected to the supply and a sliding contact would connect to the lamp circuit, all the lamps being connected in series.

A more convenient and economical method which could be adopted if your supply is A.C., would be to use a transformer with a primary voltage of 210 and a secondary output of 12 volts 12 amps. This could be used with a variable resistance on the secondary side consisting of 33 yards of 17 s.w.g. nickel chrome wire, the lamps then being connected in parallel.

Foaming Agent : Emulsifying Oil

WILL you please answer the following queries :

(1) What are suitable proportions of quillaia powder and borax, which when added to 2 ozs. of soft soap solution would produce a "foam shampoo"? I have been given to understand that quillaia and borax produce a foam. If soft soap is not obtainable, could I replace it by using an equivalent amount of a synthetic detergent ?

(2) How could I emulsify a small quantity of an essential oil, in order to make the oil soluble in water ?

(3) Can you give me a formula for a "wax polish," suitable for polishing floors, furniture and leatherwork ?—E. Savidge (Blackpool).

(1) QUILLAIA bark is a well-known foaming agent. The following is a formula for the preparation of a concentrated foaming liquid which may be added in small amount to your soap solution in order to increase its foaming capacity :—

Quillaia chips	$5\frac{1}{2}$ ozs.
Alcohol (rect., or meth. spirit)	10 ozs.
Water	24 ozs.

Boil together gently for 15 minutes. Cool; add alcohol; filter. Make up with water to a total bulk of 32 ozs. Iso-propyl alcohol can be used in place of rectified spirit. For a good quality material, methylated spirit should not be used in view of its objectionable odour.

To a limited extent, soap can be replaced by a synthetic detergent, such as "Teepol" (obtainable from Messrs. R. W. Grieff and Co., Ltd., Royal Exchange, Manchester), but in our opinion it is highly dangerous to use any of these synthetic detergents in the manufacture of toilet products in view of their strong defatting action and of their consequent liability to give rise to skin troubles.

(2) To emulsify an essential oil, proceed in the following way :

Essential oil	88 parts.
Oleic acid	10 „
Triethanolamine	2 „
Water	80 „

Mix the triethanolamine, oleic acid and 30 parts of the essential oil. Stir well and rapidly. Then add slowly, with rapid stirring, 33 parts of the water. This will give a thick cream. Continue stirring. Then add first the remainder of the essential oil and finally the remaining water.

Triethanolamine is only obtainable for essential use. Messrs. A. Boak Roberts and Co., Ltd., Buckhurst Hill, Essex, manufacture a substitute called "Abracol," which might serve your purpose equally well.

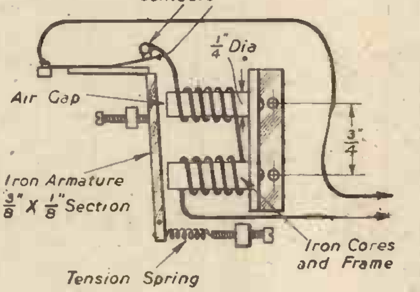
(3) To make a suitable wax floor polish, melt up a quantity of wax in an old can, keeping the temperature as low as possible. Then add slowly about five times the weight of white spirit, together, if possible, with a small amount of raw linseed oil. Stir well and then pour into tins to cool and solidify. By adding more or less white spirit you can vary the consistency of the polish.

Cut-out for Model Railway

I HAVE recently built a model railway, using a step-down transformer for supplying current at 20 volts for driving the engine from A.C. mains.

Can you give details of a cut-out or by-pass to transfer the current in the event of a short, as I am afraid I shall burn out the transformer ? Can you also give size and type of wire for a hair drier, and where it can be obtained ?—H. Bayley (Oldham).

YOU do not state the normal full load current of your transformer or the current at which you require the protective overload trip to operate. Assuming, however, that you want the trip to operate at about



A simple cut-out for a model electric railway.

1.5 to 2 amps., you could make a reliable cut-out from the mechanism of an electric bell or buzzer, or construct one to the dimensions shown in the accompanying sketch. Each limb of the electro-magnet could be wound with 50 turns of 20 or 22 s.w.g. enamelled wire to create poles of opposite magnetic polarity. An additional light lever is pivoted or suspended by a flat spring as indicated, this making contact with a fixed contact when the armature is away from the electro-magnet. Connect the two coils in series with the contacts, and in series between one pole of the transformer and the train. On overload the armature is attracted to the electro-magnet, and the contacts separate by gravity. You will appreciate that the tripping current will depend on the air gap between the electro-magnet and armature, and on the adjustable spring tension acting on the armature. The contacts can be reset by a lever or a knob attached to a stiff wire which passes freely round or through a hole in the contact lever.

Assuming you wish to use the hair drier on about 230 volts, we suggest you use a heating element of 10yds. of 33 s.w.g. nickel-chrome resistance wire, which you may be able to obtain from London Electric Wire Co. and Smiths, Ltd., of Church Road, Leyton, 10. If desired, the heating could be increased by cutting out a short length of this wire.

Polishing Powder : Clean Lacquer : Plastics

FOR a number of years I have been using a polishing paste for nickel plated articles with a polishing spindle, but now this product is very hard to obtain, and the binder used was a non-greasy one. Could you supply me with the formula of any dry or non-greasy binder to be used with this, or other formula ? I think the composition contains lime, chalk, crocus, or rottenstone.

If you have any formulæ for colourless lacquers I would be pleased to have them.

Could you suggest a substitute for kieselguhr, used for polishing brass, and how it may be obtained ?

Will you recommend some books on Plastics and Vitreous Enamels, and also a book on formulæ and recipes ?—E. C. Russell (Howth).

(1) A GOOD polishing powder for your purpose can be made according to the following formulæ :

Chalk	3 parts.
Rottenstone	1 part.
Whiting	1 „

This mixture can be made into block form by the addition of 10 per cent. white china clay, followed by hydraulic compression. It can also be made into block form by moistening with naphtha, following by light compression, but blocks formed in this manner are liable to crumble unless they are contained in tins or other containers.

For the finest polish, use chromium oxide and/or rouge (i.e., fine iron oxide).

(2) Cellulose acetate dissolved in "Cellusolve" (Chemical and Metallurgical, Ltd., Moorgate, London, E.C.) makes a good clear lacquer. So, also, does scrap celluloid dissolved in a mixture of equal parts of acetone and amylacetate. Guncotton dissolved in a mixture of equal parts of alcohol and ether forms pyroxyline lacquer for the very finest work. Unfortunately, it is, at the present time, almost impossible to procure the majority of these raw materials unless you can show some special priority claim for them.

(3) There is really no effective substitute for kieselguhr for the purpose you name. Ordinary chalk is the nearest product to it, but you might like to try mixing up to 25 per cent. of fine asbestos powder (Turner Brothers, Ltd., Rochdale, Lancs), in order to render it somewhat more "woolly" in texture.

(4) G. D. Hiscox's "Recipes, Formulæ and Processes" (Crosby, Lockwood and Son) is a well-known formula compilation. The most modern work of this kind is "The Chemical Formulary," published by Chapman and Hall, Ltd., in four volumes. You should, however, not put too much dependence upon formula compilations, for none of them is 100 per cent. accurate.

So far as we have been able to trace, there are no specialised books on the difficult subject of vitreous enamelling. It is possible, however, that Messrs. W. & G. Foyle, Ltd., Charing Cross Road, London, W.C.2, may be able to locate a foreign work on this subject for you.

Plastics is now a very extended subject, divided up into many different departments. However, the following books are of a general character, and they might suit your needs :

"A.B.C. of Plasticisers." (3s.)
L. M. T. Bell : "Making and Moulding of Plastics." (12s. 6d.)
K. Brandenburger : "Processes and Machinery in the Plastics Industry." (25s.)
"British Plastics Year Book." (15s.)
"Plastes : Plastics in Industry." (15s.)
H. R. Simmonds : "Industrial Plastics." (22s. 6d.)
R. S. Morrell : "Synthetic Resins and Allied Plastics." (28s.)
(Prices in brackets are pre-war net prices.)

THE Cyclist

Editor: F. J. CAMM

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Phone: Temple Bar 4363

Telegrams: Newnes, Rand, London

Comments of the Month. By F. J. C.

Post-war Surplus and Its Disposal

THE cycle trade was not helped along the road to recovery after the last war as a result of the Government's policy in relation to the disposal of surplus stocks. Goods which had cost the country many millions were jobbed off at prices representing but a tithe of their original cost, and the inevitable result was that factories which were expecting to return to their normal activities after four years of munition making found that the market was being supplied from these surplus stocks.

It is not surprising, therefore, that a trade slump followed. Unemployment succeeded the slump. The argument adopted by the Government was that the public should have the benefit of the cheap purchase of goods which had been purchased from money provided by the public as a result of heavy taxation. It was an entirely mistaken point of view, and the cycle trade was not the only one which suffered as a result of this abrogation of the very first principle of the law of economics.

What is to happen with surplus material when this war ends? The Government is already concerned about that problem, and has consulted various trade organisations. We understand that members of the cycle trade have discussed the matter as a result of a suggestion from the Board of Trade. It is obvious that the Government will not adopt the wholesale scrapping of surplus materials as in the last war. In most cases the Government is purchasing spare parts from firms licensed to make them, and not necessarily from the original makers. Obviously there will have to be an agreement between these two. One suggestion which has been made is that the various factories spread over the country and which undoubtedly will be idle for a time when the war is over should be used as depots for the storage of this surplus, so that the industry can draw from this with the idea of distributing it through the normal trade channels. Payment would not be made to the Government for the surplus except against such withdrawals. The sale price and the conditions of sale could be agreed and thus avoid price cutting.

We learn that the War Cabinet has decided in principle to establish a Disposals Committee, and has invited the manufacturers to submit a scheme. The policy of the Board of Trade is that in the absence of such a scheme the department itself would undertake the responsibility of post-war disposal, and in that event they might establish a non-profit trading organisation to handle all surplus stocks of bicycles and parts. Sales by auction would not be permitted. There must obviously be some preliminary sorting of the surplus. There must be distinction between surplus which it is impossible to repair, that which is suitable for reconditioning, and that which is unused. It is possible that the Government may desire to remain the legal owners of the property with the manufacturers acting as agents, drawing a fee for reconditioning and distributing. The goods would be sold under a warranty.

It must be remembered that many of the bicycles purchased by the Ministry of Supply have been of the non-standard type —24in. frames with 28in. wheels, and it is unlikely that there would be a large demand in the home market for such machines, although there should be a considerable market overseas.

Some have suggested that the Government should operate a scheme by which surplus machines shall be delivered into the countries which the Allies will occupy after the war, and thus avoid a home market problem. Others in the trade think that only the serviceable goods should be retained, and that the rest should be scrapped. Some of the machines and materials sold to the Government have been made to special specification, and to suit special purposes, and firms would naturally not be anxious to take such surplus back. Other firms thought that they would prefer to purchase the surplus material of their own make, and to scrap the lot.

A committee has been set up by the trade to consider all aspects of the problem, and to draw up a memorandum on the subject.

Child Cyclists

THE importance of training children to use bicycles is stressed by the Board of Education in a communication to the National Committee on Cycling. The National Committee had suggested that the Board should appoint instructors of cycling as they do for cricket and football.

The Board reply that a considerable amount of such instruction is provided by the Central Council of Recreative Physical Training. They add that they have encouraged the special measures taken by Local Education Authorities and other public bodies to train children to use bicycles and other means of transport with safety to themselves and other road users.

So far as public elementary schools are concerned, they find that the instruction is most effective when given by the school teaching staff, but in some places valuable help is given by the police.

"The recruitment of specialist instructors," they add, "is not contemplated."

No Increase In Tyres

THE "appreciable quantity" of synthetic now coming from the United States does not mean that tyres will be available in larger quantities, Lord Rothes, Director of Tyres, at the Ministry of Supply, stated when presenting a bicycle, given by British cycle manufacturers, to Leading Aircraftman Hogg for the best of 11,830 slogans on saving cycle tyres. Mr. P. W. Howard, chairman of the Cycle Tyre Group of the Tyre Manufacturers' Conference, disclosed the fact that the number of bicycles now on the roads had risen from 8,000,000 to approximately 10,000,000, which means 20,000,000 covers and 20,000,000 inner tubes in constant use. All cycle tyres and cycle tubes are to-day being made wholly of synthetic, said Lord Rothes.

Lighting-up Time

THE National Committee on cycling have circulated the following letter to the Press:

"May we remind cyclists that the arrival of 'double summer time' does not in any way affect lighting-up hours as fixed by the Statute passed before the war? This year they are, until April 16, from half an hour after sunset until half an hour before sunrise; and, between April 16 and October 8, from one hour after sunset until one hour before sunrise. The hours of sunset and sunrise are of course different in different parts of the country."

That Old Rag

WE are not referring to a back issue of the Club Journal. We draw attention to the following notice sent out by the Directorate of Salvage and Recovery.

"It's about that dirty old rag you threw under the bench because it put two smuts back on your nickel-plate for every one it took off. It's wanted.

"Rags that are too dirty for further use in the bike-shed may not be too dirty for processing at the war factories, where special laundries deal with them. Not only is the rag cleaned for further use, but even the oil in it is recovered.

"Few cyclists can keep their machines in trim without a bit of rag. There must be few who do not accumulate several bits of old rag in a year—unless they throw them away. But that would be breaking the law, and, of course, the 'brothers of the wheel' are a most law-abiding fraternity.

"Engineers' wipers are urgently wanted in the factories at the moment, and cyclists do not need telling how important a piece of rag is for precision work at the milling machines. The Ministry of Supply is making an appeal for every piece that can be spared, and it is felt that the 10,000,000 cyclists in the country might easily contribute a ton or two if they tried.

"So please hunt through your shed for any old rags, no matter how oily or dirty they may appear, and put them out for salvage. Make a separate bundle of them, and don't mix them with clean rag salvage. The collector will know what to do with them when he calls."

Around the Wheelworld

By ICARUS

Herne Hill Track

THE secretary of the N.C.U., Mr. A. P. Chamberlain, writes:

"Readers of *The Cyclist* will remember that two and a half years ago many clubmen volunteered for work at Herne Hill Track, clearing weeds, etc.

"This voluntary labour did much good, and all were keenly disappointed when no permit was forthcoming to resurface the track.

"I have to announce, however, that the Union has now received the official Ministry's permission to resurface the track, and the contractors are ready to proceed with this work as soon as the preliminary clearing has been done.

"Therefore, may I appeal to clubmen and all interested in the sport of cycle racing to come forward once again and give us a hand to get Herne Hill ready for the contractors.

"If you are able to volunteer for only a few hours a week, it will all help. The work to be done is nothing like as heavy as that done two years ago. It consists of pulling the weeds out of the cracks between the concrete and applying weed killer.

"Volunteers will help substantially if they can take any useful tools along with them. Practically anything will do, such as a sharp hand trowel, chisels, scrapers, etc., and with a sufficient band of willing workers we shall be ready for the contractors in a fortnight from the publication of this appeal, and it is understood that the resurfacing will be completed in about a month from that date. So the sooner we can get the job done, the sooner will the N.C.U. opening meeting at Herne Hill be held on a track with a better surface than it has ever had.

"If you volunteer, ring up TERminus 4368."

Halifax R.C.C.

THE above club will hold on May 7th a road race from Halifax and via Sowerby Bridge, Ripponden, Scammoden, Denshaw, Ripponden, Scammonden, Denshaw, Ripponden, Sowerby Bridge, and finishing in Savile Park Moor, Halifax. The proceeds will go to the Mayor's Comforts Fund.

Cycle Pumps

MR. A. MARTIN, of Glenthorne Road, Hammersmith, writes: "Referring to article concerning cycle pumps, I should like to offer a suggestion. I note your remarks about the small leather washer that is in the pump connector which screws into the pump, but the air generally escapes from the end that screws on to the valve where this tiny washer generally becomes dislodged.

"I recently screwed an ordinary water-tap washer, either leather or rubber, to the valve before screwing on the pump. I find this prevents any air escaping, and the tyre is pumped up much more quickly."

Improved Bag Carrier

THE illustration shows an additional fitment to the bag carrier marketed by the Patent Fitall Steel Tongs Co., 172, Cornbrook Street, Manchester, 15. Owing to the shortage of cycle baskets this will fill a need, as most families already possess a marketing basket which will conveniently hold considerably more goods than the average cycle basket. It has the advantage of not fouling the brakes, it can be taken off and replaced quickly, and it does not necessitate unbuckling straps when shopping. It will carry a tradesman's basket or box quite as readily. It will be seen from the illustration that two eyelets are inserted between strands of the basket, put in from the inside. There are two prongs to prevent pulling through.

R.T.T.C. Notes

AFTER careful consideration of the applications received for the post of part-time national secretary, the National Committee has appointed Mr. S. Amey ("Wynfrith," Inwood Avenue, Old Coulsdon, Surrey) to the position.

The basket carrier referred to in the accompanying paragraph.

As a result of this appointment, Mr. S. R. Forrest (1, Glenwood Road, Stoneleigh, Epsom, Surrey), who was elected national hon. secretary by the national council meeting in January, will in future act as an assistant hon. secretary of the council.

The distribution of the 1944 handbook will now be undertaken by Mr. Amey, and orders may be placed with him. As previously stated, the handbook will cost 1s. per copy, post free.

Mr. Forrest will continue to deal with correspondence relating to pending matters, but all other correspondence for the attention of the national secretary should be sent to Mr. Amey.

Fifty Miles National Championship Trophy. The national committee has accepted the offer by Mr. L. Dixon (Oak C.C.) of a perpetual trophy for the 50 miles national championship.

The Road Time Trials Council

IT has been decided that the levy on riders shall apply only in the case of open events. It has already been stated that the amount of the levy for 1944 is fixed at 3d.

The national committee has accepted the offer by the North Road C.C. of a perpetual trophy for the 12 hours National Championship.

A 25 miles National Championship event for women will be held in 1944. An invitation to undertake the promotion of this event has been sent to a district council, and further particulars will be given as soon as possible.

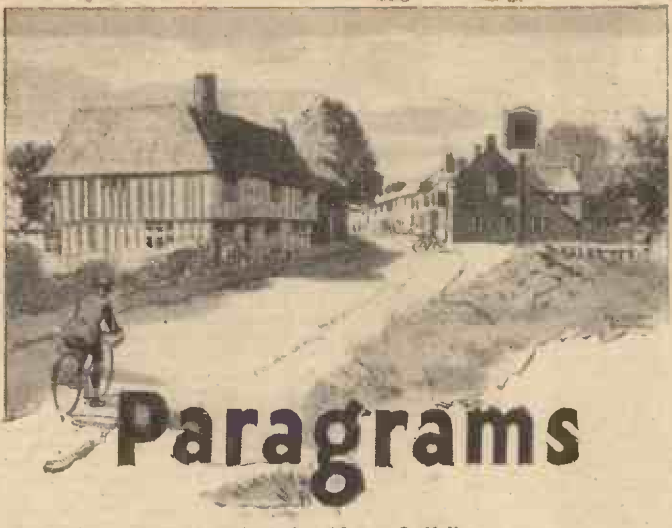
The council's handbook for 1944, which is now being printed, will contain the list of approved events, with details of the promoting secretary, the rules and regulations of the council as amended by the national council meeting, the full conditions applicable to the national championship events and the national best all-rounder competition, which have now been settled, the names and addresses of district council secretaries, an up-to-date list of clubs affiliated to the council, and a list of approved watch testers. The handbook will cost 1s. per copy, post free, and clubs are requested to place their orders with the secretary of their district councils, through whom the distribution will be made.

Sir Miles Thomas at Roadfarers' Club Luncheon

SIR MILES THOMAS, A.F.C., vice-chairman of the Nuffield Organisation, was the guest speaker at the Roadfarers' Club luncheon at the Waldorf Hotel on April 14th. Full report will appear in the next issue.

(*Continued on page* 59)

Mr. F. E. Parkes, of the Sun Cycle Co., C. E. Blackwell, and Prof. A. M. Low, at the recent Roadfarers' Club Luncheon.



Paragrams

Stratford St. Mary, Suffolk.

Tommy Charleton Honoured

TOMMY CHARLETON, president of the Wellam C.C.—and other clubs—has been elected on the committee of the Newcastle-on-Tyne "Holiday at Home" Committee.

Traders' President

W. J. LORD, of Coventry, has been elected president of the National Association of Cycle Traders for the second consecutive year.

Brentwood Road Club

FORMER secretary of the Brentwood Road Club, H. E. Thornton, has returned home after seeing service in Africa and Italy.

Open 100 in Wales?

THE Port Talbot C.C. have decided to hold an open "100." Club membership of 51 is exclusive of 31 in the Forces.

Lady President

MISS D. E. WICKENS, known to all keen Plymouth cyclists as "Wicky," has again been elected president of the Corries C.C.

Barnesbury's Loss

DICK ELDER, Barnesbury C.C., has been killed in action. He was serving with the R.A.F.

Broad Oak Forces News

TWO members of the Broad Oak C.C. who have been serving overseas have returned to this country. They are R. Burnell and A. Groves.

Comrades Ashore

WHEN a British man-of-war put into port recently it had aboard Eric Reddish and J. Holmes, well-known Yorkshire riders, in addition to members of the Vagabond and Wolverhampton C.C. Cycling was the order of the day.

Wisbech Wheeler Home

WILLIAM COUSINS, well-known member of the Wisbech Wheelers, is home after several years of service with the R.A.F. in Canada.

Captured at Anzio

GEORGE HARVEY, Lichfield C.C., is a prisoner of war. He was taken at Anzio beachhead.

D. K. Hartley's New Club

WELL-KNOWN Dukinfield rider, D. K. Hartley, now serving with the R.A.F., has joined the Cambridge Town and County C.C. as a second claim member.

Proud Record

TO have four secretaries only in its 53 years of existence is the proud record of the Banbury Star C.C.

Scotsman's New Role

ROBERT REID, pre-war member of Glasgow Caledonia C.C., previously reported missing while serving with the Brigade of Guards, is now fighting with Marshal Tito's forces in Yugoslavia.

Death of H. Syner

HERBERT SYNER, stylish old Ordinary champion and former president of the F.O.T.C., has died. He was 80.

Hercules Man Decorated

FORMERLY in the employ of the Hercules Cycle Co., Flight Sergeant Instructor D. Collins has been awarded the D.F.M. He has been on several operational sorties.

Swindon Member Missing

BRYAN CABBAGE, Swindon Wheelers, who was a sergeant in a R.A.F. Pathfinder Squadron, is reported missing following a raid over Berlin.

Keighley R.C. Record

OF Keighley Road Club's membership of 102, 28 are with the Forces.

Carelessness

FOR leaving her machine on the footpath in the black-out, thus creating an obstruction, a Grangewood cyclist was fined 7s. 6d.

University C.C. President

S. A. MILNER has been elected president of the University C.C. He is 24 years old.

Benevolent Fund President

FOR the third consecutive year E. L. Payton, J.P., has been elected president of the Motor and Cycle Trades Benevolent Fund.

Syd Cozens Commissioned

SYD COZENS, famous British professional rider, has been commissioned in the R.A.F.

Doncaster Paragon R.C. Loss

MEMBERS of the Doncaster Paragon Road Club mourn the death of Lt. H. Fielding, who died of wounds while serving in Italy.

Welcome to Serving Cyclists

SERVICE cyclists stationed near King's Lynn are welcomed by the King's Lynn C.C. to take part in fixtures. Details may be had from G. Garside, Edenthorpe Main Road, West Lynn.

Glade Member Missing

MEMBERS of the Glade C.C. have heard with regret that their member Harry Watts, Royal Artillery, is missing. He was serving in Italy, and had seen service in North Africa.

Y.H.A. at Merseyside

AN increase of 1,000 in membership of Merseyside Y.H.A. is reported. Last year visits to hostels exceeded any one pre-war year by over 7,000.

Kingston Road Club

THE Kingston Road Club is to be reorganised. Arrangements are in hand for the catering of all types of riders.

Battersea's Cycle Park

BATTERSEA BOROUGH COUNCIL have sponsored a cycle park, which has been opened near one of the borough's busiest shopping centres.

President-elect

A. J. BRADBURY is president-elect of the Manchester Wheelers. He is also chairman of the National Association of Cycle Traders.

Met in Italy

TWO members of the Boundary C.C., K. Cope and D. Clarke, met unexpectedly in Italy. The former is with the R.A.F. and the other with the Royal Navy.

AROUND THE WHEELWORLD

(*Continued from page 58*).

Road Accidents—January, 1944

FEWER adults but more children were killed in January, as the result of road accidents, than in any previous January of the war.

The total number of deaths among road users of all ages were 560, a decrease of 29 compared with the previous January. There was, however, an increase of 308 in the injured, the total being 10,711.

Of the 82 children killed, 72 were pedestrians and 10 were cyclists. These figures compare with 63 and 12 respectively in January, 1943.

The main causes of accidents to children, as shown by a special inquiry last winter, are darting into, or running across, the road, and stepping from behind other vehicles. These account for at least four-fifths of the fatalities.

Asphalt Roads in Wartime (B.S. 1152)

THE issue by the British Standards Institution of B.S. 1152, rolled asphalt suitable for road construction and maintenance under emergency conditions, comes at an opportune time, coinciding as it does with news that asphaltic bitumen is to be released in sufficient quantities to enable local road authorities to tackle the problem of road maintenance during the coming spring.

The roads throughout the country, due to war conditions, have in many cases been subjected to drastic forms of traffic far beyond their capacity, and in other cases have long outlived their period of maintenance. For this reason alone, engineers and surveyors will, without exception, welcome this lead by the British Standards Institution, to which we commend their close attention.

The standard, which has been drawn up in conjunction with The Asphalt Roads Association, provides a clear issue both as regards the use of available aggregates and the composition of the asphaltic cementing agent, giving at the same time a certain amount of tolerance for the easy and efficient interpretation of the three main types of mixtures provided for in the specification.

Copies of the above standard may be obtained on application from the British Standards Institution, 28, Victoria Street, London, S.W.1, price 2s.

50 Miles National Championship

THE Yorkshire District Council of the R.T.T.C. has accepted the invitation of the National Committee to undertake the promotion of the 50 miles National Championship in 1944. The event will be held in conjunction with the Yorkshire Cycling Federation 50 on week-end No. 21.

12-hours National Championship

THE Manchester District Council has accepted the invitation of the National Committee to undertake the promotion of the 12 hours National Championship in 1944. The District Council has decided to promote the championship as a special event on week-end No. 29.

100 Miles National Championship

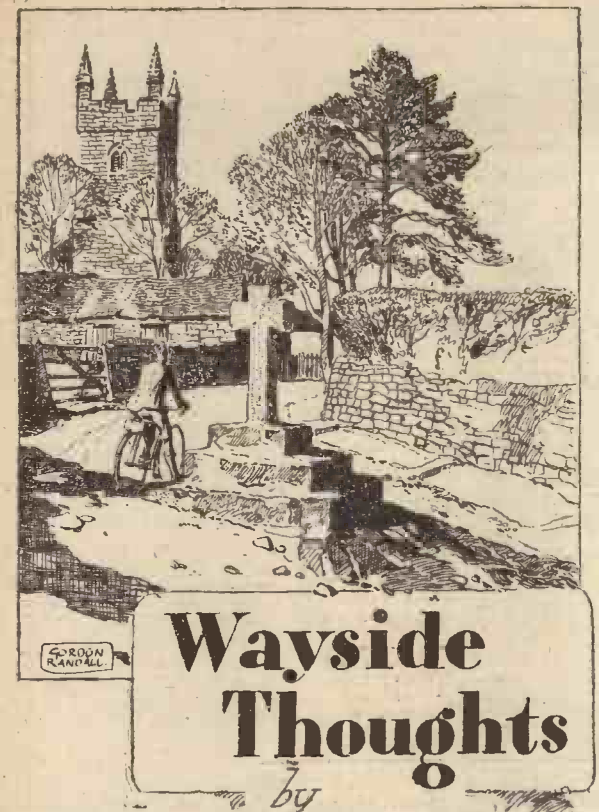
THE London West District Council has accepted the invitation of the National Committee to promote the 100 miles National Championship. The event will be run in conjunction with the Bath Road 100.

Bells!

BRITAIN is to make 800,000 bicycle bells this year, less than one quarter of the usual quantity.

"The result of this decreased production," said a manufacturing authority recently, "will mean that tens of thousands of cyclists who normally rely upon a bell must give other 'audible warning' unless they are fortunate enough to obtain one of the small substitute horns which may be available in small quantities

"The dome of a bicycle bell is usually made from special metal to give it resonance, and of this, at the moment, there is none to spare from more vital work."



Wayside Thoughts

by

F. J. URRY

Sheepstor, Dartmoor village.

Improve It

UP the road there is a multitude of people going for a ride, and most of them, alas, are not making the best of it. The old rider and the club man swing past under the power of easy pedalling acquired by long practice; they lean on the brisk wind and chatter as they go, fine types of cyclists who have learned how to make the wheels spin with easy endeavour, and who, at the end of the day will be as fit and happy as they now are pedalling past me. For I am sitting on a bridge coping enjoying a pipe in the comfortable warmth and beauty of this spring sunshine, and watching the inconstant procession heading for the woods and the rivers into this burly sweet-smelling sou'wester. And I am struck by all the differing styles that go to make the parade of cyclists, all of whom are apparently on pleasure bent for the purpose of welcoming this bonnie day. One would almost think it would be impossible to see such a diversity in the simple method by which a bicycle is propelled; but here is the demonstration in being, and the proof beyond cavil, of the need for teaching people—most people—the art of cycling. How difficult it is to put this truth over to the buyer of a bicycle who has no contact with club life, the best teacher of the art of cycling extant, because it is so varied in its ranges, and so truly democratic in its criticisms. But we must recognise that club life will never interest the great army of riders, the utilitarian, the family man, or the individual who rides because he or she is petrol-less, and therefore it needs other methods; and the best I can think of at the moment is a series of small advertisements sponsored by the whole trade for the better use of their products. But riding is not cycling: it is a misuse of the bicycle that is almost bound to lead to disillusionment.

Not Now, as Then

I KNOW some people seem to think my aim to make cycling ideally applicable to all active mankind is a far cry that will never be attained, and the easy method is to allow these things to take care of themselves. But surely the advocacy of any game must be to direct attention towards improving the general technique of playing it, otherwise such advocacy is mere window dressing and is unworthy of the space it occupies. We are told by the manufacturer that his particular type of machine is the best possible, but that I consider to be empty phraseology unless it is backed by the written instruction and outline of the best possible method in which to use it. When I was young we were given all this information by the maker who was then a practical rider. He knew how best to ride a bicycle with the least effort or the greatest speed, much the same thing when reduced to the intensity, or otherwise, of the mood of the moment. And it is true enough that in the nineties of last century, sloppy-riding cyclists were few and far between, and when we saw one he immediately became a subject for conversation and criticism. Then came the car, followed by a certain loss of interest in the right riding of their products by the members of the industry, and the subsequent increase in all forms of road travel, in the spate of which cycling was relegated to an obscure place, and the thought of it as an art tossed aside under the careless caption that "anybody knows how to ride a bicycle." If you believe that caption to be true, do as I did on that sunny afternoon, watch the procession swing into a breeze, and you will find about 80 per cent. or more know so little about cycling that most of them would forgo this travel method if any other were available. That I fear is true, and we are doing very little about introducing a cure.

A Case for the Trade

NOW, I am far too fond of cycling to take the easy line of thinking: what does it matter? I enjoy it, why worry about other people? I believe cycling should be the greatest single game Britain can actively play, with the consequent greatest return in health and pleasure, and all this attained at so trifling a cost. Having found a good thing for my well-being and enjoyment of life, I believe in handing on the information far beyond the point of just making a statement, and leaving the other fellow to grope for the details. Unfortunately, however, one man or a small body of men keenly interested in the game cannot reach out to the wide public who own bicycles, and use them with the careless action that undermines the first pleasures of the pastime, that aptitude to propel the machine with the easy rhythm discernible in the action of the practised cyclist. This desirable objective must be the care of the industry, for only the industry possesses the wherewithal, and at the end of the story, only the industry will profit by the results on financial grounds. But whether the trade believes it is an important part of its job to make all its customers good cyclists and so to insure to them that listen the full pleasures of the pastime, is a question to which I do not know the answer. I think I know what it ought to be, a far wider advertisement of correct riding with simple illustrations and instructions broadcast through the press. To-day most cycle advertisements are an apology for disappointment, or an indication of the excellent goods to be offered to a discerning public in the post-war period. Surely some of this space—if not all of it—would be earning a higher reputation for the advertiser if they used it in the endeavour to make better cyclists, fitter folk to enjoy the good machines we are promised on the return of peace.

A Rare Break

I HAD a curious mishap occur to my bicycle recently which I have never before experienced. It was a very windy day and I had ridden ten miles into the breeze, and after making a call on a friend, started to push up his steep drive when the crank broke through the cotter-pin drilled drift and tore away part of the chain wheel spokes. It was a pretty mess without any hope of repair sufficiently firm to carry me home. I had a look at the fracture and it was obvious a flaw was the cause of the trouble, one of those little faults that rarely happen to irritate us. Here I was, three miles from the nearest station, an appointment to keep in half an hour, and on this occasion with the burden of a broken bicycle. By dint of hard walking and vigorous free-wheeling with a foot to the ground to kick along, I managed to keep my "date" and spend most of the day in friendly company; but the trouble of a home return with a wrecked machine was not inviting. Now this is where the help of friends is material. I happened to be within a mile of Sir Edmund Crane's home, called in with my peck of trouble, had an excellent tea to cheer my gloom, and found Sir Edmund constructively sympathetic, for he took my bicycle to town and fixed it up with new chain wheel and cranks. It isn't often one meets with such good fortune or such good friends, and the kindly facts are worth recording. I went home by train, and waited nearly 45 minutes on a cold station for the arrival of a dilatory locomotive that seemed to lack all interest in the time table; and during that time-spending period I thought once more of the marvellous convenience of a bicycle, and the wonder entered into me why so many active people wait on draughty stations for late trains, and thereby risk contracting colds and all the ills of chilliness.

Holidays Away

THE holiday season is with us, and if you are a cyclist with experience of touring you will be wishing to add a joyous chapter to your personal freedom of the road. You will be thinking of the places you know, examining the maps to find the roads that lead to places you want to know, and wondering when the time of release will come to you, even as I do. To say we will make such and such arrangements for holidays in these times is beyond the likelihood of occurrence, for many of us are tied pretty tightly to our jobs, and do not know from week to week when the shackles will be loosened. We have got to take pot luck, and that is not always easy for the individual who desires to go touring, for there is no gainsaying the fact that "straight" touring—the place to place wandering beloved by most of us—is growing much more difficult because so many people have dropped out of the catering business, mainly owing to the troubles of supplies. This condition rather restricts our activities, and makes centre-touring much more attractive, for having found a hotel, farm or cottage in a desirable district, you are at least sure of your bed o' nights. It is not always easy to find the harbourage indicated, particularly at short notice; but I suppose most of us do know of numerous spots where the welcome is as warm and the food as good as the times permit, and if we can plan the time to fit conveniently into such hosts' booking diaries, then I think wisdom suggests this method is the best, even though the area may be familiar ground. Holidays at home may be good war-time practice, but if you can arrange to take them in less familiar places without calling in the aid of the railways, then I say such holidays are infinitely better on every count: and this is where the cyclist scores.

By the Way

RIDING to work morning after morning along the familiar route is a refreshment in salutation. When you have carried this habit over the best part of half a century you touch humanity at every social angle on your journey, and the contacts are very pleasing. It is on the morning journeys that these salutations occur, for then the time contract keeps you to a set period, and a wave of the hand, a toot of the horn, or a flung word of greeting sends you on your way rejoicing that so many people seemed pleased to see you passing-by. Knock-off time has a widely varying hour, and the happy contacts are not so frequent. Candidly I believe many regular motorists, the works janitors postmen, policemen, petrol pump artists and the regulars on the route, look out for me, because if I lapse for a few days when holidays happen, they want to know where I have been. These are genial associations that lend a smile to the dreary streets, and they seem to me to grow warmer as the years roll on.

St. Mary's, Teddington. This little church (now restored) famous for its associations with Peg Woffington. Near the altar is an interesting memorial to her memory.

CYCLORAMA

By
H. W. ELEY

A winter's ride.

Club Journals

ONE of the encouraging things about cycling in wartime has been the virility of many clubs. Why, even in spite of paper shortage, there is still a goodly number of club magazines . . . small in size, maybe, and less ambitious in character, but, nevertheless, genuine "journals" telling of the activities of clubs, and helping in no small measure to keep members together, and foster the true spirit of the road. And the lot of the "editor" of a club journal is not a particularly easy one nowadays! Many of his one-time contributors are away on service; those that remain have duties in connection with fire-fighting, civil defence, and Home Guard. Let us pay homage to the good fellows who manage, in spite of the difficulties, to keep journals alive, and through them, promote the club spirit . . . with an eye on those brighter days to come.

My First Mount!

MY mind went racing back to boyhood's days on a recent occasion when I had stopped to look in a cycle dealer's window. Two bikes were displayed, and as I looked at them a small boy came up, glued his face to the window, and said to the lady with him (his mother, I assumed)—"That's the bike I want for my birthday!" There was an expression of ecstatic longing on the boy's face as he spoke, and I found myself hoping that a kind "daddy" would produce the needful, and see that the bike was there on "the day." I could picture the joy which "possession" would bring to that youngster! I could recall my own first bike—also a birthday present; and I knew that one of the biggest thrills I shall ever experience was that first ride on my first mount!

Shrove-tide

ON Shrove Tuesday I ate pancakes . . . and was glad that even in wartime I could at least keep up one old custom! And I was delighted to know that the age-old town's football match had been played in Ashbourne! Shrove-tide may be of no importance to some, but there are others for whom old festivals, and ancient survivals mean a lot . . . and I am one of such. Years ago, the arrival of Shrove Tuesday was the signal for the appearance of whips and tops, and "hoops." Ye gods! the idea of a modern child trundling a hoop along the side-walk makes me smile!

Planning a Tour

RAILWAY travel gets more and more difficult; fresh posters appear on stations imploring us to refrain from "taking the train." Well, the cyclist can be patriotic, and smile about these restrictions connected with the iron road. He can still journey by cycle . . . and journey far! Which reminds me that I have been indulging in a little "arm chair" touring . . . pondering over maps, and planning imaginary journeys into all sorts of delectable places. In my dreams, with pipe alight, I have cycled through pleasant Wiltshire villages, where the cottages are thatched as nowhere else in England; I have cycled down Devonshire lanes, where the air has been heavy with the scent of primroses; I have ridden through old towns like Rye, and Kings Lynn, and Warwick, and Ely and Glastonbury. And good indeed it has been!

Planning Ahead

A STUDY of the cycle trade papers suggests that the manufacturers and the retailers are fully alive to the desirability of planning ahead for post-war days. I have been struck by the articles dealing with selling and advertising and the "shape of things to come" in the cycle trade when the guns have ceased to boom and the 'planes to drone . . . and we get back to something like that normal England which we loved so well. Speed the day!

Cyclists' Attire

A LITTLE burst of sunshine the other week-end . . . and what a heartening increase of cyclists on the roads! I watched some of them, noted the trimness of their machines and the rational character of their clothing. In this latter connection what a revolution has taken place since the early days . . . women riders with voluminous skirts, and men dressed up to resemble a kind of "cross" between a gamekeeper and a fly-fisherman! Now . . . opportunity for the body to get the air and the sun, and perfect freedom of action for the limbs. I fancy that in some few ways the "good old days" were in fact the "bad old days."

Cycling Scholars

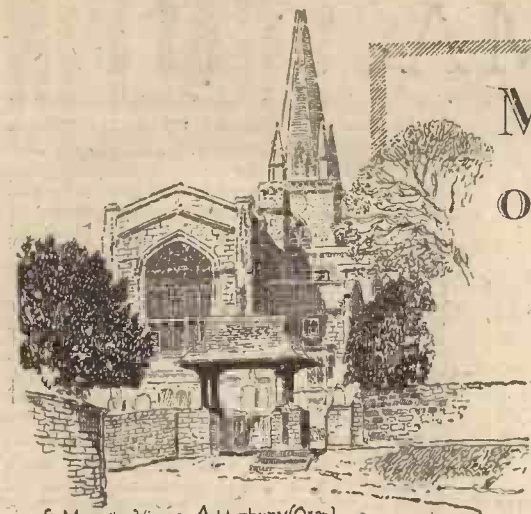
MODERN boys seem to be lucky in the matter of bicycles. I have observed, on many occasions recently, crowds of lads emerging from the gates of a school, and the majority have bikes . . . splendid, modern bikes which must have cost fond parents a deal of money. But the point I wish to make is that some instruction should be given to these fortunate boys in the rudiments of cycling; they ride "anyhow"; they do not know the art of correct pedalling; and they certainly need admonition about lack of care on the roads. I do not know the proportion of road accidents affecting juvenile cyclists, but I fancy that the record must be pretty bad. I wonder whether schoolmasters would take kindly to the thought that some instruction about riding might be given to scholars? The great thing is to teach correct riding methods whilst the rider is young and receptive. I hope that any schoolmaster readers will note my point!

Early Spring

DESPITE the keen winds, and the rather late arrival of days which merit the name of spring, the birds are active in housing matters, and already a tree-creeper is busy building in my garden, and there is tremendous activity among the thrushes and blackbirds . . . the latter popping out of the bushes on the lawn and looking like sleek black harbingers of all the other birds to come. Soon, when the "bread and cheese" is out on the hawthorn hedges, there will be a great chorus of song from the trees and bushes everywhere, and we shall know that King Winter has been deposed from his cold throne, and that the "time of singing birds has come." With it will come the reign of the buttercup, and the celandine, and in some shady dell we shall find the first bluebells. Good days! And not all the black deeds of war can kill the new life of the earth or the burgeoning the trees. . . .

Memories

OLD "books of snaps" can be either boring . . . or full of interest. Last week I happened to come across an album of pictures taken at odd times during cycling tours. And I confess to nostalgic longings when I looked at a picture taken outside the "Feathers Inn" at Ludlow . . . in the summer of 1935. What a gorgeous front has that famous inn! Quite one of the best in England . . . and I recalled that wondrous trip through Shropshire, in and around the country of Housman and Mary Webb. I remembered Church Stretton, and Wenlock Edge, and those typical black-and-white timbered houses, and made a note that when the roads are free again I will repeat that Shropshire tour. And the album also contained pictures of quiet Ely, with its stately cathedral, of some Cambridge "backs" . . . but I put the book away, for it brought discontent with these times when holidays are so difficult, and care-free touring is not to be contemplated.



St Mary the Virgin. Adderbury (Oxon) For Strength

My Point of View

BY "WAYFARER"

Winning the Day

ON the day after that February Sunday when it snowed from morning to night in my part of the world, I decided to walk to business, instead of (as usual) cycling. On the route I have used four times a day for nearly four years I am a "marked man," and at least two of the people I met cried out: "What! No bicycle?" One of this pair, who—bolder than I—was cycling (and carrying a parcel) was encountered again a few weeks later. He was then driving his car, and he slowed down and called out to me: "You won, that day!" Mystified, I dismounted and crossed the road to the motorist, who repeated that I was the winner on the occasion referred to. I was still puzzled, and he then said that it was he who had greeted me on that snowy morning, and asked where my bicycle was. Five minutes later, he added, he skidded and broke his arm; and so, he repeated, "you won, that day."

Well, with all my shortcomings, I *do* know when I am whacked. My great friend, W. P. Cook—one of the most enthusiastic touring cyclists who ever turned a pedal—would never admit defeat, and he came to his end through an accident caused when cycling in snow. Personally, I feel that at my time of life I can't afford to be flung off my bicycle; and so, when the conditions of travel are ultra-difficult, I take my courage in both hands, and find some other method of transport. I prefer to miss one day's cycling now and again to running the risk of bringing my cycling career to an untimely end, especially when there is still so much to be seen and done.

Like a Polar Bear

ONE of the advantages of writing in a monthly periodical is that you can speak quite freely about the weather, without running the risk of sabotaging the war effort. There's no need to write with one eye on the calendar! And so I am able to say that, so far as I am concerned, the month of March forsook tradition, and came in like a polar bear. On the first Saturday in the month I was caught bending. After tea at a Worcestershire haunt, my pal and I started for home, obtaining en route a series of long-distance views of the Malvern Hills, with a threatening back-cloth of angry red, and other local lumps. With still a dozen miles or so to go, a sudden change came over the scene, and a flurry of snow commenced. That flurry soon turned into the real thing, and a good and proper snow-storm ensued. Everywhere was quickly white and we were ploughing through the dried rain in a quite deserted world. A strange thing happened. A brilliant flash illuminated our way, and I at once put this down (seriously) to an excess of energy on the part of my acetylene lamp. But a loud rumble followed, and we realised that a young thunderstorm was snooping round. The performance was repeated, and it was quite an experience to be cycling, in March, in so curious a combination of climatic features. It is only fair to add that, such is the versatility of our weather, I was able, just three weeks later, to have my tea in the open—in a garden (a garden commanding an inspiring vista of the Vale of Evesham) with hosts of midges manœuvring about and a bee or two zooming by. Thus March went out like a turtle-dove!

Simple Arithmetic

CERTAIN cyclists, particularly newcomers to the pastime, and those who think that cycling is a game for only a portion of the year, may fitly be reminded of the fact that twice two are four. Further, there may come occasions when, incredibly enough, the answer to this very elementary fragment of simple arithmetic will be a lot more than four. Let me explain. You ride out to a place (say) 15 miles distant, have tea and then turn for home. You have achieved the outward journey quite comfortably, but twice two are four. You have another 15 miles to do in order to reach home. What about it? Are you in a fit condition to complete your journey in comfort? If so, all well and good. Perhaps that 15-mile outward ride was done with the generous help of the wind, or over a course whose mean gradient was well in your favour. If you are not fit this is where the stock answer to twice-two is hopelessly wrong. And so I say, to novices and unfits, don't forget your simple arithmetic: don't be too ambitious at first: don't be lured too far outwards by a helping wind: don't be snared by the easy going over favourable gradients. True, the breeze may have gone to bed before you commence your return ride, but the hills will still be there, and, in any case, you will not be quite so fresh as when you started out from home. Despite the textbooks, twice two can feel like a lot more than four!

"Travel": Restricted Meaning

AT the moment of writing, there is a great deal of talk about the possible restriction of "travel"—meaning, of course, rail travel—when the Second Front is inaugurated. The matter is not one which will concern me personally, because some time ago I entered into a self-denying ordinance which keeps me out of trains for (I hope) "the duration." It would be extremely nice to have a look at Scotland, and other distant places, which are presently out of reach without railway aid, but I must wait for happier days. On the general subject of this possible restriction of "travel," all I have to say is that we cyclists will be unaffected. We possess our own transport system, which functions without that fuel so urgently needed for other purposes, and we shall thus proceed on our way—carrying out our day rides, our tours, etc.—without in any way hindering the war effort, and, incidentally, with a great deal more comfort than, according to report, railway trains now afford. So once again the cyclist scores.

Line of Least Resistance

AN acquaintance with whom I was chatting the other day harked back to his cycling career (now buried in the dim and distant past), and told me that the best ride he ever did was from A to B. He proffered what I thought was a curious explanation as to why he chose that particular journey: he possessed a contour book, and this was the flattest route he could find! Everyone to his taste, of course. For my part, I am not in the habit of thus electing to follow the line of least resistance. My preference is all the other way, and I would eschew the flat route and take that which possessed its share of ups and downs. Why? Because of the greater variety of cycling in those parts of the world where the road sometimes stands on its hind legs. I have often said—and I now repeat—that, if my future cycling had to be limited to one particular district, and I were offered the choice of a locality like North Wales and one like the Fens, I would choose the North Wales type every time.

Normal Practice Here

ACCORDING to my newspaper, there is a strict "curfew" in one (at least) of the Balkan countries. During the hours of darkness everybody has to be indoors. Special permits, however, are issued, and it is a condition that the holder of such must walk in the middle of the road. Some of those permits must have found their way to this country, judging by the number of people who walk in the middle of the road, especially at night-time!

Notes of a Highwayman

By LEONARD ELLIS

The London Octopus

ONE wonders, amid the welter of schemes for post-war reconstruction and development, amid all the promises of a better-planned England, whether we shall emerge a happier country or not—whether the so-called improvements will appeal to the majority. It is certain that in spite of the fact that we are unable to exist without our fast traffic, telephones and refrigerators, there is dormant in most people an aching urge to return to the primitive. But what are we promised? Two acres and a cow?—not by any means. Wider roads, which mean less greenery, faster traffic, fly-over crossings, motor ways and so on, and one sadly reflects that in time all these aids to enjoyment might gradually eat up all our playing fields and countryside. We have realised when it is too late that London has become a monstrosity. Although many cyclists make nothing of the crossing from east to west or north to south, how many more are there who regard the greatest city on earth as an awful barricade between them and the counties of Kent or Buckinghamshire. The prospect of thirty or forty miles of town riding is not a cheerful one.

From Town to Country

LONDON has been growing for centuries and there is little change in the scenery from the Bank to the extreme edge of the suburbs. Curiously enough, when one reaches that edge in most cases the scenery changes most abruptly. Consider the Oxford Road out of London. Oxford Street, Bayswater, Shepherds Bush, Ealing, Southall and Uxbridge. Here as we pass through can be seen relics of the old countryside our fathers enjoyed, but for us—no break in the line of houses until we come to the Old Treaty House, now the Crown Hotel. Here many years ago Charles and Cromwell met to talk over the Treaty of Uxbridge. Here also as we cross the river we enter the countryside, although admittedly it is not very beautiful for the first mile or so. The fact remains, however, that we have positively left the town behind. What collections of houses we now encounter are villages and country towns, and not suburbs. Here actually we can start to tour, and not without justification and reward.

At the End of the Tram-track

WITHIN a mile or two are at least two villages that are well worth visiting. Denham is two miles from Uxbridge on the north side of the Oxford Road, and Fulmer lies on the south side some two miles beyond that. The former is a charming village in spite of modern building. Mercifully all the new houses have been built beyond the range of vision of those who go to see the famous, unspoiled village street. Here is a scene as typically old English as one could find in a day's ride. Low cottages, little country shops with "bull's eye" windows, several old inns, and an amazing wealth of wistaria that attracts thousands of sightseers in the early summer. Denham is noted as the site of two old seats with histories that go back many centuries. The old church is built of flint and is remarkable for the number of monuments. Fulmer is another pretty village and is even less modernised than Denham, although much smaller. The church has a fifteenth century doorway, and in front of the old inn stands the skull of a great elephant from which vandals stole the silver plate within the last year or two. It recorded how this wild bull elephant was shot in 1855 by Major Lytche in the Poona Valley, British Burma. It had killed many people in its lifetime and had for long terrorised the natives in the district. Its age was estimated at 200 years, and it was 11ft. 3in. high. Fulmer Place is another old place with a history.

The elephant's skull at the Black Horse, Fulmer.

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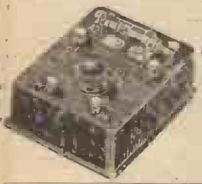

MICROPHONES

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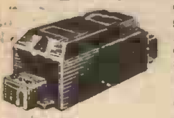

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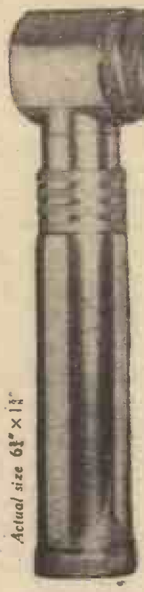

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