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PRACTICAL MECHANICS

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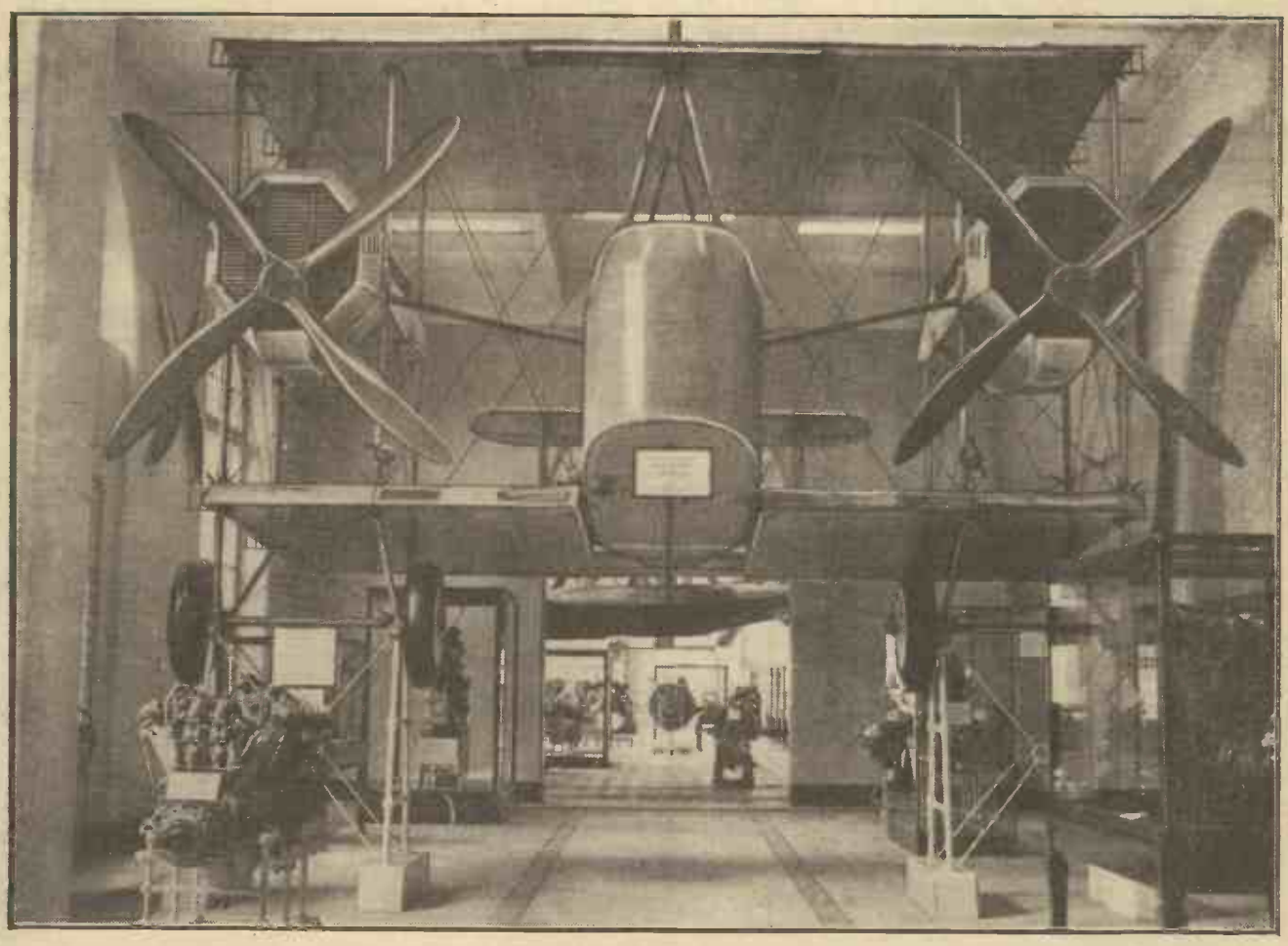
EDITOR : F. J. CAMM

SEPTEMBER - OCTOBER 1950



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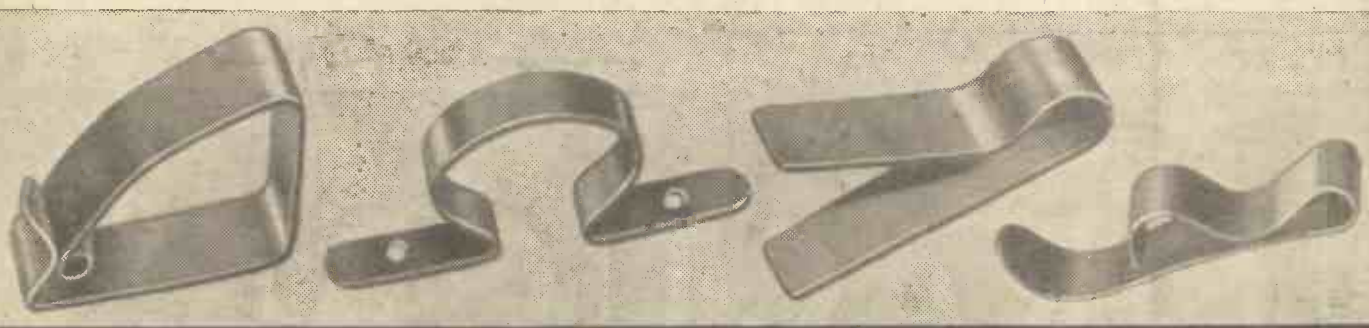

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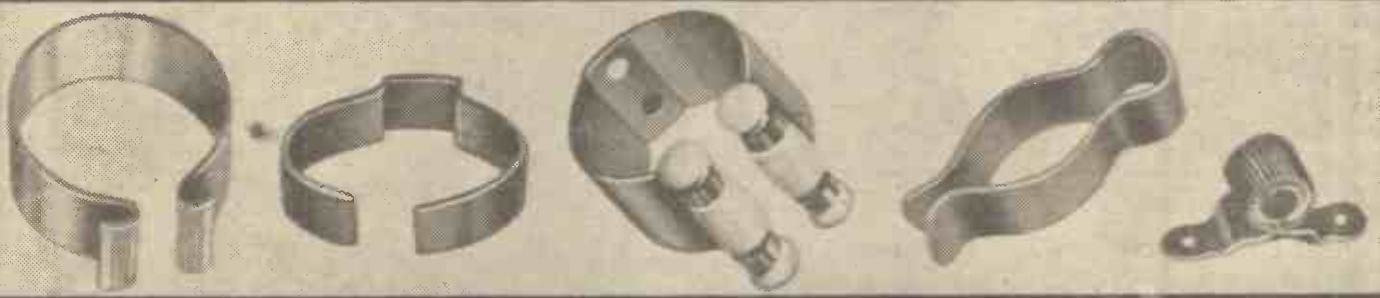

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PRACTICAL MECHANICS

EDITOR F. J. CAMM

SEPTEMBER-OCTOBER, 1950
VOL. XVIII. No. 203

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

FAIR COMMENT

By The Editor

Flying Saucers

I HAVE received a large number of letters on the subject of flying saucers. What are they? Do they really exist? Are they from other planets? Are they weapons of war? New forms of radiosonde? The fact is that flying saucers do exist, and the United States authorities admit that they are responsible for them. Photographs are available showing them in flight. From the tangled reports which have appeared in the Press no one would be able to form an accurate opinion of what a flying saucer really looks like. These reports indicate that they vary in size from 250 feet to a few inches. They fly at all heights. Some are self-propelling, others are radio-controlled. They do not exude exhaust gases. They are silent, they can poise and hover and travel at immense speed.

It is known that in Maryland in the United States an American project has been progressing during the past three years. As various experimental flying saucers are produced they are released into the air and this would account for the varying reports as to their size. These experiments are conducted by the United States Air Force who have not released any statements concerning the basis of their experiments. Facts about these saucers were recently given in a broadcast by Henry J. Taylor working in co-operation with the U.S. Military Authority. He told his listeners that the following words are stencilled on the saucers: "Military secret of the United States of America Air Forces. Anyone damaging or revealing a description or whereabouts of this missile is subject to prosecution by the United States Government. Call collect at once (followed by a telephone number and the address of a U.S. air base). Non-explosive."

Flying Saucers have been sighted in 39 of the 48 United States. One responsible watcher said that they appeared to be revolving at about 200 revolutions per minute at 6,000ft. and travelling at from 500 to 700 miles per hour.

Another man in Houston, Texas, picked up a circular flat disc marked "U.S.A. classified secret device. Notify Col. F. Hackett, Washington." Col. Hackett denied any knowledge of the device. I have no information beyond that and readers may form conclusions as valid as mine from the foregoing.

There have been many attempts in the past to produce aeroplanes with truly circular wings, the design being based on the mistaken belief that automatic lateral and longitudinal stability would be secured. Some of them were partially successful but they were no more stable that the more normal types.

I have often thought that guided pilotless aircraft such as the VI were wrongly conceived in that to achieve their object they destroyed themselves. A considerable amount of expensive equipment is fitted to them. Surely it should be possible to design one on the boomerang principle which at a predetermined moment dropped its bomb and returned to its base for further use. It will be seen at once that such a design could be produced, and there is no scientific or practical reason why it should not; a considerable saving of time, money and material would be effected. The principles of the boomerang are well understood and it might pay to experiment with powered boomerangs.

The most satisfactory power unit, of course, would be a jet motor.

TELEVISION LINK WITH CONTINENT

THE first Continental outside broadcast televised during the month of August marks a considerable advance in television technique. It is the first time the Channel has been spanned by microwave television links which carry the programmes in a series of hops from Dover to the roof of the London University building from whence it was transmitted by land-line to Alexandra Palace, and retransmitted to London and Midland Regional televiewers. The Calais-London broadcast brought a programme transmitted 90 miles away. There were three intermediate stations on the route to London, in addition to the terminal stations at Calais and Dover. A microwave link was used for the first lap across the Straits of Dover, with the transmitter 200ft. above ground in the tower of the Town Hall at Calais, and the receiver on a mast at Dover. Another microwave link carried the signals from Dover over the 26 miles to Warren Street, near Lenham. The next stage from Warren Street to Harvel, about 18 miles, was accomplished with a V.H.F. link. From Harvel, which is near Wrotham, the signals carried the last lap to London, where the receiving equipment had been installed on the London University Senate House in Bloomsbury. From there the signals went by cable to Alexandra Palace, having travelled a distance of 95 miles in four stages.

The portable microwave television link, such as that produced for the purpose by Standard Telephones and Cables, Ltd., is a frequency modulated S.H.F. system employing carriers of the order of 4,000 megacycles, and operating between points within visual range of each other and not normally more than 30 miles apart. For transmissions over longer distances one or more repeaters may be used. These comprise, without modification, a standard receiver for demodulating incoming signals and a transmitter for remodulating the resulting video signals and passing them on in the desired direction at a frequency shifted from that of the previous link of 40 megacycles to prevent mutual interference.

The complete mains-operated transmitters and receivers are transportable, being broken down into a number of portable units. Except in the case of semi-permanent receiving terminals, equipment is designed for use in a motor van. The 4ft. paraboloid transmitter and/or receiver assembly may be mounted on a spigot on the roof so that no equipment need be removed from the van for short and unobstructed radio linkages. Where transmission paths are not clear of buildings and leafy trees, it is necessary to find a more elevated or suitable vantage point.

The rapid developments of the past year in television radio links have produced lightweight equipment which can be taken to the scene of action and set up immediately. Several of these units can be used in tandem, the picture being transmitted from one to another, thus permitting much greater distances to be covered. Experimental work only started last year, and two sets of equipment were used successfully for televising the Boat Race this year.

THE "PRACTICAL TELEVISION RECEIVER"

WE have produced in the *Practical Television* laboratory a highly efficient 18-valve television receiver which can be built by any amateur from the instructions given in that journal. Back issues of it, so successful is our new companion journal, are unobtainable; for the convenience of readers unable to obtain the issues containing the instructions we have produced a booklet at 3/6, or 3/9 by post, giving full instructions, theoretical circuits, wiring diagrams, list of components and photographs of the instrument both finished and in course of construction. Copies may be obtained from or through most newsagents, or from the Publisher, Book Department, address as on this page.

NEW VOLUME COMMENCES

VOLUME 18 commences with this issue. As in the past, indexes have been produced for Volume 17, comprising issues dated October, 1949, to August, 1950, inclusive for 10d., by post. It will be observed that owing to the no overtime working in the printing trade we were compelled, in order to make up for lost time, to combine the September and October issues, and so Volume 17 contains only eleven issues. This present September/October issue therefore commences Volume 18. It is hoped that readers will take advantage of this service to our readers.—F. J. C.

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Small Water-power Plants

Constructional and Operational Details of Water Wheels and Turbines Suitable for Small Streams and Rivers

By ROLT HAMMOND, A.C.G.I., A.M.I.C.E.

THERE are many places in the British Isles, especially in remote districts, where small streams and rivers lend themselves to power development on a small scale, and those who wish to achieve the best results without waste of money may be interested to learn a few facts helpful to them in planning a water-power scheme.

The first and most important task is to

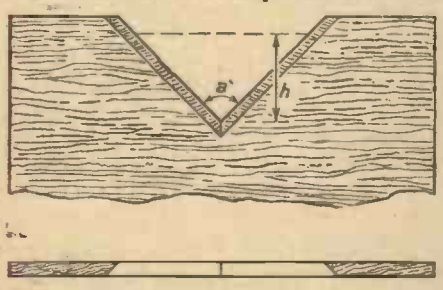


Fig. 1.—Simple measuring weir with triangular notch.

carry out a careful survey of the proposed site, because without an accurate knowledge of local distances and differences of level it will be impossible to plan anything. There is no need to use expensive instruments or complicated methods; the whole area can be surveyed with a prismatic compass and a good tape, using the standard methods as laid down in any good book on elementary surveying. Important level points should be established with the aid of level and staff, and such instruments can probably be borrowed from a contractor, or from the local county surveyor. In any case, it would be wise to have a talk with the local surveyor at the outset, just to make sure that no water rights are being infringed, and that the work proposed will not interfere with local amenities. All this kind of preliminary discussion will go with a swing if the designer and builder has clear and accurate drawings, and can explain every detail of what he intends to do.

Gauging Stream Flow

The poet tells us "that even the weariest river flows somewhere out to sea," so that every stream and river has a gradient and this should be measured accurately, as much will depend upon this in gauging the flow of the stream. Our next task will be to gauge stream flow, and several methods are available for doing this, but it should be emphasised that every method has its own particular application and that the main object of flow measurement is to obtain a sound and accurate idea of what the flow will be over a considerable period. There are cases where even large water-power schemes have given disappointing results in practice because the flow measurements were not taken over a sufficiently long period of time.

For very small streams, a direct measurement of flow can be made by means of a calibrated collecting tank or receiver, but this is not a satisfactory method, and can only be used for very small flows. In the case of a wide stream or small river, measurement of flow is by means of a current meter; this is a standard type of surveying instrument, and comprises a small horizontally mounted wheel with conical buckets which is suspended from a cable and measures water speed by a simple electrical contacting device. The cross section of the stream will have to be measured accurately and plotted to scale, and water-velocity readings will then be taken at, say, ten feet intervals across the width of the stream; any good text book on hydraulics will describe the method used for measuring flow in this manner.

Failing the ability to borrow a current meter, stream flow can be measured by means of floats, their time of travel being measured over a given distance by stop watch, and their position picked up by suitable observation.

A Measuring Weir

Flow of a stream can be accurately and conveniently measured by constructing a weir across the stream and measuring the flow through a notch. The water upstream of the weir should be deep enough to avoid any perceptible velocity of approach to the weir, because this will lead to inaccurate readings. The triangular or vee-notch is the most suitable type of measuring weir, because relationship between wetted perimeter and area remains constant for all heads, but care should be taken to ensure that the sides of

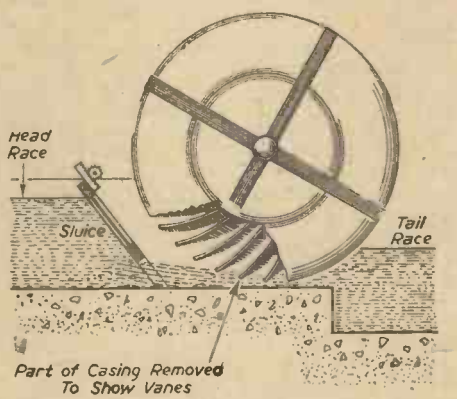


Fig. 3.—Diagram showing general arrangement of an undershot water wheel and sluice.

the notch are equally inclined to the vertical. The vee-notch shown in Fig. 1 may be made of hardwood but if it is to be in position for a long time, then it would be better to line the sides of the notch with stainless steel, as wood is liable to be damaged by floating branches and other debris. If the notch can be sited in a place where it is not likely to suffer from disturbance, then so much the better.

The discharge Q in cubic feet per second over a triangular notch is given by the formula:

$Q = 4/15$ k.w.h. $\sqrt{2gh}$

where w, h and g are in feet units, the latter being the acceleration of gravity. k is a constant, which varies from 0.59 to 0.62, according to the angle a, being 0.59 when this angle is a right angle, and in this case $w = 2h$ and the above formula then becomes

$Q = 0.3\ h^2\sqrt{h}$ cubic feet *per minute*, where h is in *inches* and k is 0.59.

The notch should be carefully levelled when it is installed, and the edge of the notch must be sharp, otherwise the readings will be quite inaccurate. Measurement of head can be made on a gauge in the bed of the stream some distance upstream from the weir. It is even better practice to provide a stilling chamber in the form of a glazed earthenware pipe set on end in a bed of loose stones. Fig. 2 shows a hook gauge, which is a very convenient and accurate instrument. This can be made up from a micrometer head or similar device, the exact level being revealed when the hook just touches the surface of the water from below. It may be worth while investing in complete automatic recorder gear, such as that made by the Lea Recorder Company, Ltd., of Manchester.

Fig. 2.—A hook gauge.

Another very useful method of measuring stream velocity is by no means a pitot tube, the lower end of which is immersed in the stream and left open, the water rising in the tube above the surface of the water. The velocity is given by the approximate formula $V = 1.7\sqrt{h}$. An instrument known as Perrodil's hydrodynamometer has also been used with success; this measures the velocity of a stream by the torsion which is produced in a wire by the pressure of the water against a disc mounted on an arm at right angles to the wire. The velocity is given by the formula $V = c\sqrt{a}$, where a is the angle of torsion and c is coefficient, which is found by experiment, or may be calculated from the coefficient of torsion of the wire. It is claimed that this instrument is very sensitive and can be used with success for measuring very low velocities.

These are but a few of the methods used for measuring stream and river flow, but in case the reader should require more detailed information, he is recommended to consult "Stream and Channel Flow," by E. E. Morgan, published in 1937.

Designing the Plant

Having obtained an accurate idea of flow, we are now faced with the problem of designing the plant, and the first essential is to decide on the best type of water wheel or

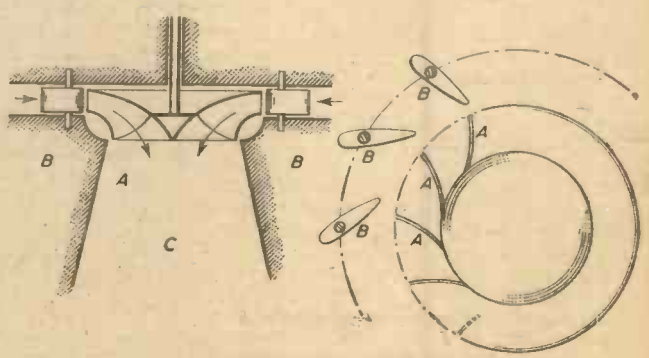


Fig. 4.—Section and plan diagrams of a reaction turbine.

turbine to adopt. For heads up to about 6ft., the undershot water wheel is a good proposition, and Fig. 3 shows the general idea. This wheel is a kind of turbine, and the designer should aim at setting the vanes at such an angle that the water will enter and leave the turbine or wheel smoothly and without shock. The best speed for the outer ends of the vanes is about 55 per cent. of that at which the water enters the wheel, although it can vary from 50 to 60 per cent. without disadvantage. The diameter of the wheel should be about three or four times the head, so that we should have a 24ft. diameter wheel for a head of 6ft. It is interesting to note that a wheel of this type erected in Angoulême, France, in about 1847, attained an efficiency of about 68 to 75 per cent., so that the undershot wheel is certainly worth considering for a small power development. Suitable gearing would probably have to be installed if the wheel were to be used for driving a dynamo.

The selection of the most suitable turbine for the scheme is a very important matter to decide, but before this can be done it is necessary to understand what is meant by that very useful factor known as "specific speed." This is used as the basis of comparison for water turbines, and has been defined as the speed at which the turbine would run, at its designed efficiency, under a head of 1 foot when reduced in size so that it would produce one horsepower under that head. An impulse wheel of the Pelton type, used for high-head plants, and not likely to be of interest to us in this present article, has a specific speed varying from 15 to 30, the corresponding specific speed for a very low speed Francis turbine varying from 50 to 70.

Specific speed is given by the formula $n_s = n\sqrt{N}/H^{5/4}$ wherein n is the speed of the wheel in revolutions per minute, N is the output of the wheel and H is the head on the wheel. These facts being known, the specific speed is then calculated, and if the makers are given a note of this they will be able to recommend the best type of turbine to conform to these figures, and thus to ensure the best operating efficiency. These makers have curves which show the highest specific speed that can safely be employed at a given head and with given suction conditions.

The most usual type of turbine for low and medium heads is the reaction turbine, which consists of four main component parts, namely: the casing, the guide apparatus, the runner and the draft tube; in Fig. 4, A indicates the runner, B the guide vanes (which are turned by the governor mechanism as the speed varies) and C is the draft tube. The latter enables the turbine to be

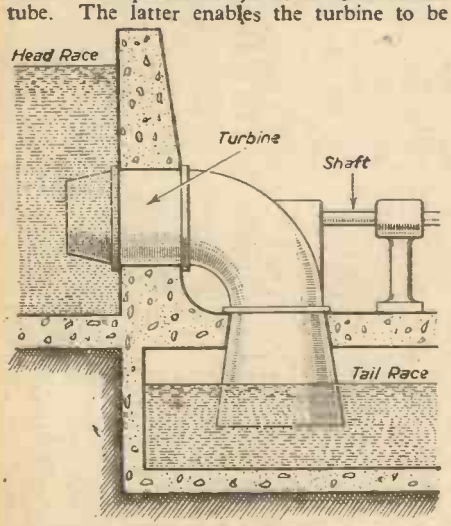


Fig. 6.—Alternative arrangement for a low-head installation.

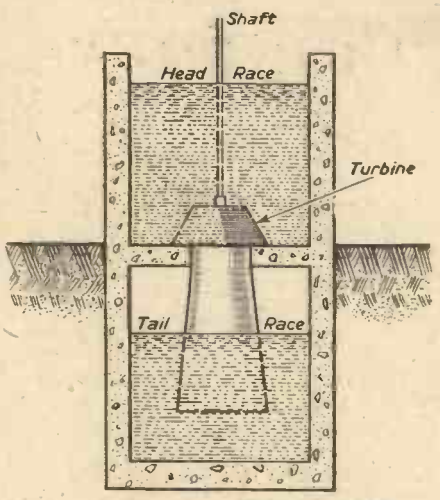


Fig. 5.—Section of a low-head installation.

set above the level of the tail water without loss of head due to its elevation. By having a suitable taper on the draft tube, much of the kinetic energy of the water leaving the runner can be recovered. This is not of very great importance in turbines of low specific speed, but for units of high specific speed, up to a quarter of the energy in the water may be recovered in the draft tube, in which case its design assumes great importance.

Type of Setting

Having obtained our turbine, we next have to consider the most suitable setting, and this will be determined by the manner in which the water reaches the turbine. In a low head installation, water will reach the turbine through an open flume, as shown in the two alternative arrangements in Fig. 5 and Fig. 6. In the former, the turbine itself has no casing, and is merely set at the bottom of an open chamber; the latter turbine also has no casing and is set at the side of the flume.

In Fig. 7 we have a larger type of the same turbine, that is of the reaction type, with the runner entirely encased and the whole installation set in a mass concrete foundation which forms part of the power station. This refers more to the larger types of plant, but a modification of this would be very suitable for a small turbine installation where the head might be as much as 200 feet, as in the case of a Scottish burn with a steep gradient. In such a case, the water would be collected in a forebay at the top of the stream and led down the mountain side in a pipe, with concrete anchor blocks holding it in position at intervals.

Regulation of this kind of turbine is accomplished by moving the guide vanes B (Fig. 4) which admit more or less water to the turbine. The most satisfactory type of governor is the automatic oil-operated servo-motor mechanism, and in modern plants some form of centrifugal pendulum is used to control the admission of oil under pressure to the actuating cylinder of the guide vane operating gear.

General Considerations

All mechanical and electrical gear for this type of plant should be obtained from specialist firms, but the man who is fortunate enough to have a stream on his property can do a great deal of what may be termed the civil engineering work himself. Moreover, a man who is a good mechanic or wheelwright can make a very good undershot water wheel which will serve him well and pay a good dividend.

Strainer Racks

He can also make simple sluice gates and strainer racks, the latter being very important in order to avoid any possible damage to the turbine. In designing a pipe line for a relatively high head, a specialist should be consulted, and it is worth spending a fair sum on this because great danger may arise in a pipe line owing to accidental water-hammer effects. Again, he will have to obtain valves and similar accessories from specialist firms, but probably a great deal of the equipment can be bought second hand. For a low head plant the sluice valve is suitable, but for higher heads we must employ the Larner Johnson or English Electric types.

Expansion and Contraction

A very important point to be watched in designing the pipe line is to make provision for expansion and contraction between the anchor blocks due to changing air temperature. An empty pipe in the hot sun reaches a temperature far above that of the ambient air. In solid rock there is no difficulty about getting a good foundation for the anchor blocks, but these foundations should be keyed in with rag bolts or reinforcing bars, set in cement grout, in holes drilled in the rock.

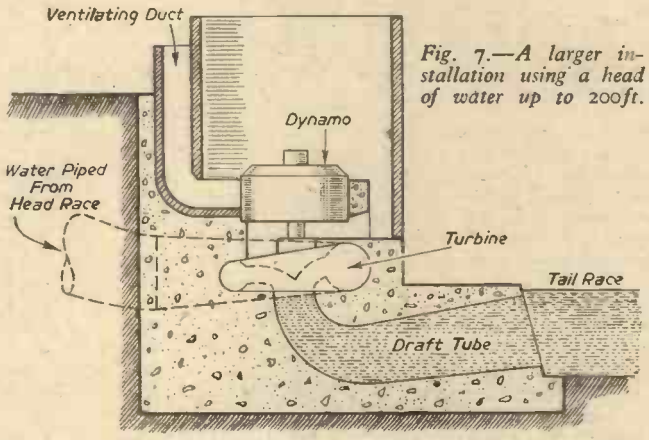


Fig. 7.—A larger installation using a head of water up to 200ft.

Consult the Makers

In any water power development scheme, however small, it is wise to consult turbine makers who have a vast experience on which they are able to draw. The constructional work is mainly common sense, but that too should be done in consultation with the turbine maker, who can give very good advice in this respect.

Flexible Mould Compounds

The Use of Vinyl Elastomers for Hot-melt Compounds

By F. J. CHRISTOPHER

HOT-MELT compounds are being used in place of gelatine for forming flexible moulds. The compounds, which are known as "Vinamolds,"* were developed and are manufactured by Vinyl Products, Limited. They are based on a vinyl resin, and can be melted down to a liquid to be poured around articles of plaster, glass, metal, earthenware, pottery or china to form flexible moulds of great strength for the production of casts of plaster, cement or cold-set resins.

The hot-melt compounds are thermoplastic, completely water-resistant, and do not shrink or split as does gelatine or glue. They are fully recoverable, and are not affected by the phenol-formaldehyde-type cold-setting resins, or by plasters with a high lime content which heat while setting. Because of their tensile strength and flexibility, casts with deep undercuts can be removed from one-piece moulds without damage to the cast or mould, and hundreds of perfect casts can be produced before the life of the mould is expended when it can be remelted for further use.

"Vinamolds" are produced in three grades of flexibility (see table), and a fourth grade is being developed. Selection of the correct grade depends on the shape and size of the object used for a model. The highly flexible grade (HMC. 776) is suitable for forming moulds for small compact objects. The fairly rigid grade (HMC. 21) is suitable for forming moulds for long, slender objects such as the column of a table-lamp stand. The intermediate flexible grade (HMC. 774) is suitable for forming moulds for medium-size objects such as book-ends, small figures, statuettes, etc. Cased moulds may be necessary where the weight of the filling is likely to cause distortion.

Melting the Compounds

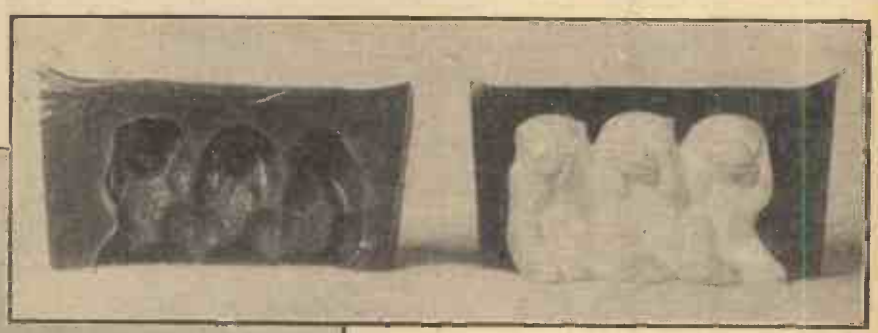
The "Vinamolds" are true gels and liquefy when heated, but their thermal conductivity is low, and care must be taken when melting to avoid local overheating which may char and decompose the compounds. Frequent stirring is necessary, and this should be done slowly to avoid forming air bubbles which are not easy to remove. A lid must be provided for the melting-pot, and this should be kept on at all times, except when stirring or pouring. Aluminium, glass, enamelled iron or stainless steel vessels are suitable for melting the compounds; copper vessels should *not* be used. Electrically-heated jacketed melting-pots are obtainable for melting large quantities; these are thermostatically controlled, and require very little attention in use. Smaller quantities can be melted in a glue pot, or porringer, with the outer vessel left empty, or filled with paraffin wax or powdered graphite. Steam-heated jacketed containers are suitable for melting the compounds if steam pressure of 80lb. per square inch can be exceeded. Water baths are *not* suitable. Electric or gas-cooker ovens can be used to heat the compounds at temperatures of 160 to 180° C. (320 to 356° F.). Very small quantities of the compounds can be melted over an electric hot-plate or a gas-ring, if an asbestos mat is used and the hot-melt stirred frequently. The "Vinamolds" are supplied in slab form, and whatever kind of melting-pot is used, the compounds should be cut into small pieces to facilitate even melting, or they can be broken down by passing strips of the compound through a mincing machine.

A group of moulds and casts; moulds in background were formed by pouring; moulds in foreground were formed by dipping. Two of the moulds are peeled back to demonstrate elasticity. Dark castings are cold-set resins; light castings are plaster. (*Photo: Vinyl Products, Ltd.*)

Pre-treatment of Models

Pre-treatment of non-porous models made of metal, glazed earthenware, china or glass is not necessary before pouring the hot-melt compound, but they should be warmed before pouring to prevent chilling of the compound, and in the case of glass or china, to prevent the model cracking. Porous objects of plaster, cement, earthenware, etc., require treating before pouring the hot compound; they should be immersed in molten paraffin wax to drive out trapped air and to seal all pores, or given a coat of a good cellulose enamel; this pre-treatment is necessary to prevent blisters from forming by heat expansion. Faithful reproduction of even the finest details of the model is a feature of the "Vinamolds," and small blemishes on the model should be carefully repaired before mould-making takes place. A reproduction of a plaque showed a faint hair-line scratch which was hardly distinguishable on the original.

The model should be placed in a container of glass, metal, card, wood, plaster, etc.,



A small mould cut in half to show cast. It is not necessary to cut small moulds of this type; mould has been cut to illustrate this article. (*Photo: Homecrafts.*)

Demonstrating the remarkable elasticity and tensile strength of "Vinamold." Mould is one used to cast indian head plaque; parts of mould are less than a quarter of an inch thick. (*Photo: Homecrafts.*)

* Registered Trade Name

Removing a cast from a one-piece mould. Cast is plaster, mould is "Vinamold" HMC.774. (*Photo : Vinyl Products, Ltd.*)

before pouring. The top of the container should be slightly larger than the base to facilitate easy removal of the formed mould from the container, and the container should be deeper than the model to allow for a slight shrinkage of the compound in setting. The model can rest on the bottom of the container or it can be suspended upside down inside the container. The liquid hot-melt should not be poured directly on to the model; the flow should be directed against the side of the container to rise *slowly* round the model, and pouring should be uninterrupted. Small moulds can be formed by dipping the prepared model in the liquid compound, allowing it to cool, and dipping again until a sufficient wall thickness has been built up. In most cases a wall thickness of a quarter of an inch is sufficient, but this depends on the size and shape of the model.

One-piece Moulds

One-piece moulds can be formed for all objects unless they have elongated projections such as in the "Javelin Thrower" (the javelin), or apertures such as in a figure with arms akimbo (the holes between arms and body). Where the filling hole is smaller than the bulk of the model, the mould can be cut open at one side to allow easy withdrawal of the cast; a rubber band should be used to hold the mould together for refilling. Moulds for models with apertures or projections can be made in two or more parts by attaching the base of the model to the side of the container, and by pouring the melted compound to the level of the parting line, and allowing the hot-melt to cool to room temperature before again pouring the compound to cover the model. French chalk should be dusted on the surface of the division level if the fairly rigid grade (HMC. 21) is used, but the other two grades will not stick and will part easily. Any small blemishes in the mould can be smoothed out with a heated knife blade.

Casts of Cement or Plaster

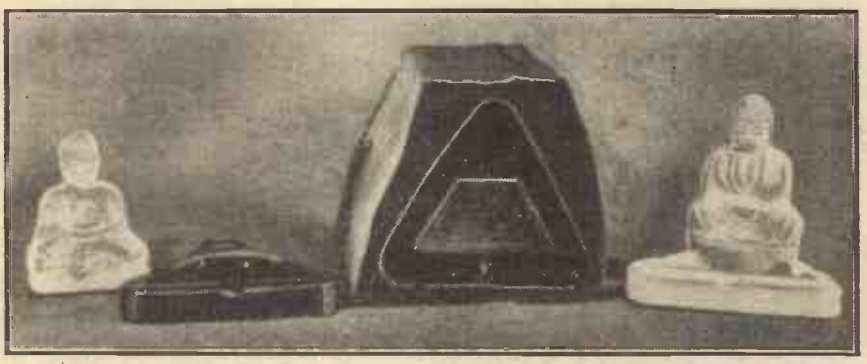
Treatment of the moulds is not necessary before casting as neither plaster, cement, nor cold-set resins will stick to the mould. In making casts of cement or plaster, the mixture is poured into the mould and entrapped air in deep undercuts is removed by stirring the mixture and by tapping the sides of the mould; if there are any very deep undercuts it may be necessary to make air vents in the mould. Hollow casts can be produced by inserting a core of "Vinamold" which should be withdrawn when the cast has set, or by mixing a slurry of the casting material and partly filling the mould with this—shaking the mould so that the slurry coats the mould as it sets. It may be necessary to do this several times to build up a wall thickness of sufficient strength. Moulds should be flushed out with water after use to remove any loose particles of plaster or cement.

Cold-set resins are made by mixing synthetic resin with a hardener; the mixture can be poured directly into the mould which does not require pre-treatment. Care should be taken to remove entrapped air. The cold-set resins gel quickly, but they can be cured if so desired by placing the filled mould in an oven heated to a temperature of 75° C. (167° F.). There is a slight shrinkage of the cold-set resin of .04 during setting. After removal from the oven, the mould should be allowed to cool before removing the cast; premature withdrawal may damage the mould in its softened state.

TABLE OF GRADES

	Vinamold HMC.21	Vinamold HMC.774	Vinamold HMC.776
Softening Point (Ring and Ball)	131° C.	139° C.	136° C.
Liquid at ..	150 to 155° C.	145 to 150° C.	145 to 150° C.
Viscosity of melt	medium	low	low
Elasticity ..	fairly rigid	flexible	highly flexible

THE COMPOUNDS SHOULD NOT BE HEATED TO TEMPERATURES OVER 200° C. (392° F.)



Combination of a broken plastic ashtray and glass paperweight. Container for mould was stiff card; sides have bulged in pouring, but cast is unaffected. (*Photo : Homecrafts.*)

Reaction Soldering

A Process of Coming Importance

By J. F. STIRLING

THEY call it "reaction" soldering because it results from a chemical reaction which is made to take place between the two metal surfaces which are to be joined together. It would, however, be better to use the term "chemical soldering," because such an expression or designation is more clearly indicative of the nature of the process.

Metallic Chlorides

Reaction or chemical soldering first came into practical use just before the beginning of the last war. It made slow progress at first, and even now its use is not widespread for the reason that it is only really adaptable to certain types of soldering. Various mixtures of metallic chlorides and bromides have been used, but the mixture found to be most efficient is one of zinc chloride, ammonium bromide and sodium fluoride. These ingredients are intimately mixed together and stored in a tightly-corked bottle. The zinc chloride is very deliquescent, or moisture-absorbing. Consequently, the mixture will never be dry. It will always resolve itself into a paste. Hence, it must be kept in well-corked bottles. Do not store the mixture in glass-stoppered bottles. The zinc chloride can often act as a peculiarly efficient adhesive for glass stoppers in bottle-necks, and much difficulty is often experienced in extracting stoppers from bottles containing this material or admixtures of it.

Method of Using

For reaction soldering, the parts are cleaned in the normal manner. No flux is needed because the soldering mixture acts as its own flux. The mixture is smeared thinly on *both* contacting surfaces, which are then brought together in firm but not too tight contact. The joint is then heated either with a bunsen burner or with a small blowlamp. The result of the heating is a complex chemical reaction which produces metallic zinc on the contacting surfaces. The liberated zinc is in a molten condition. It "keys" well to the metal surface and forms a very strong joint. In fact, the joint thus created is usually stronger than that made by ordinary solder, and it will stand up to a higher temperature than will the normal soldered joint, the melting-point of zinc being 418 deg. C. (787 deg. F.).

The reaction-soldered joint must, of course, be well washed in warm water to remove the remaining salt encrustations which cling to it. If this washing is not thorough, any remaining traces of zinc chloride will set up corrosion of the joint.

The proportions of the three ingredients of the soldering paste are capable of much variation. Usually, the mixture should contain equal parts of each ingredient, although some workers may prefer to keep the zinc chloride in excess, since this is really the main active ingredient of the paste and the ingredient from which the soldering metal is derived. Potassium bromide may be substituted for ammonium bromide, but the latter gives better results and at a lower temperature.

For Large Work

There are two disadvantages of the process. The first is the fact that copious white fumes are evolved during the heating of the joint. The second is that the method cannot be applied to really fine work, such as the joining of thin wires and metal foils, since these would tend to melt or oxidise completely during the heating. For any really substantial soldering job, however, the process is convenient and easy to work. It is best operated on copper and brass, but it can also be used on aluminium and its alloys. It was indeed, in connection with this type of work that reaction or chemical soldering was first devised.

Animal Glues

Some of their Advantages as Compared with Synthetic Resin Glues

By W. E. FLETCHER, B.Sc., Ph.D.

IN a recent article in this journal Mr. D. N. Buttrey, M.Sc., wrote about synthetic resin glues as ideal for use in the home workshop. In so doing he made critical references to animal and fish glues. If the author had contented himself with simply describing the advantages of synthetic resin glues and had not attacked animal and fish glues then his article would have been a fair technical contribution.

Immortal Craftsmen

Unfortunately, however, some of Mr. Buttrey's assertions are rather misleading. For this reason the matter cannot be passed over without a truthful statement of the *facts* —in justice to all manufacturers of animal and fish glues. In the first place, the fact that such immortal craftsmen as Sheraton, Hepplewhite and Chippendale used animal glues in the construction of their superb furniture is evidence of the time-honoured supremacy of animal glues. For not only for years but for centuries the magnificent pieces created by these craftsmen have remained firm in all their joints.

Does this fact suggest that with animal glue: "Invariably the glue line is the weakest link in the assembly"; or "Embrittle with age"; or "Is often attacked by bacteria or mould growth"? Further, does it suggest that "shrinking during drying and ageing causes gap-filled joints to craze and crack on the glue line with consequent weakening of the joints"?

The evidence provided by the Sheraton, Hepplewhite and Chippendale masterpieces should be quite sufficient to repudiate flatly such misguided criticisms of the effectiveness and "lastingness" of animal glues.

Some Anomalies

But there are other points in this matter which should be dealt with not by the negative method of "defending" animal and fish glues—they need no defence—but in exposing a few of the anomalies of Mr. Buttrey's case for synthetic resin glues. (I shall not deal with fish glues in this article because these adhesives are entirely different and are rarely, if ever, used for wood-jointing.) What, then, are the anomalies to which we refer?

Mr. Buttrey suggested that there are many uses to which both phenolic and urea formaldehyde resins could be put in the "home workshop"—but let it be made perfectly clear to anyone who wants to use these adhesives for home use that he will find them extremely difficult to obtain in *small quantities*. There are several reasons why manufacturers do not make these glues available through the normal retail channels:

(a) Risk of dermatitis from contact of these compounds with the skin. In fact, industrial users are obliged to provide special protective creams to safeguard the hands of their workpeople.

(b) The limited shelf-life—Mr. Buttrey says 3 months in a cool place—is a manifest disadvantage to both stockists and prospective users. One needs little imagination to appreciate the intricate marketing problems involved in selling a product that has to pass through the normal wholesale and retail channels and *yet be used within* 3 *months*! It is assumed, of course, that all who handle such glues have taken good care to see that meantime it is kept in "a cool place"!

(c) Most synthetic resin glues have a short pot life once the hardener has been added. Typically; at 50° F., 3 hours; at 60° F., 1 hour; at 70° F., 45 mins.; at 80° F., 30 mins.

Admittedly, this is not a particularly serious disadvantage under factory conditions where production can be geared to meet it, but for the handyman or ordinary home user the disadvantage is, of course, a very serious one.

(d) Assuming, however, that the amateur does use synthetic resin glues, he will get an unpleasant shock when, if for any reason, he wishes to plane any part of the woodwork which has been glued with synthetic resins. They set hard and brittle and can have no beneficial effect on the sharp cutting blade of the plane! Moreover, they actually change the character of each piece of wood into which they impregnate, adversely affecting its natural resilience, and some evidence indicates that under stress the wood may therefore break at a lower value than if no resin were present. Any modern veneerers will give evidence as to the cracking of the wood veneers when adhered by synthetic resins.

Animal glues, on the other hand, even when thoroughly set, are relatively "flexible" and retain this property indefinitely.

There is some truth in Mr. Buttrey's remarks to the effect that "animal glue rapidly disintegrates in water and pieces separate." But this is not really an important criticism, because where water-resistant joints are required—window-sills, doors, gates, etc.—protection is almost invariably provided by paintwork or varnish, and no other protection is therefore needed. Indeed, for centuries, different types of exposed structures constructed with animal glues have successfully "weathered all storms" and passed the test of time.

With regard to Mr. Buttrey's point on the subject of shrinking during drying, etc. (referred to at length earlier in this article), unless special hardeners are used, if a ⅛in. thick layer of S.R. and hardener is cast and left open to the atmosphere for a month or two it will first shrink slightly and then completely disintegrate into small cube-shaped pieces.

Scientific Tests

In conclusion, a few words should be said on the methods employed in a modern animal glue factory to ensure that the finished products cannot be infected by either mould or bacteria, and that their strength is uniform and consistent with the requirements of whatever purposes for which they are to be used.

Bacteria Test.—Samples from each batch of manufactured animal glue are stored for a specified time under laboratory conditions created to be most conducive to bacterial attack. In the event of such glue becoming infected it would be, of course, immediately rejected. Thus all glues which are issued from a modern animal glue factory can be said to be proof against mould and bacteria infection.

Tensile Strength Test.—Modern animal glues are scientifically tested for strength in accordance with B.S.I. specifications, and are not released for sale unless they show a tensile strength of some predetermined figure considerably higher than the specification minimum.

Limitation of space prevents me from dealing at greater length with this subject, but the foregoing facts demonstrate that many of the observations made by Mr. Buttrey in his article have been proved untenable.

Finally, animal glues are very simple to use, and there *is* no better glue for most types of woodwork. These adhesives have measured up to, and successfully withstood, the test of time.

Mathematics as a Pastime

The Proper Proportion

DO you play bridge? When a pair of players win two games, without their opponents winning one, the pair get a bonus of 700. Suppose now that what they used to call "military exigency," or some other annoying reason, causes the play to stop when one game only has been won. How many points should be scored for this game? And let us assume that the winning pair is as likely as not to win the second game.

The chance of winning the second game is ½ to ½. But then, even if the pair lose the second game, all is not lost: a chance of winning the third game remains. What is the value of this chance? Of course, if the third game has to be played, the chance of winning it is again ½ to ½. But then there is an even chance that the game will not be played. The value of that chance is therefore ½ of ½. The pair winning the first game has ½ + ¼, or ¾ compared with ¼. The 700 points should accordingly, if mathematics is to rule, be distributed 525 and 175, greatly different from the rule in practice.

Well, tackle this ancient problem: two players agree that the first to score three games takes the stakes of £3. A wins two games and B one, when they are obliged to break off. How should the stakes be divided?

Put down the results possible of the fourth and fifth games. They are: (1) A wins fourth and wins fifth; (2) A wins fourth and loses fifth; (3) A loses fourth and wins fifth; (4) A loses fourth and loses fifth. In one only of these four results, the last of them, does B take the stakes. The division is accordingly 3 to 1: A should take £2 5s., B 15s. It is not £2 to £1.

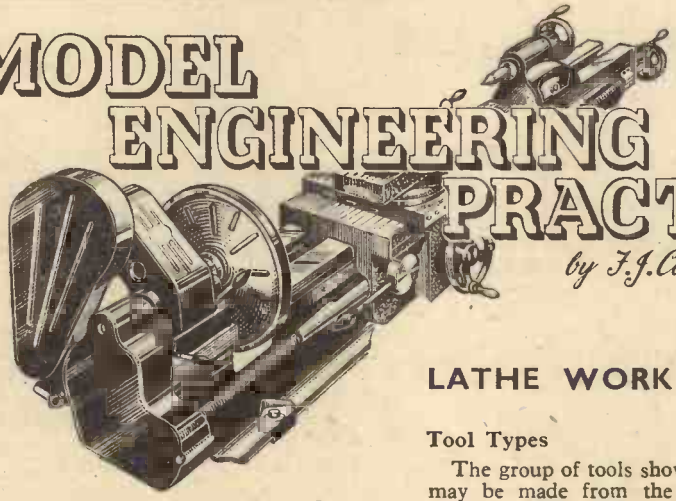
Again, you see, the chances are ½ to ½ for the fourth game, and ¼ to ¼ for the fifth game.

What about this question of the loaves? The hungry hunter met two shepherds, one having five small loaves, the other three, all alike. Equal division ensued, and the hunter paid 8 pennies for his share. How should the pennies be divided between the shepherds? Not in the proportion of 5 to 3, but in the proportion of 7 to 1. For, consider: each eats a third of 8, that is 2⅔; one shepherd, therefore, gives up 2⅓, the other only ⅓.

15th Article of a New Series

MODEL ENGINEERING PRACTICE

by J. J. Camm



WHERE solid tools are used it is better to use a steel of deep section. Rectangular steel tools are more rigid. The rectangular steels are obtainable in many sections in both carbon and high-speed. High-speed tools are the most advantageous. The cheapest way to use high-speed steel is in "tool-bit" form in a special holder, or to use "tipped tools."

Cutting and Clearance Angles

Fig. 18 shows the cutting and clearance angles. A tool cannot function correctly if improperly set. With a "rocker-bar" type tool-post the effect of rising or dipping the nose of the tool is to alter the front clearance and top-rake angles. If the base of the tool is rising towards the front, the front clearance angle is decreased and the top-rake increased, and vice versa.

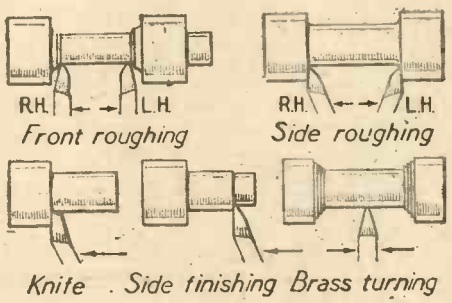
The tool shown in Fig. 18 is a right-hand tool—it cuts towards the chuck. The front clearance angle is the amount that the front of the tool slopes out of perpendicular. Top-rake is the amount of back slope from the nose of the tool; side-rake is the amount that the cutting edge slopes away from the work. The tool is ground on both sides to give side clearance. For soft mild steel the top- and side-rakes may be at their greatest. Tougher material, like nickel and similar alloy steels, and cast-steel require less rake, because keen-edged tools will not stand up to them. The harder the material the more the rake is reduced. Tools for hard brass are made flat-topped to prevent digging tendencies; with cast-iron the rake is reduced to provide a cutting edge that will withstand the abrading action of the metal.

LATHE WORK (Continued)

Tool Types

The group of tools shown in Figs. 19 to 22 may be made from the bar without prior forging. Their uses are as follow:—

Front-roughing Tools.—Roughing out, turning or facing particularly suitable for tough material and cast-iron. Figs. 23 to 27 show method of application to bar work, arrows show direction of feed for right- and left-hand tools. For slender work the radius at the nose should be made small; requires both top- and side-rake.



Figs. 23-27.—Uses of front-roughing, side-roughing, knife, side-finishing, and brass-turning tools. (See Figs. 19-22.)

Side-roughing Tools.—General turning of a shouldered character when set at an angle, as shown in Fig. 24, or when set square with the work. The "swarf" comes away over the tool clear of the work. Use with a deep cut and medium feed. The nose of the tool should form an angle of a few degrees less than 90, the corner being radiused. Requires both top- and side-rake.

Knife Tools.—Chiefly used for working with mild steel. Made so that when the cutting edge is presented square to the work the front face has a back slope of 5 deg. (see Figs. 23 to 27). Deep cut, fine feed. Side-rake only.

Side-finishing Tools.—Like a knife tool, but has a small flat stoned on the front square with the front face. This flat is set square with the direction of travel; it obliterates feed marks produced by pointed or round-nosed tools. Light cut, fine feed. Slight top- and side-rake. May have a wider face and top-rake only for use with coarse feed. They then require very careful setting to be successfully used.

Brass Turning.—The small round-nosed tool is suitable for machining hard brass, gun-metal and the like. Used for roughing out and turning as in Figs. 23 to 27, and can be fed in either direction. Flat-topped, no rake.

Outside and Inside Screw-cutting Tools.—Both made with top- and side-rake. Front clearance of inside tool as for boring tools. Main cutting should be done on leading flank of tool by feeding top slide along slightly as well as increasing depth of cut. Allow both flanks to cut on last one or two cuts (see Fig. 28).

Boring Tools.—Boring tools are shown in Fig. 28 below. The round-nosed tool (Fig. 28) is suitable for straight-through holes, and has both top- and side-rake. The counterboring tool can be used for boring into corners or flat bottoming; has both top- and side-rake. The recessing tool is suitable for cutting oil channels in bushes or bearings, etc. Made with top-rake only. To prevent interference by rubbing, the clearance face should be reduced in depth to that shown.

Parting Tool.—Make the blade of the tool wider at the cutting edge to prevent binding. Grind the rake by holding the tool vertically against the face of the grinding wheel.

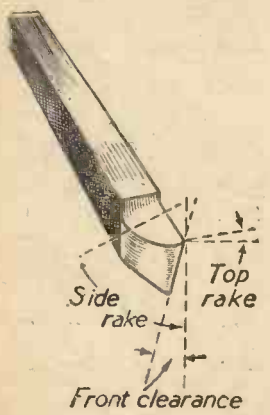
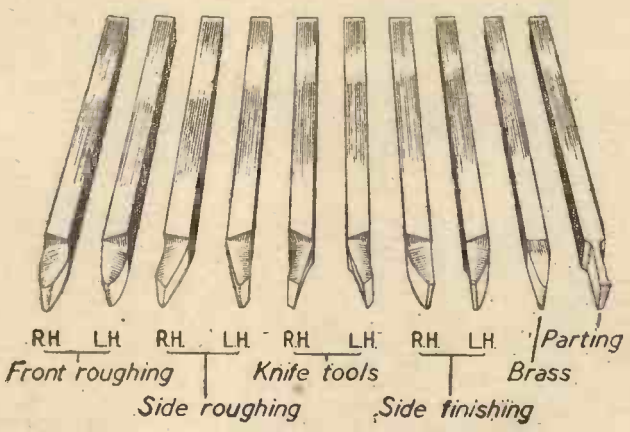


Fig. 18.—The various tool angles referred to in the text.



Figs. 19-22.—Front-roughing, knife, brass, parting, side-roughing, and side-finishing tools.

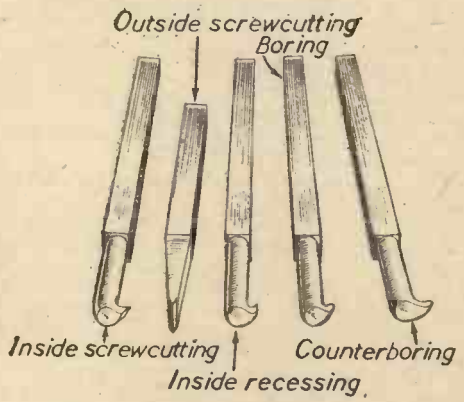


Fig. 28.—Screw-cutting and boring tools.

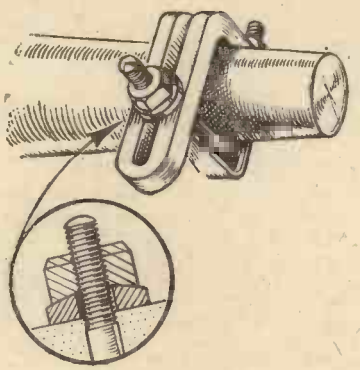


Fig. 29.—A special carrier for gripping tapered work.

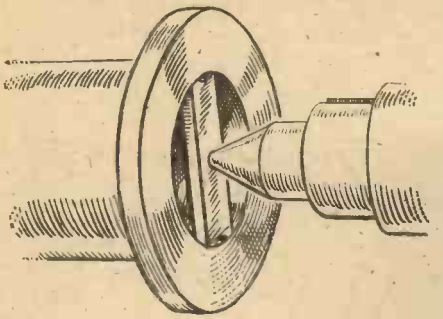


Fig. 30.—One method of turning a flanged cylinder between centres. This method is often adopted when carrying out turning operations on finished work so as to avoid chuck marks.

Jaw Chucks

These are purchaseable in sizes to suit the centre height of the lathe. Additional to these the turner is often compelled to make special fixtures for holding the work. The work must be tightly locked, otherwise the work may be scrapped or fly out and cause damage.

Face-plates

The face-plates (see Fig. 36) have a number of slots cut in them, and the work is held to the face-plate by means of bolts and clamping-plates passed through appropriate slots. Note that these slots are so arranged that it is possible to clamp a casting of any shape to it. For example, suppose it is required to bore a hole in a square casting, the hole to be out of the centre, the procedure would be first to chalk over the surface of the casting, to carefully mark out the position of the hole by means of the dividers, and then loosely to attach the casting to the face-plate so that its position can be adjusted until the circle scribed on the casting revolves truly when viewed in relation to the point of a scriber held in the tool-post and brought into close proximity. After finally locking the casting down, the truth of the setting should again be checked by this method.

The Angle-plate

The angle-plate is a right-angled casting with slots in it similar to those in the face-plate, and the angle-plate is attached to the face-plate in a position suitable to the casting being operated on. For example, if it were required to bore the mouth of a crank-case to receive a cylinder, the crank-case would be bolted to an angle-plate attached to the face-plate in this way. The angle-plate is also useful for boring or turning work at an angle; it is only necessary suitably to pack the work to bore a hole to any required angle of casting.

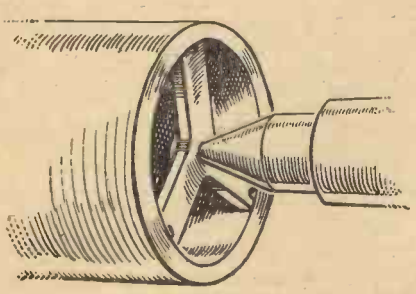


Fig. 33.—Another method of turning cylindrical work between centres.

The Independent Jaw Chuck

The independent four-jaw chuck (Fig. 34) can similarly be used to hold work of irregular shape. It has the great advantage of quick adjustment, for by means of a key each jaw can be moved independently and the work "thrown over" until the setting is correct, according to the work to be done.

There are many other methods of chucking work: sometimes it may be necessary to solder the work to a round disc held in the chuck when the work itself is of such a character that it cannot be operated on in any other way, or it may be shellaced to a piece of metal or secured to a piece of wood. From this the reader will perceive that the method used to hold the work is absolutely dependent on the work itself.

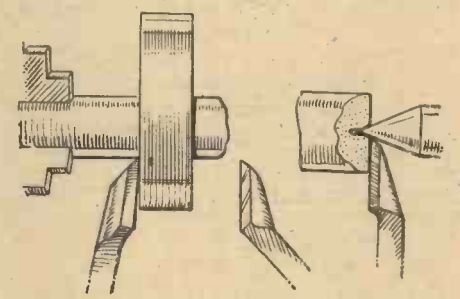


Fig. 31.—Various applications of the knife tool. The bent knife is used when the saddle can be advanced to the work.

Tool Angles

	Bronze	Cast Iron	Steel	Wrought Iron	Brass
(a)	5°	15°	20°	25°	10°
(b)	3°	3°	3°	3°	3°
(c)	3°	3°	3°	3°	3°
(d)	85°	70°	60°	56°	80°

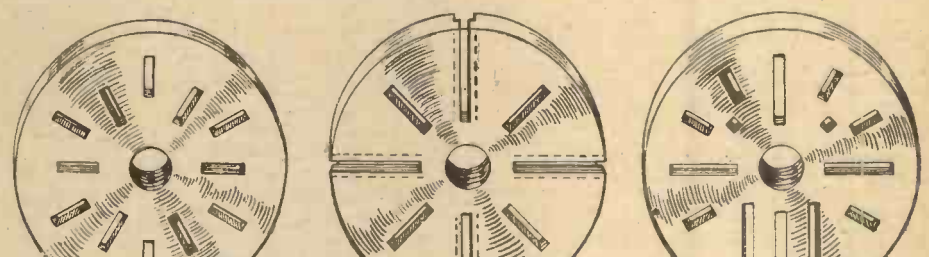


Fig. 36.—Various types of face-plate.

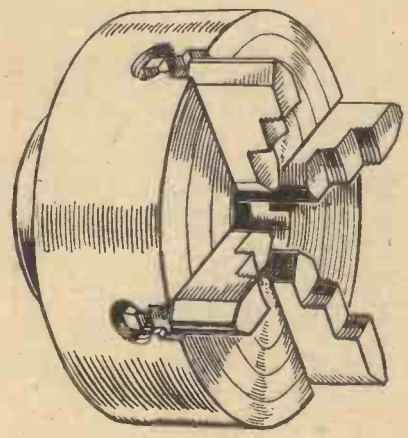


Fig. 34.—The four-jaw independent chuck. This is chiefly used for holding irregular-shaped pieces and for accurate centring of work. It is not a self-centring chuck.

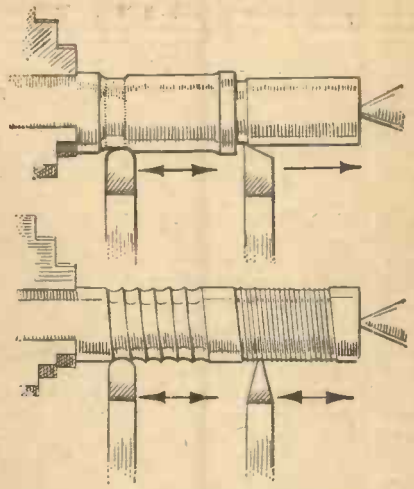


Fig. 32.—Various tool applications.

Turning Tools

The first thing the amateur will discover on attempting to turn is that the tool needs to be ground to a special angle according to the material being turned, that it needs to be driven at a certain speed according to the diameter and the material being turned, and also that tools of various shapes are necessary to operate on particular shapes of work.

Roughing Out

For roughing out, a deep cut and a fairly coarse feed are used, as shown in the top left sketch of Fig 32; and for finishing, a light cut and slow feed is used, as in the right-hand sketch of the same figure. A sharp-pointed tool should never be used as, however fine the feed, it tends to cut a screw-thread. For this reason tools of the form shown in the lower sketch (Fig. 32) tend to give a smoother finish.

The cutting and clearance angles of tools are shown by Fig. 35, which should be used in conjunction with the small table shown above. The use of the knife tool is clearly indicated in Fig. 31.

(To be continued)

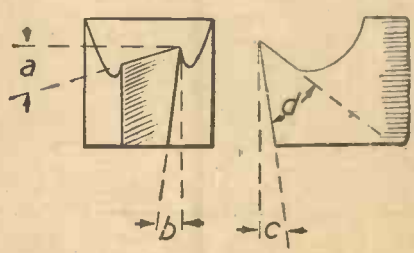


Fig. 35.—Tool angles (see Table).

Britain's Progress in Aircraft

Afterthoughts on the Royal Air Force Display, 1950

By THE MARQUIS OF DONEGALL

The de Havilland 112 in flight. This aircraft, named the Venom, and powered with a de Havilland ghost jet engine, is a single-seat fighter, and can be used as a fighter-bomber.

FRIDAY was the lucky day at the recent R.A.F. Display. Everything, I believe, went according to plan.

Saturday was only unlucky in the sense that a cross-wind had blown up and therefore I was denied the thrill of seeing Lt.-Commander J. K. Quill inducing the Bleriot XI off the ground. However, Wing-Commander T. D. Calnan got the 1911 Deperdussin off on its 25 h.p. engine, and Squadron-Leader G. Banner urged the 1912 Blackburn to dizzy heights of 30 feet or so.

The Sopwith Pup, ace-fighter of that far-off war, even did aerobatics.

The other unlucky thing about the Saturday display was that the nylon tow-rope broke and thousands were denied the experience of seeing a Dakota pick up a stationary glider while travelling at some 130 m.p.h.

Since I first saw this feat performed in France, shortly after D-Day, I have considered it to be one of the most spectacular things anyone could hope to witness.

The Canberra Bomber

So we can now take the Saturday's programme. Except for the cross-wind, the weather could hardly have been better.

The English Electric Canberra bomber with two Rolls-Royce Avon jet engines, performed aerobatics with the grace and neatness of a fighter. And, as the pilot came down flattening out from his dive, he was across the four miles of the airfield almost before you could locate him. This, at about 200 ft. over our heads.

One expects fighters to go very fast, and the Meteor N.F. 11 combined unbelievable speed with the beauty of a bird. It is a lovely sight to see these jet-fighters, including the de Havilland Venom and the new Hawker 1081 streak across the airfield and then go into a vertical climb until they disappear into the clouds at 2,000 feet. We had individual aerobatics by a de Havilland Vampire. This is the standard R.A.F. single-jet day-fighter. Its speed is 531 m.p.h. and it holds the world's altitude record of just on 60,000 feet.

Many of you will remember the historic R.A.F. attack on the prison at Amiens in 1944. A reconstruction of the attack was staged in memory of Group-Captain Pickard, D.S.O., D.F.C., who led the attack, stayed afterwards to see that the job had been done and did not return. There were 100 Frenchmen in the prison under sentence of death. Through the Resistance they made it known that they would rather take a chance if the R.A.F. would bomb the place. So accurate was the bombing that most of the French prisoners survived and most of the Gestapo were killed, as it was known that the Germans lived in the right-hand end of the building.

Just as they did on that occasion in real war the R.A.F., at the Display, blew to pieces the right-hand side of the reconstructed Amiens prison and left the rest intact. It was one of the most impressive demonstrations of accuracy that I have ever seen. They had to have a whole area, beyond the airfield, cleared of every living thing . . . just in case they overshot the target. They didn't . . . at 500 m.p.h.

Saturday's display started at 10.30 a.m. with Apprentices' and Cadets' Massed Bands.

Gliding Demonstration

This was followed by the gliding demonstration by four of well over 2,000 A.T.C. Cadets who have recently qualified for their "A" gliding certificates. They were accompanied by their instructors in Slingsby Sedburgh sailplanes, sent off by motor-winches and, after circling for a while, they landed in a very small space.

We then had the 3in. mortar demonstration by the R.A.F. Regiment. An attack was made on a prepared area of the flying-field which was covered with white powder. Doubtless the attackers achieved their objective. They certainly raised an incredible amount of dust in the process with the result that the success of their efforts was difficult accurately to assess.

On Friday, the Cooper Trophy Race for the 20 Auxiliary Air Force Fighter squadrons was won by Flying-Officer Hazelwood of 600 Squadron in a Meteor MK.4 at a pace of 511 m.p.h. The finish was so close that no spectator could hope to decide the winner, and it seemed to take the handicappers some time before they made up their minds.

On Saturday, this item was replaced by air drill performed by 12 Spitfires and 12 Vampires, all of the Auxiliary.

Rehearsal for this type of item is particularly difficult for business and professional men. On this occasion various circumstances, including weather, made a complete rehearsal impossible. Had I not been told this, I would certainly not have guessed it from the high standard of the formation flying of the Spitfires, integrated with that of the Vampires.

Next, I saw the demonstration by the two Chipmunks which are used for training the Volunteer Reserve and the University Squadrons. The aerobatics of Flight-Lieutenants Roxburgh and Gibbons were beautifully synchronised as they met each other from opposite ends of the flying area.

This Display ended with the two machines flying towards each other going into a perfectly timed spin and flattening out into line to a perfect landing one behind the other.

The English Electric "Canberra" jet bomber, powered by two Rolls-Royce "Avon" turbo-jet engines, is the world's first jet bomber.

Low Speed Aerobatics

As a contrast to the low speed aerobatics of the Chipmunks (top speed 143 m.p.h.), we had individual aerobatics by Flying-Officer Nick Carter in a Vampire (top

In the foreground is another view of the de Havilland 112 Venom, which is equipped with an engine 66 per cent. more powerful than the Vampire. Behind is the de Havilland Comet four-jet air liner, the world's fastest commercial aircraft.

speed 531 m.p.h.). This machine was the Vampire 5 which is a fighter-bomber as opposed to the Mark 3 which is a fighter. Flying-Officer Carter streaked across, putting the machine on its back over the centre of the flying ground, and then going into a hesitation roll (8 point). He then did various other rolls which were performed very quickly.

Then came the efforts of the veteran machines already mentioned, followed by individual aerobatics by a Meteor 4, perhaps the most impressive feature being the amazing vertical climbing power of the Meteor.

It is worth recalling that in 1946 a Meteor established the world speed record up to that date of 660 m.p.h., and that the present model climbs at a rate of 7,350 feet a minute.

Formation Flying

As the afternoon wore on there was formation flying by Harvards—famous veteran trainer of the war days which is still in service. These were led by Captain G. D. Stephenson, C.B.E., spelling out the letters R.A.F. as the perfect formation, which I counted as 35, swept over Farnborough. It was a most impressive sight.

The circus of three helicopters called Gertie, Gladys and Gussie, and their ringmaster in the proverbial pink coat and top-hat, caused much laughter, and has been described in detail many times.

Apart from the attack on Amiens prison, already mentioned, we had individual aerobatics by a Spitfire 16. We had a mock attack by enemy bombers, the conversation between the defending Meteor leader and his pilots being broadcast over the loudspeaker system. The most noticeable feature of this display was the apparent manœuvrability of the normal-engined machines as opposed to the jet-propelled type.

After formation aerobatics by a team of Vampire 5's, during which trails of red-white-and-blue smoke were very effective, we had a demonstration by new aircraft types. Most impressive to my mind, as mentioned before, was the English Electric Canberra. Others included the Hawker 1081 jet-fighter, the D.H. Venom fighter and the very graceful Meteor NF. 11.

Mass Fly Past

The whole Display wound up with two parts of a mass Fly Past. In the first part machines seemed to arrive from every direction including Sunderlands, Dakotas, Hastings, American Super-Fortresses and Lincolns, which flew above the others, to remind us of the night-bombing tactics of the war. The Royal Australian Air Force and the Royal Canadian Air Force were represented, a Dakota of the Indian Air Force, and two of the New Zealand Air Force. The South African Air Force flew aircraft belonging to R.A.F. Transport Command.

Few people have seen every R.A.F. Display since the first one in 1920, but having seen about half of them I can definitely say that this year's surpassed everything ever attempted before.

The Model Engineering Exhibition

By W. J. B. L.

I THINK the Twenty-fifth "Model Engineer" Exhibition in London must have been a surprise to many who had been critical of some of the features introduced into recent exhibitions. Chief butt for criticism was the working models arena, which took up so much space in the Royal Horticultural Hall, as well as giving rise to a great deal of noise from time to time. In 1949 many enthusiastic visitors interested in the competition models expressed regret that so much of this section was displayed on shelves against the walls, where examination of individual models was difficult. This year all the competition models were on four stands in the centre of the Hall, where they made a most impressive exhibit all together and were in a good light for critical examination by keen model-makers. The standards of workmanship among both competition and loan models were very high indeed.

Demonstration Area

In place of the working models arena there was a Demonstration Area, where visitors could see demonstrations of model-making, on models actually under construction. This feature proved most interesting and instructive. The passenger-carrying locomotive track was at one side of the Hall, but this year the track was elevated five or six feet above the ground, which the young passengers appeared to appreciate very much: in fact, they seemed to prefer it to the ground level track of previous years.

The new layout of the Exhibition Hall allowed for good space to be allotted to club stands, which was much appreciated by clubs taking space. I was glad to see old friends at the stand of the Society of Model and Experimental Engineers. When visiting the Model Railway Club stand I received a warm welcome from the club's chairman, Mr. G. P. Keen, who showed me many of the excellent exhibits provided by club members, incorporating some outstanding examples of improvements in standards of railway modellers' work.

D.S.I.R. Display

A most interesting addition to this year's exhibition was a display by the Department of Scientific Industrial Research. The models shown by this department came from three of their stations: the National Physical Laboratory, the Fuel Research Station and Chemical Research Laboratory. The ship division of N.P.L. displayed an example of model ships used in the testing tanks; these models are made in paraffin wax from the lines supplied by a ship designer. The Aerodynamics Division of N.P.L. exhibited a model wind tunnel with a compensated measuring mechanism which records the force and moments of model aeroplanes in its air stream. The Fuel Research Station provided a model of a calorimeter building, which is used for domestic heating research.

An attractive exhibit was this 2in. scale model of the Mogul type express loco entered by L. Billingham, of Haywards Heath. The small model is an 0-2-2 Rainhill Rocket-type loco entered by J. W. Powell, of Ashton Keynes.

Producing High Vacua

What it is, How it is Obtained, and its Uses

By F. W. COUSINS, A.M.I.E.E.

(*continued from page 385, August issue*)

Pumps For High Vacua Needing A Fore-Vacuum.

THE principle of this pump is founded upon the Kinetic Theory of Gases, referred to previously. It will be remembered that the molecules of a gas strike the surrounding boundaries and rebound at random under forces due to thermal agitation. If one of these boundaries were to be given a motion of translation then the molecules striking such a boundary would have imparted to them a component of velocity equal to the velocity of the said boundary. Referring to the diagram of Fig. 12, there is shown in schematic form only the fundamentals of the Gaede Molecular Pump. A cylinder is arranged to rotate within a stator the clearance between the periphery of the cylinder and the inner wall of the stator being very small except at that portion located between the inlet port *m* and the exhaust port *n*. When the cylinder rotates inside the airtight stator gas is dragged from *m* to *n* and a pressure difference is built up as shown by the manometer. Gaede has shown that at ordinary pressures the difference in pressure effected by the pump is given by the relationship

$$P_n - P_m = \frac{6\eta u L}{d^2} \qquad \text{——————(7)}$$

where η is the viscosity of the gas, **u** the velocity of the cylinder, L the length of the slot between *m* and *n*, and d the clearance between the cylinder and the stator between *m* and *n*. If, however, a fore-vacuum pump is used in conjunction with this pump the low pressure obtaining at *m* ensures that the mean free path of the molecules is large compared with the dimension " d " and the number of molecular collisions becomes relatively small as compared with the number of collisions between the gas molecules and the walls of the slot between *m* and *n*. Consequently the molecules are given motion by the rotating cylinder, but the relationship at equation (7) is, however, no longer true. The pressure ratio now becomes constant and independent of the fore-vacuum pressure and dependent only on the speed of rotation of the cylinder. It follows that reduction of the fore-vacuum pressure below a certain value does not produce any increase in pumping performance.

The Diffusion Pumps or Condensation Pumps

Diffusion or condensation pumps are pistonless and employ as the working medium a vapour into which the gas molecules pass by diffusion and are then removed to a part of the pump where the vapour is condensed to be evaporated again in the boiler of the pump and re-circulated as a vapour to maintain the evacuation process. The limiting factor for the ultimate vacuum is the vapour pressure of the working medium at the temperature at which it is condensed. According to the working medium employed, so is the pump classified; there are two main groups, those using mercury as a working medium, and those using organic liquids of low vapour pressure such as " Apiezon Oils."

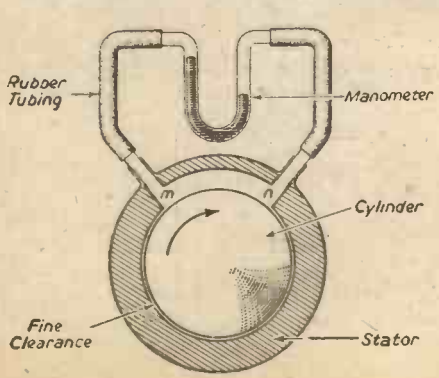


Fig. 12 (Left).—Schematic diagram of a Gaede molecular pump.

The Mercury Vapour Pump

The mercury vapour pump was pioneered by Gaede[9] and Langmuir[10]. It consists essentially of a boiler for the mercury which sends a stream of mercury vapour up a central tube to issue through one or a plurality of jets, the mercury vapour stream trapping the gas molecules which diffuse into it from the vessel to be evacuated. It is general practice to exhaust the vessel to be evacuated by a fore-vacuum pump through the mercury vapour pump, the mercury being then boiled at the pressure produced by the said fore-pump. A condensation type mercury vapour diffusion pump is shown in Figs. 13 and 14, and the components are clearly designated, the operation of the pump is exactly as described, and the water jacket ensures that the downwardly directed stream of returning mercury vapour is condensed and fed to the boiler. In early pumps of the diffusion type a careful regulation of the mercury vapour temperature was necessary, but with the condensation type the mercury vapour does not tend to enter the upper parts of the pump provided the end of the jets are inside the water jacket. The maximum pumping speed is found to occur when the pressure is such that the mean free path approaches the dimensions of the jet from which the mercury vapour issues.

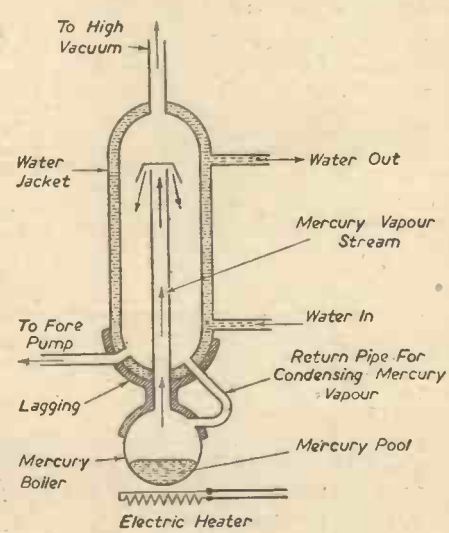


Fig. 13.—Mercury vapour pump.

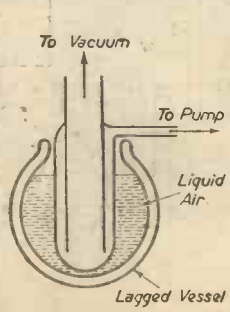


Fig. 15.—Sectional diagram of a freezing trap.

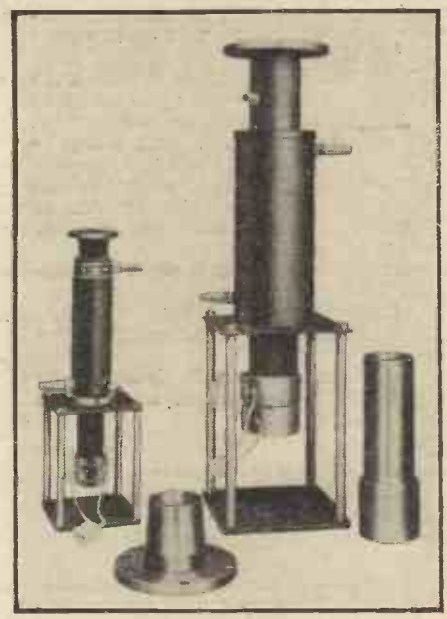


Fig. 14.—Mercury diffusion pump, with male and female flange-to-cone adaptors.

Special devices known as freezing traps are often used to ensure that no mercury vapour reaches the vessel being evacuated. A typical freezing trap is shown in Fig. 15, the freezing mixture being either solid carbon dioxide mixed with ether, or liquid air.

It will be obvious to the reader that the limiting factor deciding the ultimate vacuum to be attained is the vapour pressure of the working liquid (mercury in this case) at the temperature at which it is condensed. This point has been referred to before and it is owing to this that new liquids have been made available having very low vapour pressures at room temperature. The most important of these are termed " Apiezon Products," Apiezon being from the Greek απιεσον meaning " without pressure."

Since mercury has a vapour pressure of approx. 10^{-3}mm. Hg. at room temperature it cannot achieve a better vacuum than its vapour pressure, unless, of course, a freezing trap is employed, but this reduces the effective speed of pumping. The oil condensation diffusion pump, however, overcomes these disadvantages.

The Oil Diffusion Pump

This type of pump is similar in construction to the mercury vapour pump, but the working liquid is " Apiezon Oil " having a vapour pressure of the order of 10^{-7}mm. Hg. at room temperature. This means that such a pump may produce a vacuum of 10^{-7}mm. Hg. without any form of cold trap, and the pumping speed is kept at a high value.

A modern three-stage primary oil diffusion pump is shown in Fig. 16. It comprises a boiler for the oil heated by electrical means; the oil vapour rises up the central pipe system and issues from the jets. The distance from the wall of the pump to the jet is termed the " pumping radius," and since this is large for the top jet, the compression ratio upon the gas is low and the other jets have gradually

decreasing pumping radii so that the compression ratio is gradually built up to permit the evacuated gas to be efficiently handled by the fore-pumps. It is important to prevent the oil from becoming overheated ; this may arise from too high a heat input or too low a volume of cooling water in the coils. Also, it may be produced by allowing the backing pressure to become too high. For this reason the heaters are not used above a backing pressure of 0.3 mm. Hg. The two main requirements of the oil used are :

1. Low vapour pressure at room temperature.
2. Sufficient thermo-stability.

It will be noted that no lubricating action is necessary.

Four Apiezon oils specially developed for pumps of the kind described are given in Table 3 below.*

Regarding Pumps in General

All vacuum pumps are characterised by the following three criteria :

(*a*) The pressure it exhausts into.
(*b*) The final vacuum it generates.
(*c*) The speed of evacuation (i.e., pumping speed) at any given pressure, that is the volume or the mass of gas abstracted

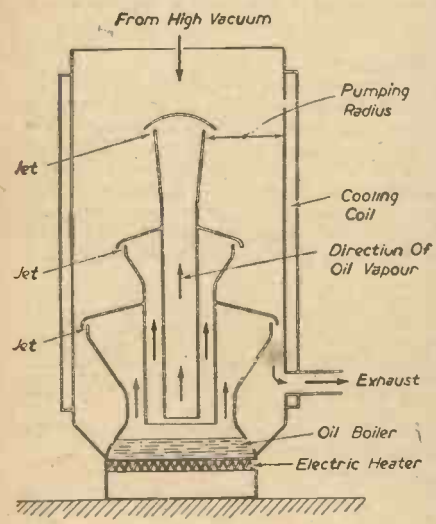


Fig. 16.—*Three-stage oil diffusion pump.*

per unit time, measured at that pressure, from an enclosure containing gas at the same mean pressure ; this is due to W. Gaede. It will be noted that this definition very correctly gives the speed at a specific pressure, and does not attempt to give a general pump speed for all pressures. The equation $\int = \frac{dv}{dt}$ applies here where $\int$ is the pumping speed, and it may be attained by plotting " v " against " t " and obtaining the tangent of the slope of the curve.

Finally, it should be carefully noted that in most vacuum systems a network of piping exists between the pump and the enclosure being exhausted, and this offers a resistance to gaseous flow which is dependent upon a conductivity factor ; the rates of flow of gases at the same temperature being proportional to the square roots of their respective molecular weights when the connecting pipe dimensions are kept the same. Further, the limiting vacuum within the enclosure may only be maintained by continual pumping, should the enclosure be sealed off a pressure in excess of the limiting vacuum will be obtained owing to the liberation of gas from the sealing, and this may only be removed by getters.

TABLE III

Product	Application	Approx. Vapour Pressure at Room Temperature
Oil "A"	Diffusion Pump	10^{-5} mm.Hg
Oil "B"	" "	10^{-7} mm.Hg
Oil "C"†	" "	10^{-8} mm.Hg
Oil "G"	For large industrial hig vacuum pumps	10^{-6} mm.Hg

† Specially developed by Metropolitan-Vickers to compete with Dow Corning Silicone Oil 703.

* The data regarding Apiezon Products is given by courtesy of Shell Chemicals, Ltd.

Gauges for the Measurement of High Vacua

A great variety of gauges have been designed for the measurement of high vacua, each gauge operating upon changes in the physical properties of the gas as the pressure is changed, the only exception being the comparative manometer gauge which is based upon Boyle's law. It is not possible to treat all the novel and interesting gauges in turn as they provide a most detailed study ; readers who are more than casually interested are referred to the bibliography under the heading " Pressure Gauges," where the leading articles upon this matter are recorded.

Three gauges in much use to-day are selected for consideration in detail :

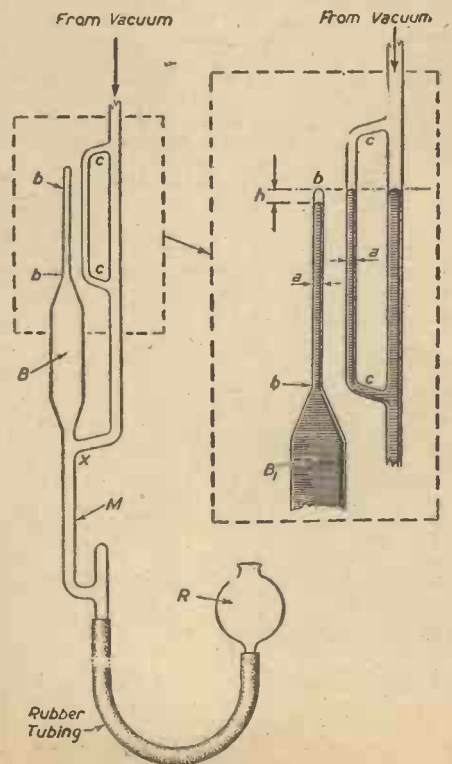
(a) The McLeod Gauge.
(b) Pirani Gauge.
(c) Ionization Gauge.

The McLeod Gauge

The McLeod gauge operates upon Boyle's well-known law. If a given volume of gas " V " at an unknown pressure " p " is compressed to a smaller known volume " *v* " and the pressure P observed, then according to Boyle's law

$$p = P\frac{v}{V}$$

A simple McLeod gauge is shown in Fig. 17. It consists of a bulb B to which is attached a capillary tube " *bb*," and this is connected to the low pressure to be measured at the pipe joint X, a mercury tube M and a mercury



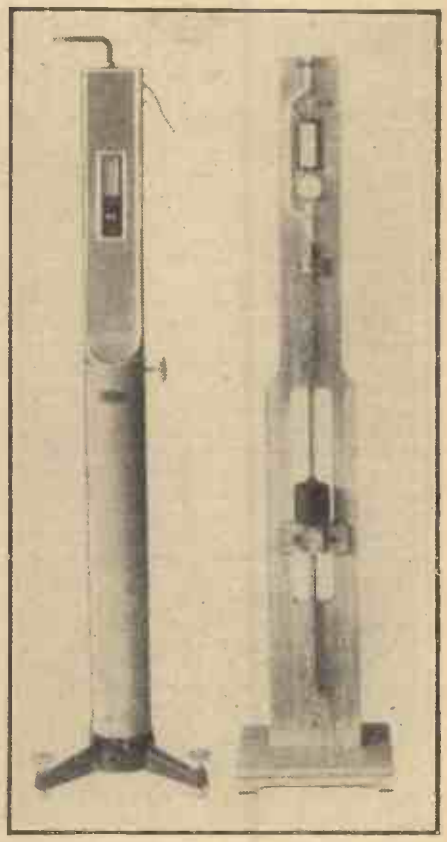


Fig. 18.—*Rubberless and enclosed McLeod gauge.*

reservoir R is also connected to the bulb B as shown. To overcome difficulties in reading the gauge a comparison tube " *cc* " is provided, the bore of this tube being identical with the bore of the capillary " *bb*."

To operate the gauge the mercury reservoir R is raised, thereby forcing the mercury column up the tube M past the joint X and thus trapping gas in the bulb B. Further compression of the gas in B is effected by raising the reservoir R still higher until finally the mercury in the capillary " *cc* " is level with the upper end of the capillary " *bb*." The pressure of the gas in " *bb* " is then equal to the height of the mercury column " *h*," this is more readily seen from the enlarged view of the gauge shown in the circle of the diagram.

If the cross-sectional area of the capillary is " *a* " and the height of the mercury column " *h* "mm., then :

$$p = \frac{h \times ah}{V} = \frac{ah^2}{V}$$

Although the McLeod gauge is constructed in many forms, the glass-steel McLeod gauge

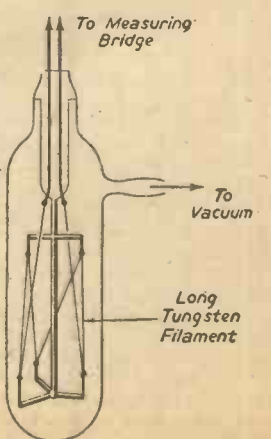


Fig. 17 (*Left*).—*Diagram of a McLeod gauge and enlarged detail of upper end.*

Fig. 19 (*Right*).—*Diagram of a Pirani gauge.*

manufactured by W. Edwards and Co. is one of the finest for precision work and its robust construction overcomes the difficulties occasioned by long rubber connections between the reservoir and the bulb. This very fine gauge is shown in Fig. 18 and it is seen to comprise a steel mercury reservoir capable of vertical movement connected by stainless steel tubing to the glass capillary system.

The Pirani Gauge

The Pirani gauge operates upon the phenomenon of gaseous thermal conductivity. It is well known that in a gas at normal pressure the coefficient of thermal conductivity is independent of pressure; when the pressure is greatly reduced, however, the matter is quite different.

In the description of the Kinetic Theory of Gases it was shown that if the gas pressure was reduced to such a low pressure that the mean free path of the molecules is large compared with the dimensions of the evacuated enclosure, then many of the gas molecules collide with the walls of evacuated enclosure without any intermediate collisions with other gas molecules.

If an evacuated enclosure is provided with a hot filament the heat conduction therefrom may take place directly from the filament to the walls, provided the pressure is of the low order discussed above. It is

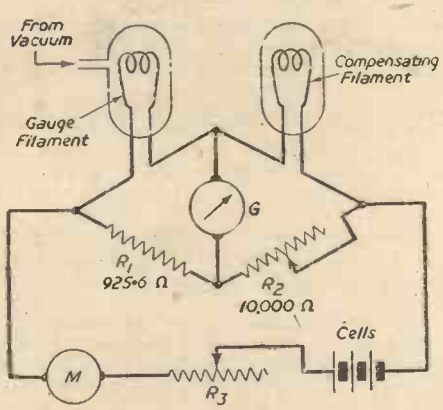


Fig. 20.—Bridge system for the Pirani gauge.

the variation of thermal conductivity of the gas at low pressure with variations in that low pressure that enable measurements to be made.

Although Pirani[11] invented the most successful gauge of his time, Hale [12] perfected the original design and the gauge is usually termed a Pirani-Hale gauge in recognition of the work of each investigator.

Hale's improved Pirani gauge is shown in Fig. 19, the current in the filament being maintained constant, while the change in voltage drop is observed as a function of pressure.

The complete gauge utilises a Wheatstone Bridge network, Fig. 20, to measure the change in resistance. One limb of the network contains the gauge filament coupled to the vacuum system while in another is inserted a compensating filament. The other two limbs of the network comprise a 925.6Ω manganin wire R_1 and a Dekadenstöpfel resistance of 10,000Ω, R_2. The milliammeter M, records the constant current which is so maintained by the variable resistor R_3. Readings are taken from R_1 which is adjusted to keep the galvanometer reading zero and thus the network balanced.

Various developments and improvements have resulted in gauges of this type which have a high sensitivity and are easily readable; the modern version of the Pirani gauge is shown in Fig. 21, these instruments lend themselves to bench or panel mounting

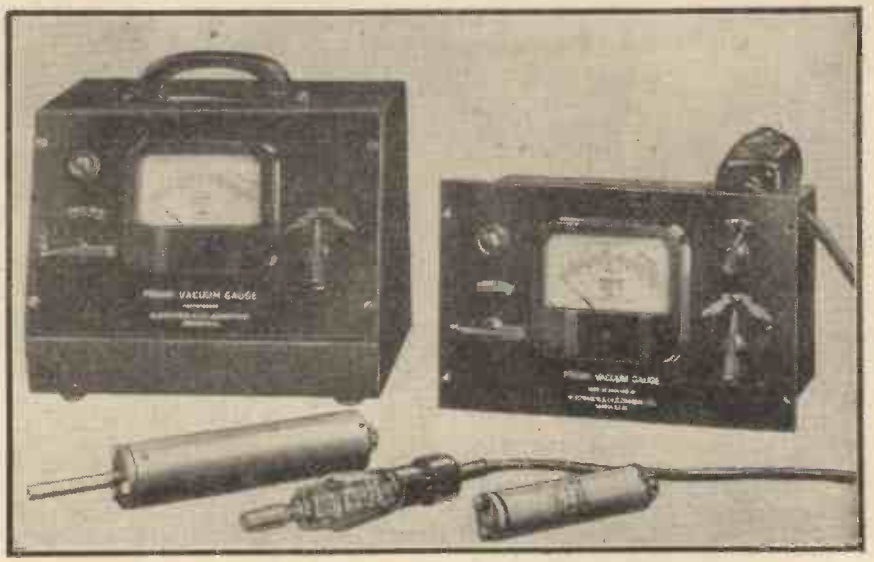


Fig. 21.—Pirani gauges.

and alternative forms of the gauge head are clearly visible.

The Ionization Gauge

When an electron stream is caused to pass through a gas at low pressure from a heated filament to an anode structure ionization of the gas molecules occurs, whereby some of the electrons are removed from the neutral atoms of the gas producing + ions which may be collected on a grid or third electrode having a negative potential. There is a certain minimum velocity of the electron stream for ionization to occur and this is given by the relationship :—

$$\tfrac{1}{2}\,mu^2 = Ve$$

where "m" is the mass of the electron; "u" the electron velocity; "V" the voltage required to produce the velocity "u"; and "e" the charge on the electron.

It will be understood that the amount of ionization increases with the pressure for a fixed value of electric current, and this provides a qualitative guide for the measurement of low gas pressures.

Yarwood [13] suggests that an ordinary triode valve such as the LS5 may be used as an ionization gauge but it is more satisfactory to use a gauge having a specially designed electrode system.

A circuit diagram for such a gauge employing what is termed the inner collector arrangement, that is to say a negative grid for collecting the + ions, is shown in Fig. 22.

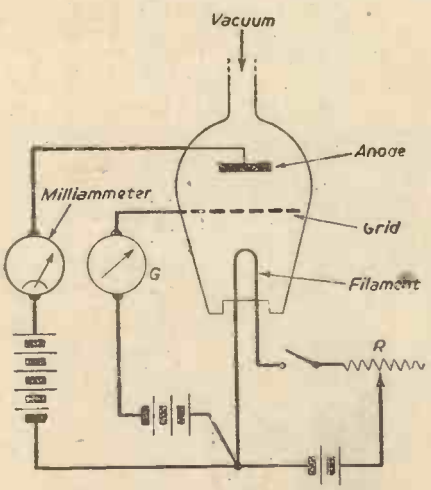


Fig. 22.—Diagram of an ionization gauge.

Many workers and investigators have advanced the design and accuracy of the ionization gauge, and a selection of the papers on this subject appear in the Bibliography.

Conclusion

In conclusion it is desired to acknowledge the many sources of information used in a survey of this nature, and it is thought that this has been taken care of in the extensive references quoted; in particular the writer wishes to thank Messrs. W. Edwards & Co., Lower Sydenham, London, for the fine photographs so readily supplied and used to illustrate the subject matter of the article.

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Electric Gas Lighter

SIR,—With reference to a letter in a recent issue concerning an electric gas-lighter, about six years ago I made a gaslighter similar to the one which P. V. Buckley describes, with the addition of a micro-switch in the primary of the transformer, and a 24-volt pilot lamp in the secondary. The switch is operated by a lever (similar to the hook lever on wall telephones), and the ignition pencil was made from a piece of 5/16in. brass rod drilled in one end, a few strands spring steel wire being fixed in the hole. I have found that steel wire gives the surest ignition. I also fastened a wooden file handle to the other end of the brass rod, with an eyelet screwed into the handle for hanging on to the lever. The reason for using brass rod was to give the necessary weight to actuate the micro-switch. The function of the pilot light was to give warning in the event of a power failure.

The switch was taken from surplus disposal equipment, and the switch assembly, switch lever and pilot light were all mounted in a small wooden box about 4in. × 4in. × 2in. The transformer in this instance was installed under the house, and the box containing the switch assembly is screwed to the wall adjacent to the gas stove. I am not enclosing a diagram of the switch assembly, as all sizes would vary according to the material on hand.

My reason for making the switch is that the ignition pencil must be placed in a position where it cannot short-circuit, and as hanging solves that problem, it is easy to hang it so that it switches off the power to the transformer.

I may mention I have been a constant reader of your magazine for many years and look forward to it each month.—H. P. J. WHITLEY (Launceston, Tasmania).

A Mathematical Puzzle

SIR,—In the July issue of PRACTICAL MECHANICS, Mr. A. Delfont asks for an explanation of the following:

$$\frac{7}{6} \times 7 = \frac{7}{6} + 7$$

The essential problem is to find two quantities whose product equals their sum:

Put $mn = m + n$

Then $mn - m = n$

$m(n-1) = n$

$m = \frac{n}{n-1}$

Substitute this value of m in the original equation:

$$\frac{n}{n-1} \times n = \frac{n}{n-1} + n$$

This is the formula you gave; and a similar formula for more than two quantities can be as easily drafted:

$$\frac{S}{P-1} \times P = \frac{S}{P-1} + S$$

where P and S are the product and sum respectively of any number of given quantities.

If $P = 2 \times 3 \times 4 \times 5 = 120$

Then $S = 2+3+4+5 = 14$

And $\frac{14}{119} \times 2 \times 3 \times 4 \times 5$

$= \frac{14}{119} + 2 + 3 + 4 + 5$

The latter formula brings out the true relationship between the quantities. This relationship is disguised in the formula for two quantities where $p = s = n$.

A particular case, included in the above general formula and which may be of interest to readers, is when we take x quantities each equal to $x^{\frac{1}{x-1}}$

$$\left(x^{\frac{1}{x-1}}\right)^x = x^{\frac{x}{x-1}} = x.x^{\frac{1}{x-1}}$$

Therefore: $2 \times 2 = 2 + 2$

$$3^{\frac{1}{2}} \times 3^{\frac{1}{2}} \times 3^{\frac{1}{2}} = 3^{\frac{1}{2}} + 3^{\frac{1}{2}} + 3^{\frac{1}{2}}$$

$$4^{\frac{1}{3}} \times 4^{\frac{1}{3}} \times 4^{\frac{1}{3}} \times 4^{\frac{1}{3}} = 4^{\frac{1}{3}} + 4^{\frac{1}{3}} + 4^{\frac{1}{3}} + 4^{\frac{1}{3}} \text{ etc.}$$

—A. B. THOMAS (Manchester).

SIR,—Reader A. Delfont's "puzzle" is just one of those mathematical problems which can be explained most easily by algebra as follows:

Take the general formula.

If $\frac{n}{n-1} \times n = \frac{n}{n-1} + n$ (proved by numerical substitution).

then $\frac{n^2}{(n-1)} = \frac{n + n(n-1)}{n-1}$

and $n^2 = n[1 + (n-1)]$

(Evaluating the square bracket $1 + n - 1 = n$)

Therefore $n^2 = n \times n = n^2$.

—E. B. DEW (Milton).

Fire-alarm System

SIR,—With reference to a recent query by your reader P. C. Campbell, of Stonehaven. Having had experience with various alarm circuits myself, I was interested in the fire-alarm circuit which was published in answer to the query.

May I suggest that by very little alteration this circuit could be greatly improved thus:

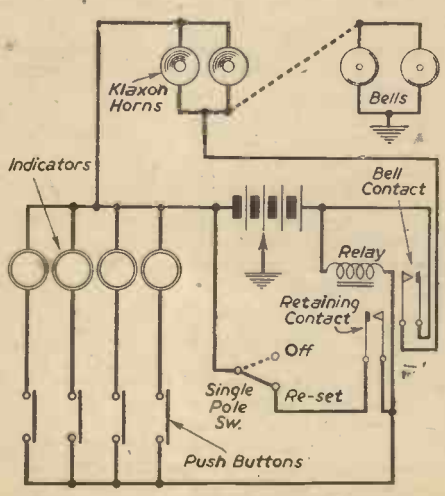


Diagram of a modified fire-alarm system.

By using an additional pair of contacts on the relay, and a single-pole switch mounted in a central position, the system will continue to operate for an indefinite period without constant pressure having to be maintained on any of the push buttons. Merely to press any one of the buttons once only will be sufficient to set the system in continuous operation.

Connecting the switch to battery and through the additional contacts to one side of the relay coil, as shown in the accompanying diagram, is all that is necessary to carry out this modification.—F. SLATER (Spalding).

"The Automatic Doctor"

SIR,—I read with deep interest the article in the July issue of PRACTICAL MECHANICS on "The Automatic Doctor," by A. M. L.

I should like to state that there is such an instrument in existence. This instrument not only diagnoses the disease, it will also reveal how much medicine to take to correct the disease. My explanation is very vague, but I can supply further information if required. May I state that the instrument is worked on the electronic reaction of the human body. It is a well-known fact that all diseases have a vibration of their own, but how to diagnose disease is not known to the medical profession fully. This instrument certainly does give correct results.

May I state that I am speaking from actual experience of having been tested by this instrument and was given a correct diagnosis, when doctors had failed. Now it is agreed by the medical profession that I do suffer from what the instrument found out.

In conclusion I quite agree with A. M. L. that the "strongest trade union in the world" would oppose anything they don't like, regardless of how much good it will do.—R. G. SALMON (Salford).

Ex-Aircraft Motor Generators

SIR,—After experimenting with ex-aircraft motor generators (type 29) I find that

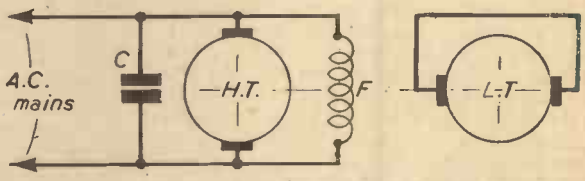


Diagram showing position of suppressor for an ex-aircraft generator.

best results are obtained by connecting up as follows:

Connect H.T. armature and the field in parallel; the L.T. brush gear must be moved round 90 deg. and shorted out with a piece of 18 s.w.g. wire.

The starting torque is quite good and the power is about 1/6 h.p.; the motor can be run without overheating for about three hours. A condenser can be connected across the H.T. brushes to act as a suppressor, as indicated in the diagram.

This machine has run a 2in. compound lathe with good results.—E. PRIESTLEY (Bradford).

SIR,—I read with interest the letter from Mr. Andrew (Barnsley), in the July issue:

May I be allowed to point out that a repulsion induction motor does not perform as a series motor. A R.I. motor runs as a single-phase machine. Starting as a repulsion motor it subsequently is changed to a more or less squirrel cage motor having a short-circuited rotor; this is accomplished by shorting the commutator bars of the armature.

A plain repulsion motor would perform as a series motor, its speed varying with the

load; the repulsion and R.I. motors are different in their set-up and performance.

A rotary would not be started in the manner suggested by your correspondent, the correct procedure would be to run it up on D.C., synchronise it to the supply and then connect it. The matter of insulated laminations does not really come in because these laminations usually carry an oxide in some form on one side of the stampings. It is not the practice to-day to insulate stampings with tissue paper as in the old days.—J. W. COOPER (Enfield).

SIR,—It may interest your correspondents to know that I am successfully using a type 31 generator to drive my bench lathe. Fortunately I have a heavy duty mains transformer, giving an output of 12 volts and about 30 amps. max. I therefore removed the brushes from the *output* commutators and wired armature (input commutator) and field in series (ignoring the shunt tapping). The motor runs quite cool—even after 30 minutes under load, and the casing is only warm to the touch. The speed is high—about 5,000 r.p.m. —but a 10: 1 reduction to the countershaft gives a useful spindle speed which does not alter much under varying loads. Incidentally the D.C. input is rated as 18 volts 12 amps, but I find that at 12 volts A.C. the current at *starting* is about 15 amps.

This seems the only way to get real power from these machines, but if one has to buy a suitable transformer it would probably be cheaper to invest in a suitable induction motor at the start. These remarks may be helpful however to those who have a transformer, or can build one.—H. D. RATTENBURY (Chepstow).

Automatic Gear Changing

SIR,—I read with very much interest the article in PRACTICAL MECHANICS entitled "Power Transmission Methods," dealing with variable gears, in which it was stated various attempts had been made to automatically adjust the gear ratio under varying conditions.

While I was in the Army I came across some Cadillac carriers, where all one had to do was to press on the throttle and it would change gears automatically according to the road conditions. If you removed your foot altogether it would drop directly into neutral. We had these vehicles about nine months, and no maintenance was needed. I am not quite sure, but I believe the system was referred to as an hydromatic gearbox.—C. ASPEY (Wigan).

Trisecting an Angle

SIR,—With reference to Mr. W. Duncan Needham's letter on "Trisecting an Angle," I would like to point out that his construction is definitely not accurate. It can easily be proved that:

Cotangent CAM = Cotangent ¼ CAD + cotangent ½ CAD and that this relationship is not the same thing as:

CAM = ¼ CAD.

I give below a table showing the error in Mr. Needham's construction.

Angle CAD	Angle CAM	Error
10°	3° 20′ 1.7″	1.7″
20°	6° 40′ 14″	14″
30°	10° 0′ 46″	46″
40°	13° 21′ 49″	1′ 50″
50°	16° 43′ 35″	3′ 35″
60°	20° 6′ 14″	6′ 14″
70°	23° 30′ 1″	10′ 1″
80°	26° 55′ 3″	15′ 3″
90°	30° 21′ 41″	21′ 41″
100°	33° 50′ 7″	30′ 7″
110°	37° 20′ 34″	40′ 34″
120°	40° 53′ 36″	53′ 36″
130°	44° 31′ 20″	1° 11′ 20″
140°	48° 8′ 16″	1° 28′ 16″
150°	51° 50′ 50″	1° 50′ 50″
160°	55° 37′ 35″	2° 17′ 35″
170°	59° 29′ 6″	2° 49′ 6″
180°	63° 26′ 6″	3° 26′ 6″

—M. DAVIS (Bexhill-on-Sea).

Circular Rainbow

SIR,—On June 4th I was on Ferring beach when I observed that the sun was surrounded by a circular rainbow, starting at about 30 deg. It lasted from 3.30 p.m. till 4.15 p.m. when it promptly disappeared.

Others on the beach witnessed the incident. —R. LAW (Ferring-on-Sea).

Club Reports

Staines and District Society of Model Engineers and Craftsmen

THE above society held their annual exhibition at the Staines Town Hall, on September 15th and 16th. As usual there were four classes in open competition, locomotives, boats, aircraft, and general. An added class this year was the club contest consisting of three nominated models from one club. Loan models were also greatly appreciated. Lone hands desiring information concerning the club should contact R. F. SLADE, Hon. Secretary, 166, Kingston Road, Staines.

Morley and District Model Aircraft Club

THE above club continues to be successful, and is now holding outdoor meetings amongst members every Thursday evening and Sunday mornings. This will enable us to build up club funds to a satisfactory level.

The club is now 50 members strong, and all are looking forward to the exhibition to be held on September 16th. It is intended to make it a club contest, and also an open one.

Our club president, R. Crewdson, has promised us a cup and £10 in prizes. The local flying club have donated three free trips in aircraft. The R.A.F.A. a prize yet to be stated. Messrs. Coles and West not less than three guineas value in kits. Competitors this year should not be disappointed in any way. Also the club intend to give control-line flying exhibitions every evening during the Battle of Britain Week. This will take place in the recreation ground in a completely fenced-in enclosure, with the spectators on the outside. The local council have already unofficially agreed, and we are now awaiting their confirmation. Our first exhibition was successful; in fact, public interest was higher than was anticipated.—B. H. WORTHY, Hon. Sec., c/o Mrs. C. Riches, Council Houses, Sutton, Norwich, Norfolk.

Ilford and West Essex Model Railway Club

A VERY enjoyable meeting was held on July 5th when Messrs. Theobald, Skinner and Pearce, footplate inspector, fireman and guard respectively, from the Eastern Region (B.R.) gave talks on their duties and experiences over long periods of service on the railways. The talks and replies to questions which followed were presented in humorous style and proved not only very instructive but equally entertaining.

The best thanks of the meeting were extended to the three speakers and the hope was expressed that the club might again have the privilege of their company at a future meeting.—E. W. CORNELL, Hon. Secretary. 42, Lincoln Road, Forest Gate, E.7.

Books Received

Questions and Answers on A.C. Machines and Equipment. By E. Molloy. Published by George Newnes, Ltd., 134 pages. Price 5/- net.

IN this handy little book, in convenient form for immediate reference, will be found the answers to most of the questions which are likely to arise in connection with the installation, operation and maintenance of A.C. machines and equipment. The first part of the book deals with questions and answers concerning elementary principles of all the main types of A.C. machines and equipment and their application to particular electrical equipment. The second part of the book gives detailed explanations concerning Power Generation and Measurement, Transformers, Rectifiers and Convertors, Lighting, Motors and Control Gear, and A.C. Heating and Welding Equipment. The book, which is profusely illustrated with line diagrams, should prove invaluable to practical men and students who require concise answers to the many questions which arise in their everyday work and studies.

Manual of the Miniature Camera. Edited by T. L. J. Bentley, D.I.C., A.R.C.S., B.Sc., A.R.P.S. Price, 12s 6d. 256 pages. Published by George Newnes, Ltd., Tower House, Southampton Street, W.C.2.

THIS important book covers almost every angle of miniature camera work and in this, the third edition, a comprehensive revision has been made, to include details of the latest types of cameras, enlargers and accessories, and to generally bring the work completely into line with present-day practice.

Separate chapters are devoted to exposure, negative film processing, and projection printing, with particular reference to the newest products and recent developments in miniature photography. Techniques such as Wild Bird, Travel, Action, Press and Colour photography are also dealt with in articles contributed by experts in these fields.

Astro-photographic

With Notes on the Construction of a 6½in.

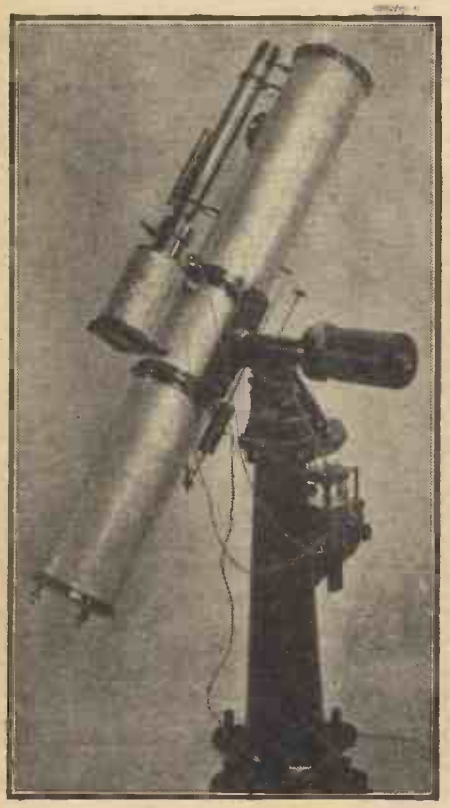


Fig. 1.—The telescope pointing south.

FROM time to time there appears in the pages of this and other journals illustrations of astronomical telescopes constructed by amateur instrument makers for their own use. In many cases there is evidence of good design and workmanship, but the builders appear to have no object, as the outcome of their labours, beyond visual observation.

It is, of course, a delightful thing to be able to see, by optical means, what can never be observed by the unaided eye. But there are limits to what it is possible for the eye to see, and, moreover, as the result of prolonged observation, the eye becomes fatigued and so sees less and less. Then again we cannot always be quite sure of what we have seen, or thought we saw, for different observers of a celestial phenomenon will sometimes make widely differing reports.

The only satisfactory way in which to see and at the same time record an astronomical condition or happening, is to do so through the medium of a photographic plate. Look through the telescope first by all means and then change the eyepiece for a camera attachment and expose a plate or film.

It was the realisation of the limits to which visual observation can be carried which led me, many years ago, to build an instrument which I thought would enable me to take photographs. It was a refractor, with a 4in. object glass by a good maker, equatorially mounted and clock driven. For visual work it was excellent, but photographically was very disappointing, and the reason was this: that the ordinary achromatic objective, though sufficiently free from colour—chromatic aberration—for visual observation is not sufficiently so for photography; in other words, it is not corrected for the whole of the spectrum. I found that although such fully corrected objectives were made—they are known as "photo-visual objectives"—the cost was prohibitive and that it would be cheaper to scrap a part of my work, abandon the refractor and make a reflector. I sold the object glass, discarded the telescope barrel, retaining the equatorial head, the clock, the breech piece which takes either the eyepiece draw tube or the plate-holder, the finder and the following telescope, counterpoise and all other fittings. Then I bought a 6½in. parabolic mirror and diagonal flat mirror and built a new barrel. The result is shown in the illustrations, Figs. 1, 2 and 3.

Mirror is Achromatic

I do not know whether all of those readers who have built reflecting telescopes are aware of the fact that the mirror of the reflector is absolutely achromatic and has, when newly silvered, greater light-collecting power than the refractor.

These facts make the reflector the more suitable and, incidentally, the cheaper form of instrument for astro-photographic work. But, since some exposures will run into hours of duration—on faint star groups and nebulæ—the telescope must be driven by a clock or power motor to keep sidereal time. That is to say, the telescope must be rotated about the polar axis at such a rate as will keep the heavenly object always in exactly the same position on the plate during the whole of the exposure without any variation.

Since, however, no clock or piece of mechanism was ever made with sufficient accuracy to accomplish this, without some means of control and correction, a gear is introduced in the clock which, operated either electrically or by hand, enables the movement of the telescope to be either retarded or accelerated as may be required. Apart from possible inaccuracy in the cutting of the gears in the clock and those of the clock drive, there are other factors which prevent perfect uniformity of motion, such as friction in bearings and other rubbing parts and lack of perfect balance in the telescope itself, its counterpoises and fittings.

I have said that the telescope must keep sidereal time, but if the moon is to be photographed this statement will not apply; the moon has, of course, a retrograde movement across the heavens and so provision must be made in the clock for altering the speed from sidereal to lunar rate. The means whereby this can be done will be referred to later. In the meantime, I will answer the obvious question which will occur to the reader: how are we to know during a long photographic exposure whether the clock is gaining or losing? Well, it is done by means of a following telescope, a refractor having an object glass of about one-third of the aperture of the main mirror. The follower is clearly seen in Figs. 1, 2 and 3; the O.G. is 2⅛in. diameter.

Follower With Spider Webs

This smaller telescope is used like a gun-sight and, like a theodolite, is provided with crossed spider webs in the eyepiece. In photographing the moon or portion of the terminator, when the moon is not full, a particular part of a lunar crater is kept dead on the point of intersection of the webs, these being visible as crossed black lines, but when faint objects such as star groups are being photographed the webs are invisible against the dark background of the sky and so they must be rendered visible in one of two ways: both by electric illumination. One of these methods is the "bright field," and the other "bright webs." The former is much simpler to make and fit because eyepieces are not interfered with and different powers can be applied—provided they are all fitted with webs—without affecting the illumination, whereas with bright webs, that is to say, a dark field, the webs have to be illuminated by an oblique beam of light from a lamp on the side of each eyepiece. The bright lines are inclined to be somewhat dazzling unless some means are adopted to dim the lamp. With the bright field dimming must be resorted to and it is an advantage to be able to get three or four degrees of brilliancy. The reflector shown in the illustrations is fitted with bright field illumination and the lampholder which also carries a tiny mirror is seen in Fig. 1 near the upper end of the follower. In Fig. 2 may be seen, on the main telescope barrel, a resistance coil, a rheostat switch and a terminal block.

Fig. 4 is a diagram of the electrical connections and this shows a small three-cell battery, also mounted on the telescope. In my own instrument the battery was separated from the telescope and was connected to a pair of terminals, near the rheostat, by a long flex, which flex was a nuisance, and I therefore recommend the battery on the barrel. In this diagram the tiny mirror is shown as being cut from a small piece of tin plate. If polished with plate powder or rouge it serves the purpose admirably of throwing a glow of light into the telescope sufficiently luminous to show the webs as dark lines and yet not too bright to dim the star chosen as the target.

Fig. 2.—The telescope pointing north-east.

Reflector Telescopes

Reflector

By E. W. TWINING

The Driving Clock

Now I come to what is perhaps my main purpose in writing this article; to give some particulars of a driving clock which shall be suitable for any reflecting telescope of from six inches to eight inches aperture. Although a clock cannot, within reason, be too large for a telescope it can, very definitely, be too small. Both the clock and the whole equatorial head shown in Figs. 1, 2 and 3 are just a little on the small side for a 6½in. reflector. They were originally made for the 4in. refractor, and the reflector is the heavier of the two, quite 50 per cent. heavier.

So, in preparing the accompanying drawings of a driving clock I have kept this point in mind and made all gears, spindles and bearings larger than my own and large enough for such an instrument as the eight-inch telescope for which I give a drawing in Fig. 5. Most of the details of the construction of the clock will be obvious from the accompanying drawings Figs. 7 and 8, but the subject of Fig. 6 first claims attention. This is the important part of the drive at the equatorial head. Of the head itself PF is the polar axis frame with conical bearings, PA the polar axis, DF the declination frame or crosshead, into which the polar axis is screwed and pinned, DA the declination axis. CC are clamps and the gunmetal plate which carries these is attached to DF through the medium of a socket attached to the plate by three screws. Into this socket fits a steel pin DP which is screwed into DF. This socket and pin drives and rotates the polar axis, and with it the telescope, when the clamps are closed on to a flange on the tangent wheel TW in the teeth, on the periphery of which the screw TS engages.

Turning now to calculations relating to gear ratios, revolution speeds and other particulars of the clock we will commence at the tangent wheel: this for convenience I have divided into 360 degrees and 360 teeth. The screw TS which engages with it is ⅝in. diameter and is screw-cut 14 threads per inch; therefore:

$\frac{360}{14} = 25.7143$in. circumference or $\frac{25.7143\text{in.}}{3.1416} = 8.185$in. diameter.

Now 360 represents 24 hours or $24 \times 60 = 1440$ minutes.

$\therefore \frac{1440}{360} = 4$ minutes per tooth and 4 minutes per revolution of tangent screw.

From this it will be seen that as the gear ratios at the end of the tangent screw, Fig. 6, and at the lower end of the long driving rod B2, Fig. 7, are both 1 to 1, the shaft B1 will make one-quarter revolution per minute.

An Epicyclic Gear

Between shafts B1 and B there is a drum containing differential, or epicyclic gearing, consisting of four gear wheels marked b, b1, b2 and b3. It is by the slow rotation of this drum by hand and by pulling on the cord in one or other direction that the movement of the telescope is either retarded or accelerated without affecting the speed of the clock.

As the ratio between b3 (on shaft B1) and b2 is 1 to 2 and between b1 and b2, 1 to 2, the shaft and wheels B will make 1 r.p.m.

The rest of the ratios and revolution speeds in the clock are:

Fig. 3.—The telescope pointing north, laid over the Polar Axis.

Shaft	R.P.M.	Gr. Ratio
Drum	¼	2
A	½	
B	1	4
C	4	4
D	18	4½
E	90	5

Shaft	R.P.M.	Gr. Ratio
B	1	4
B1	¼	1
B2	¼	1
T. Screw	¼	

The shaft F is fixed, held by ratchet R, and a, on a spindle attached to the drum, revolves around f, thus driving wheel A. F is only revolved—turning by means of a handle fitting on the squared end—for winding the clock. Through a the drive to A is still maintained even whilst rewinding the cable upon the drum.

The drum is made in three parts, machined all over, and the barrel screw-cut, with a spiral groove on the outside to take the stranded steel wire cable. The end

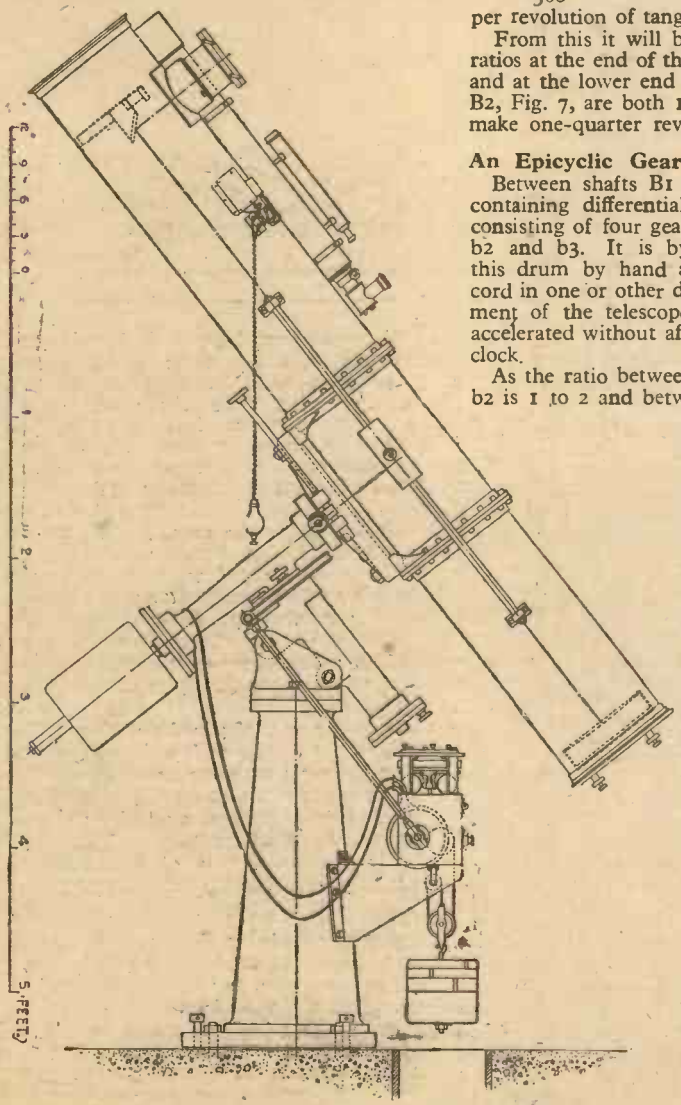


Fig. 5.—An 8in. reflecting equatorial telescope.

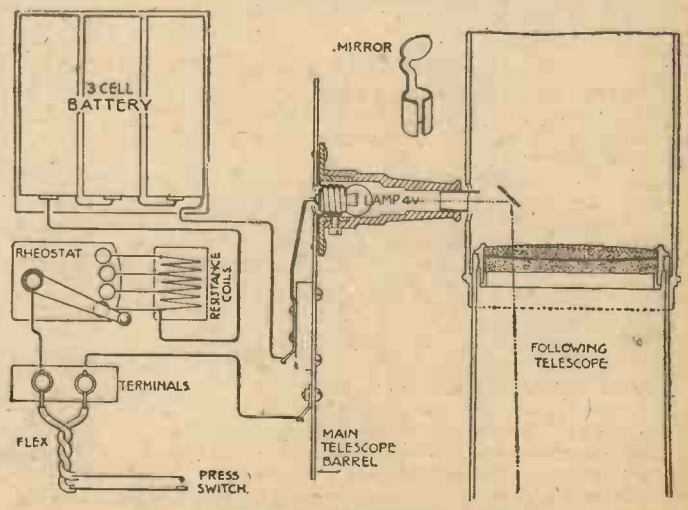


Fig. 4.—Bright field illumination of follower.

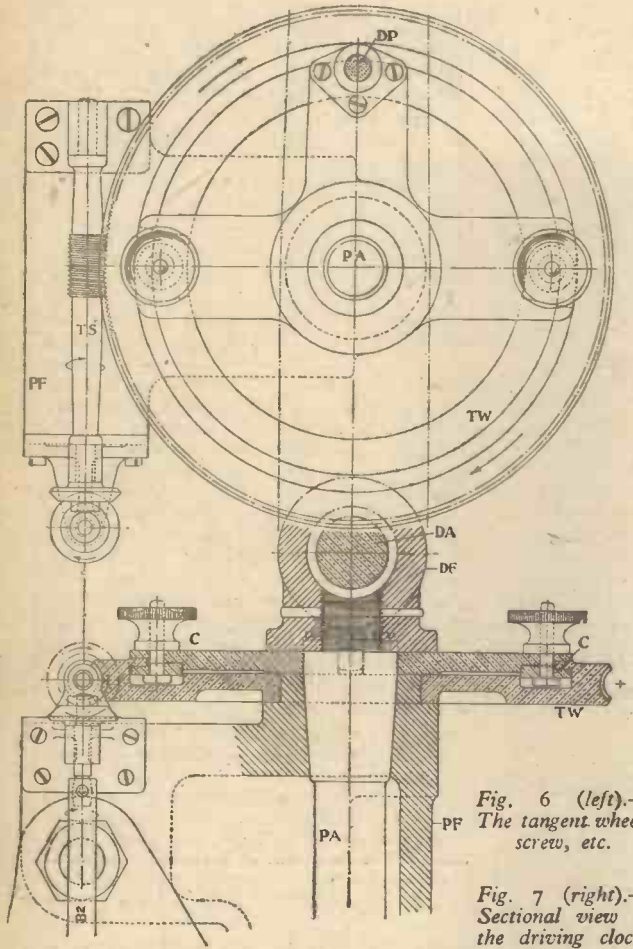


Fig. 6 (left).— The tangent wheel, screw, etc.

Fig. 7 (right).— Sectional view of the driving clock, showing the winding drum and governor gear.

cheeks can be sweated into the barrel with soft solder. Anchorage for the cable is provided by a hole drilled through the barrel and flange of the cheek at the rachet end; the cable is passed through this, the wires opened out, bunched up and made into a knob with solder. There should be twenty-one turns in the spiral groove, so that, as the drum revolves at the rate of 8 minutes per revolution, the length of run of the clock, without rewinding, will be: 8 x 21 = 168 minutes, or approximately two and three-quarter hours. This would be long enough for many photographic exposures.

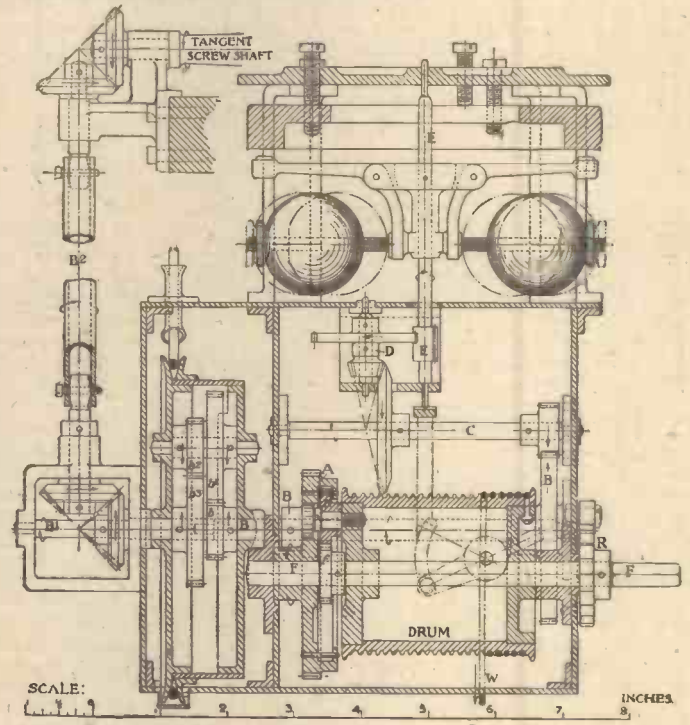
Clock Speed Control

The first of the two revolution tables shows that the speed of spindle E is 90 revolutions per minute. With the spindle the two "fly-balls" or governor weights turn and the principle of the controlling action is: that these balls fly outwards by centrifugal action. The balls are each threaded on a screwed arm tapped into the lower arm of a bell crank, pivoted on a casting pinned on E. The outer ends of the upper arm are formed into cups by sinking with a quarter-inch drill. Into these cups leather punchings are inserted—cut from very thick shoe-sole leather—they should be cemented in and then oiled. Mounted above the governor is a heavy cast gunmetal ring, carried by screws from the top gunmetal plate, which, in turn, is supported by four stout brackets rising up from the clock case.

The screws carrying the ring should have a fine thread such as No. 0 or No. 1 B.A. There are three screws tapped into the top plate only, these are pushing screws, and three which are a clearance fit through the top plate and are tapped into the ring, these are pulling screws. As the pushing and the pulling screws are arranged in pairs, at equidistant points circumferentially, means are thereby provided for so adjusting the ring that its lower surface is exactly parallel with the plane of rotation of the governor balls and with them the two leathers in the cups.

But there is more than just a matter of parallelism required to secure correct time adjustment. The ring must be sufficiently low to ensure that the leathers are rubbing when the full load of driving the telescope comes on the clock; not revolving without making contact nor even just lightly rubbing, for the governor is not merely a check against excessive speed; it must be capable of giving up some of the work which is being put into it as well as absorbing more. There should be a nice sharing up, between the governor and the telescope, of the power expended by the falling weight.

In addition to, and in conjunction with, the height of the ring, further adjustment is available by the positioning of the balls on the screwed arms; to increase the speed and reduce the leather friction the balls are screwed inwards and *vice versa*. For perfect rotation balance both balls must be exactly the same distance from spindle E and they should be secured by the knurled locking nuts shown in Fig. 7.



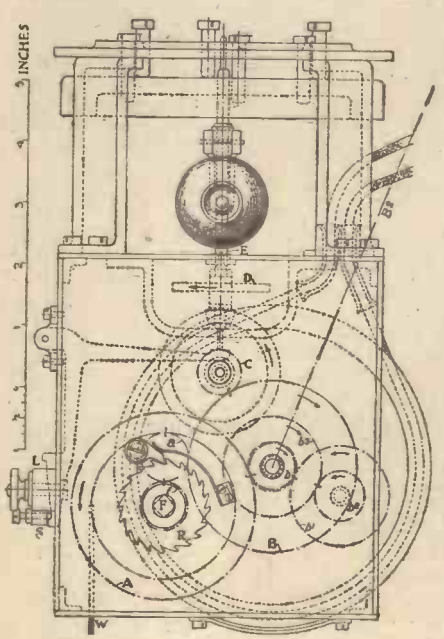


Fig. 8.
End view of driving clock.

In the mechanism of the clock there is one gear which calls for some explanation: that large internal one with which pinion a meshes. The shape of wheel A is such that it is not possible, with ordinary cutters, to form teeth of the usual pattern; therefore the wheel is machined with an internally projecting flange. This flange is carefully and accurately divided up to the correct pitch, on a scribed circle of pitch-diameter, drilled and steel wire pins inserted to serve as teeth with which a will engage. This type of gear is perfectly satisfactory: it has been fitted in far larger driving clocks than the one with which we are now concerned. Nearly all alarum clocks have this form of construction in pinions.

The spindles or shafts in the clock are all of steel. Gear wheels and pinions of hard brass or gunmetal with the exception of E, which is turned from a length of pinion wire. The case of the clock is of steel plate; planished plate, if it can be obtained. The long driving connection B2 is of heavy-gauge brass tubing. All bearings are of cast gunmetal.

Changing the Driving Speed

The changing of the driving speed from sidereal to lunar rate, to which I made early reference, is accomplished by a simple device which raises the spindle E, and with it the governor balls and leathers; thus, by a slight increase of friction, causing the clock, and with it the telescope, to rotate more slowly. The design for this changing device

is shown partly in Fig. 7, and more completely in Fig. 8, where it will be seen that a long-armed bell-crank is fitted. The upper horizontal member terminates in a flat enlargement on which, when the arm is raised, spindle E rests. The lower end of the vertical arm has a radially curved part with a sloping face; on this face presses an adjustable screw carried by a semi-rotary lever which, by a knurled nut, can be clamped in either position L or S, Fig. 8, L being the lunar rate position and S the sidereal. Thus it is possible by slackening the knurled nut, swinging the lever and re-clamping, to instantly change from one rate to the other.

Electric Slow-motion

Before closing this article I might add that it is possible to fit electric slow-motion to the epicyclic drum on the clock in place of the hand-operated cord, and if any reader should be sufficiently interested I will, after receiving an inquiry, give particulars. It was my original intention to provide this on my 6½in. reflector, and that is what the rectangular downward projecting piece of plate, below the clock bracket, was for. It was intended to take a six-volt reversible motor, acting on tangent teeth on the rim of the drum, but it was never fitted.

Colour Music

The Possibilities of this New Science and Details of a Colour Organ

By Prof. A. M. LOW

ONE day in the not so distant future we may go to the cinema to see colour films; not the colour films of to-day, which are photographs of objects in their natural colours, but symphonies in colour which are as "abstract" as symphonies played by orchestras, and where the *form* of the colour in relation to actual objects will matter as little as the relation of music to natural and artificial sounds in the real world.

Few people realise that it was more or less a matter of chance whether in the course of evolution human beings gained their appreciation of music through their ears or through their eyes. The sense of rhythm is instinctive, found in the lowest animals and in every main form of life. Perhaps the first appreciation of rhythm in all creatures was produced by the regular rise and fall of tides. In the course of evolution some animals developed organs particularly sensitive to rhythms in the air—what we now call sound. An irregular tapping on a piece of wood produces noise, but if the taps are spaced at regular intervals and the air is regularly vibrated, it may be sound, or even "music." A xylophone, after all, is only an instrument for producing fairly pure sounds of this kind.

High Frequencies

Many human beings hear only the vibrations produced in the air with a frequency somewhere between 12 a second and 5,000 a second. This "waveband" is but a fraction of possible sounds. In fact, children can hear much higher notes and dogs can appreciate frequencies greater than are audible to any human being. It is easy to make a whistle that can be heard by a dog but is "silent" for human beings.

Over the course of centuries we have produced a very complicated appreciation of these sounds, singly and mixed, and the result is the art of music. In a similar way we have also built up an appreciation of colour. There is good reason to believe that early animals, like the cat of to-day, could realise only the presence or absence of colour and not its great variety. They saw things in terms of black, grey and white. We have evolved eyes which are able to distinguish far more narrowly between the different light vibrations, just as we have evolved ears able to distinguish between the different air vibrations we call sound. Perhaps only an unbelievably expert musician could distinguish between two tuning forks, one giving 440 vibrations and the other 441 per second, but the great mass of people are able to distinguish between sounds "a quarter tone" apart and thus hear melody.

So with light. It is estimated that a well-trained eye can distinguish between something like 100,000 different colours or "shades" which, of course, is far more than the range of frequencies produced even by a full orchestra. The ordinary person could, perhaps, distinguish between half this number of colours. Even this represents only a small fraction of the "possible" colours. The shortest light waves that can be appreciated by the eye are those we call violet—15/100,000,000ths of an inch long. The longest are 30/100,000,000ths of an inch. Obviously, between these two ranges there are millions of minute differences. In addition there are theoretical reasons for believing the evolution of the eye is not complete and that, as we have come from the black and white stage of the cat to our present sensitivity, so we may go on to the point where we sense not four primary colours but over 100.

Association of Sound with Colour

There is no doubt that certain sounds are associated with various colours. It is no accident that many famous pieces of music have "colour" names; heavy chords are generally thought of in terms of sombre colours. Many experiments have been made to determine the reaction of the average person to sound and colour in combination; it is now well established that the human brain has become more sophisticated in its demands for pleasure. Simple primary colours please primitive peoples. Town dwellers demand not only subtle shades in colour, but colour also as an accompaniment to their entertainment, particularly dancing and theatricals.

The various colours are just as capable of being built up into "music," with melody, harmony and rhythm as is sound; indeed, it was more or less an accident that we chose sound rather than colour for our music. Colour "music" can appeal to the eye as sound music appeals to the ear. At various times attempts have been made to introduce performances of colour music; in the main they failed because they could rely only on placing the colours side by side or by using prisms which did not give any blending or evaluation of each colour note. They were therefore as crude as a native orchestra and did not sufficiently entertain the civilised colour sense.

A Colour Organ

The possibilities of colour music have long fascinated artists, and a large number of experiments have been made in attempts to discover how colours could be produced at will by a musician. It seems clear that the desired effect of blending could never be obtained by the aid of solid screens and prism effects, however complicated, and that liquid colour is the only possible solution. This is the principle of the latest discovery, a colour organ. The actual instrument is very small and consists of a glass screen over which a thin film of water can be made to flow. This screen need be no larger than a penny and is placed almost immediately opposite the source of light in a position equivalent to the gate of a cinema projector. Surrounding the liquid constantly moving screen are tiny colour containers, each providing its own spectrum colour—violet, indigo, blue, green, yellow, orange and red.

Each container is operated electrically by a valve connected to keys like those of an organ; the actual drive is by compressed air. By playing on these spectrum colours it is possible to project not only any colour for any desired length of time (the rhythm), but also any combination (the harmony and melody). The colours can be thrown on to a screen, but a different type of display can be obtained by directing the colour beams on to forms; human forms or a wall. At the touch of a key a bowl of flowers can be illuminated with invisible light so that the flowers appear to stand out against darkness in colour which can be changed at the flick of a button. The keys can be operated by a colour musician or by a record which would repeat any pre-determined rhythm of colour. Colour response can also be obtained automatically from definite musical notes.

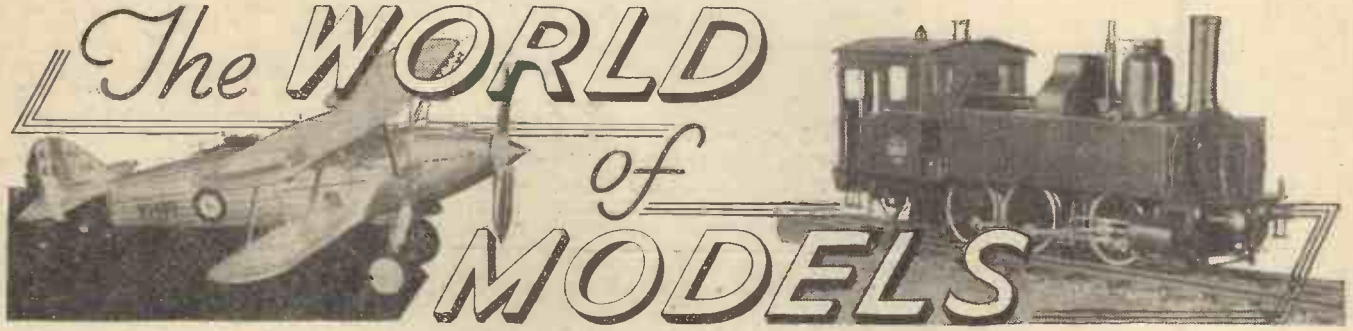
The apparatus is minute; a valve no larger than a pin gives the effect of a shimmering snow-storm on a building by injecting on the glass screen a trifle of aluminium paint. But the "snow-storm" through the light beam could embrace the whole of Buckingham Palace and be of any colour shade or localised colour. In practice, and on a full scale, the effect is like that of a giant provided with enormous brushes working on a great canvas, stippling or splashing a corner of a building or "washing" the whole surface in a fifth of a second and then changing to another colour in the same way. Parts of the screen can be coloured in a variety of colours by light, quick touches on the keys, and depth is controllable by "base" keys exactly as in the case of sound music. Our imaginary giant could wash a building in an instant with one colour, gradually edging it away with others if he wishes, or in another moment alter the whole set and build into it colour pictures and tones just as a musician would play a sonata on the keys of the finest organ in the world.

Possibilities

The possibilities of this new art are exciting. No doubt we shall have "high-brow" abstract compositions in which colours and tones are blended and succeed each other like the notes in a quartet or symphony, without any regard to natural effect or form. But, at first, it might be expected that colour music would be used rather as an adjunct to the other arts, just as for many years music was more or less restricted to aiding or illustrating dancing and marching.

Colour organs may soon be seen in dance halls, where they could provide tremendous atmosphere and "backing" to the music much more subtly than by the present crude switching on and off of lights. A new art has certainly been born; it has immense and very beautiful opportunities.

The WORLD of MODELS



Scale Model "Duke of Lancaster" : Model Foden Steam Wagon : A Fine Architectural Model

By "MOTILUS"

WE do not need to be seafarers to appreciate the fascination of a ship model, whether it be a four-masted sailing ship or the latest modern liner. I know readers will be interested to know something about a model of s.s *Duke of Lancaster*, one of three ships built for the L.M.S. Railway in 1928 by Wm. Denny & Bros., Ltd., Dumbarton. The two sister ships were *Duke of Argyll* and *Duke of Rothesay*, and all three were for the Heysham-Belfast service.

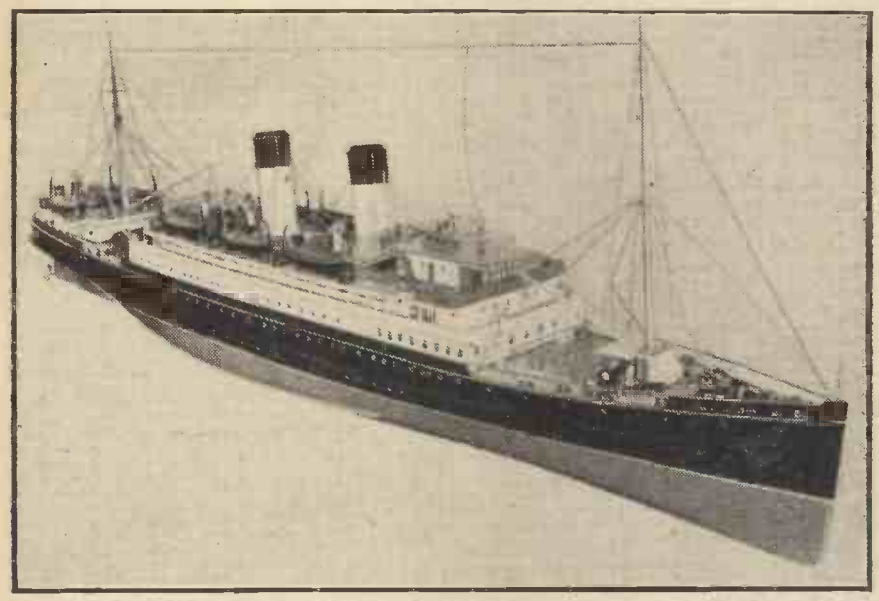


Fig. 1.—A model of S.S. "Duke of Lancaster," built in 1928 for the L.M.S. Railway Co., for the Heysham-Belfast service. The model, to a scale of ¼in. to 1ft., has recently been reconditioned, as shown in the photograph, and is now in the possession of the London Midland Region of British Railways.

The ships were similar in size : length 360 ft., moulded breadth 53 ft., tonnage 3,794. The shaft horsepower was 8,100 and maximum speed 21 knots ; they could each carry 1,500 passengers. During the war these steamers were requisitioned and took part in the evacuation from St. Valery, the Dieppe raid and D-Day operations.

The *Duke of Lancaster* was first employed as a military transport at the outbreak of war but soon afterwards returned to her home port. She was again called up and converted to a hospital ship in readiness for D-Day. During the ensuing activities she was the first hospital ship to carry out successfully her mission without mishap. She continued in this service for four months, and in October, 1944, was diverted to the services from Ostend, Dieppe and Cherbourg. After the war she was re-equipped for peace-time duties and returned to Heysham.

The illustration, Fig. 1, shows a model of the *Duke of Lancaster* after recent repainting and reconditioning for British Railways, London Midland Region. The model is to a scale of ¼ in. to 1 ft.

Model Foden Steam Wagon

Not long ago I heard from an enthusiastic model-maker in Australia, Mr. George Waines, of Innisfail, N.Q. Mr. Waines has had a Foden steam wagon under construction for some considerable time and wrote to tell me it was at last completed. He also sent me some photographs of the finished model, one of which is reproduced here (Fig. 2). All the material and finished fittings for this model came from England.

Mr. Waines supplied me with quite a number of details about the materials used, etc., which may be of interest to other model-makers. The boiler is made of 3⅛ in. diameter, 13 gauge brass tubing. The fire-box is of 12 gauge sheet brass and the end-plates are cast brass. Five boiler tubes of 7/16 in. outside diameter are fitted and the boiler is fired with a silent Primus burner. The eccentrics are an exact copy of those used in actual practice. A 5/16 in. diameter, double throw, built-up, 90° crankshaft drives through a train of gears to a ½ in. pitch cycle chain and 12-tooth sprockets.

Regarding castings, the flywheel is iron, chimney, smokebox and wheel hubs are aluminium alloy, and the remainder are all gunmetal. All were made at local foundries, to Mr. Waines' own patterns. The bodywork is done entirely with 18 and 20 gauge sheet steel. The finished model weighs about 30 lb., unladen : its measurements are, overall length 29 ins., height 13 ins. and wheelbase 17 ins. Incidentally, most of the machining was done on a wood-turning lathe over a hundred years old.

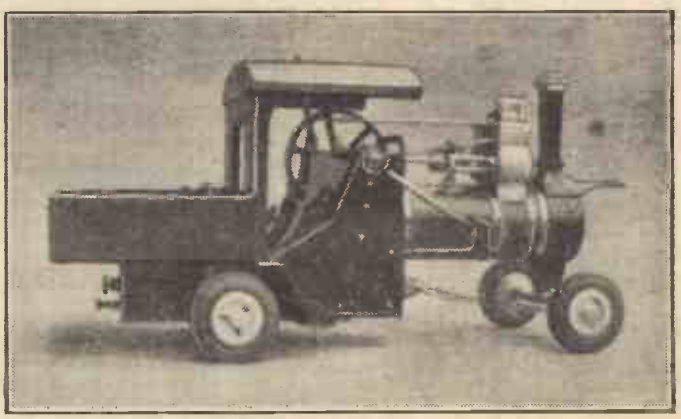


Fig. 2.—The model Foden steam wagon built by Mr. G. Waines, of Innisfail, Australia. A trim model, with some good detail work.

A Fine Architectural Model

A well-constructed architectural model always has an appeal for lovers of good craftsmanship. The model just completed this year by Bassett-Lowke, Ltd., of the extensive buildings of Messrs. J. Bibby & Sons, Ltd., Liverpool, is a good representative example of this type of modelling. To those who do not know these large factory and warehouse buildings on Merseyside, the accompanying illustrations, Figs. 3 and 4, will convey some idea of the extent of these premises.

Messrs. J. Bibby & Sons, Ltd., are an old-established company, their history dating back to 1829, when the Bibby family came into possession of the Condor flour mill, purchased by Mr. Edward Bibby. In 1854 Mr. Bibby died and his second son, James, took over the mill and opened a warehouse in Lancaster for the sale of flour and provender. Later he took into partnership his two younger sons, Joseph and James, and in 1878 the name J. Bibby & Sons was adopted. Within the next ten years the

business expanded rapidly, introducing new ideas in cattle feeding preparations. During 1885 premises in Liverpool were acquired and the head office moved to Liverpool in 1888.

Since that time the company have undertaken vegetable oil production soap manufacture, compound cooking fats manufacture, as well as continuing their animal feedingstuffs business and engaging in progressive research and development. Two experimental farms, established in Cheshire, assist in the development work in producing nutritive animal feedingstuffs.

Remarkable Detail

The model illustrated here does not show anything of the amazing interior of these factory and warehouse buildings, with their numerous complicated machines and equipment connected with the business. It is a wholly exterior model, built to a scale of 1/16 in. to 1 ft. and measuring 5 ft. 10 in. long, 4 ft. 2 in. wide and 15 in. high. It incorporates the five major building blocks, and shows clearly all approaches by road, rail and river. There are railway sidings and a portion of the elevated railway, with locomotive and trucks; transport

Fig. 3.—A complete view of the fully-detailed architectural model of the factory and warehouses of Messrs. J. Bibby & Sons, Ltd., Liverpool. The model is to a scale of 1/16 in. to 1 ft.

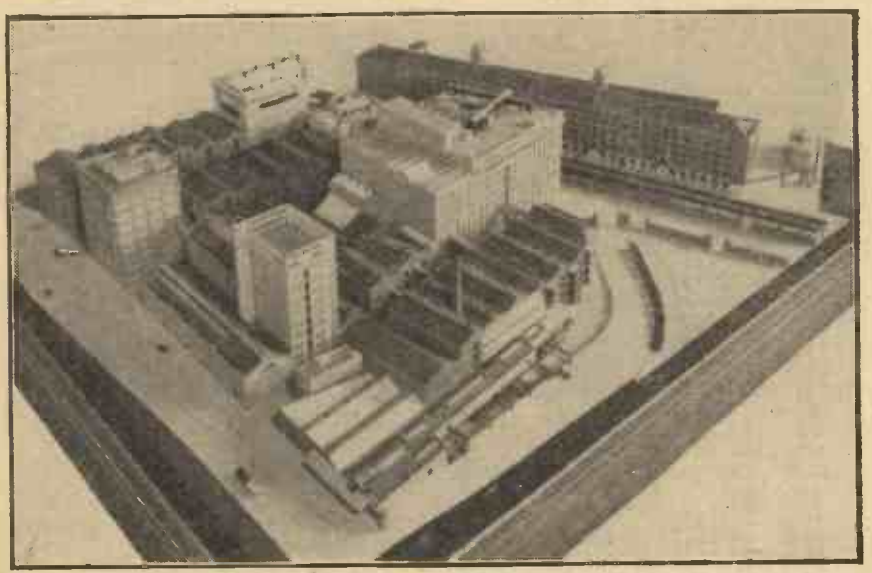


Fig. 4.—Another view of the model of Messrs. Bibby's premises, this time showing the road frontage, with the administration offices at the extreme left.

vehicles are shown approaching along the roadway, and barges and a small cargo vessel add realism to the riverside aspect.

The buildings are shown in full relief, with recessed glazed windows, recessed panels in brickwork, all pilasters, plinths, mouldings, copings, etc., and glazed rooflights, connecting bridges and pipework. Finished in correct colours, the model is a most realistic presentation of the extensive and varied premises of this well-known company.

Popular Model Railway Gauges in U.S.A.

Last March an American model railway magazine reported its annual survey of model railway fans in the U.S.A. The two most popular gauges among model "railroad" owners are still HO (OO in this country) and Gauge O. Gauge HO came first with 69.3 per cent. and Gauge O second with 22 per cent. Others gauges made up the remaining 8 per cent. or so.

The survey is most comprehensive, and not only measures the popularity of the various gauges but also gives percentages on the occupations of the enthusiasts, their ages and incomes.

The largest percentage of owners are in the professional classes (22.3 per cent.), but students run very close, being 22 per cent. Skilled workers make up another 19.9 per cent. In the age groups, about 7 per cent. of model railroad owners are under 15 years, 18 per cent. are between 25 and 29 years, 16 per cent. between 30 and 34 and 13 per cent. between 35 and 39. By the time they reach 70 years and over they have dwindled to .3 per cent.!

Standard Gauge I Dimensions

Model makers interested in Gauge 1 model locomotives and railways will be glad to learn that standard Gauge 1 dimensions have been drawn up in collaboration with enthusiastic Gauge 1 modellers. Blueprints, incorporating all these details, are now available. They are comprehensive and deal not only with locomotives but also with signals, tunnels, under- and over-bridges, points, platforms and other necessary measurements for Gauge 1 indoor or outdoor layouts. The measurements are given in inches and millimetres. The price for the blueprints is 3s., post free, from Bassett-Lowke, Ltd., Northampton, or from their London and Manchester branches.

Newnes' Engineers' Reference Book

Edited by F. J. Camm

THE third edition of this important standard reference book contains nearly 300 pages of new matter in addition to complete revision. The new sections cover Fan Engineering; Centreless Grinding; Induction Heating; Plain Bearings; Belt Transmission; Investment Moulding; Lapping and Honing; Hobbing; Surface Finishing; Properties of Plastics; Air Compressors; Compressed Air Data; Corrosion Treatment; Mirror Finishing; Polishing and Buffing; Gas Welding; Weights; Additional Screw Thread Tables; Weights of Materials; Use of Rubber in Presses; Shafting; Pipe Flanges; Lighting of Buildings.

The book comprises over 1600 pages, fully cross-referenced, and hundreds of diagrams, tables and formulæ of great value to mechanical, civil, structural, automobile, and aeronautical engineers, designers, draughtsmen, works managers, gauge and toolmakers, time and motion study engineers.

It costs 45s., or 46s. by post.

OUR COVER SUBJECT

THE National Aeronautical Collection at the Science Museum, South Kensington, London, S.W., was re-opened to the public recently. Located in the Western Galleries of the Museum the collection contains many of the world's most famous and historic aircraft. Fully representing the history and development of aeronautics from the earliest conception of flight to the latest rocket-propelled aircraft the National Aeronautical Collection has become the rendezvous of all interested in the history and development of aeronautics. Progress in aviation is extensively illustrated from the original Lilienthal glider to the world's first successful jet-propelled aircraft. The rapid development of aircraft propulsion is clearly shown in all stages from the original steam aero-engine of Sir Hiram Maxim to the latest Rolls-Royce Derwent V gas-turbine.

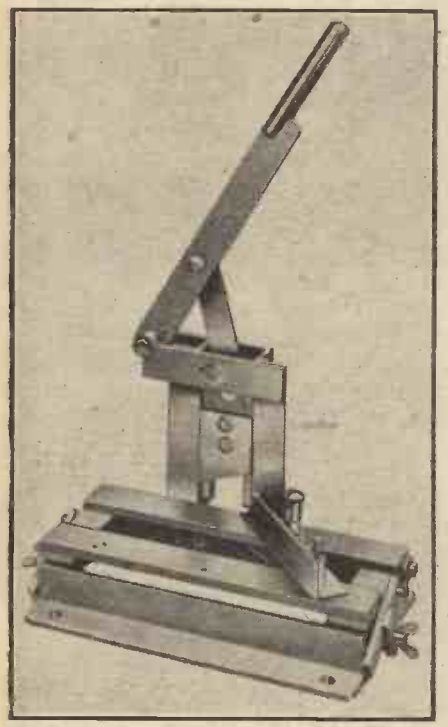
Our illustration shows a view looking through the galleries. The plane hanging from the roof is a Vickers Vimy Rolls-Royce. This aeroplane made the first direct trans-Atlantic flight on 14th/15th June, 1919, piloted by Alcock and Brown.

Trade Notes

A Review of the Latest Appliances, Tools and Accessories

Compound Mitre and Shaving Machine

A NEW machine, known as the Mitor No. 302 compound mitre and shaving machine, was recently placed on the market by Mitor, Ltd., 4, Vaughan Road, Harpenden, Herts. The machine, which is



The Mitor No. 302 compound mitre and shaving machine.

made from the best quality mild steel, has a tungsten steel blade, and will produce perfect mitres and joints. It will also cut at all angles from 45 deg. to 90 deg. in both directions, flat or on edge. Provision is made for precise mechanical locking at both extremes, and there is a clamping screw for all intermediate angle settings. The new machine, which has a cutting capacity of 2in. by 1in., weighs 21lbs. and is priced at 98s. 6d.

Multicore Model Television Factory

At the National Radio and Television Show, Birmingham, Multicore Solders Limited specialised in practical soldering demonstrations, and the special manufacturing feature this year was undertaken by factory operatives from the works of the General Electric Company.

The complete centre section of Multicore's large island stand was laid out to represent an interesting cross section of a typical television assembly line, together with an ingenious floor design enabling the public to view the assembly operations very closely. The G.E.C.'s works staff, who come from Coventry daily, assembled R.F. units for the G.E.C. Television Model No. BT.2147, each unit involving the assembly of approximately 60 parts. The complete operation, including 130 Ersin Multicore solder joints, took more than one hour, and the completed units were then despatched to Coventry for testing and incorporation. A special collection and delivery service between the Multicore stand and the G.E.C. works enabled the daily supply of parts and completed units to be exchanged.

Cable End Identification

TO simplify identification in complicated electrical circuits, the use of some form of cable marker is now becoming standard practice. Various forms of marker have been employed, ranging from the hand-written paper tag to the more elaborate thimble-shaped, engraved, plastic cable-end ferrule.

Due to its durability, neatness and legibility the last named has always been regarded as the most satisfactory method of identification, but even this has its disadvantages as many firms find it impracticable to carry

The Critchley interlocking plastic cable-end ferrule.

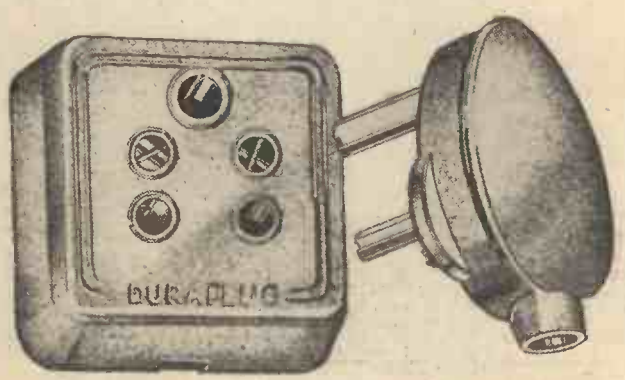
large stocks of these specially engraved ferrules. In order to eliminate this difficulty, Critchley Bros., Ltd., of Brimscombe, Glos., have designed a fully interlocking plastic ferrule consisting of several units, each of which is engraved with a single digit or letter. From these an almost unlimited number of code numbers or combinations can be built; in fact, more than 1,000 different identifications can be made up from a stock of ferrules numbered from 0-9, using only a three-figure code.

To prevent the digits or letters from movement, each ferrule unit is made with a key and keyway (see illustration) which ensures that they can only be assembled with the engravings in line and cannot come out of alignment at any time. These ferrules can be supplied in black with white engraving or vice-versa, and other colours can be supplied to order.

Entry of cables from both right and left, without one side reading "upside down" is provided for by ferrules being engraved for either hand as required.

Duraplug Plugs and Sockets

W. W. HAFFENDEN, LTD., Richborough Rubber Works, Sandwich, Kent, have recently placed on the market a range of rubber plugs and sockets, designed to withstand the hardest knocks. The all-rubber casings ensure perfect insulation, and the flexible pin mounting provides good contact, and permits use in standard 2-pin sockets by the removal of the earth pin. The new Duraplug is fitted with a cord grip and, apart from the feature that it is unbreakable, it has the advantage that no metal parts are exposed. If necessary, it can be used as a floating connector. The plugs and sockets are made in three sizes—2 amp., 5 amp., and 15 amp. at retail prices ranging from 1/9 to 3/6.



A "Duraplug" 5-amp. rubber socket, and a 15-amp. rubber plug.

"Marlco" Tool Protractor

A NEW tool for the rapid and accurate measurement of tool angles was recently introduced by W. H. Marley and Co., New Southgate Works, 105, High Road, London, N.11. Correct tool shape is recognised as an essential factor where maximum production is to be attained, and visual inspection of the final shape has in the past resulted in a great deal of wasted time and effort. With this instrument, which is simple to operate, the final shape is accurately measured whether the tool be hand or machine ground. All angles relative to the cutting edge of such tools as turning bits, can be measured directly. It is also useful for measuring the individual components of any compound angle.

The "Marlco" tool protractor is a precision instrument, the bearing end of the

The "Marlco" tool protractor.

pointer being hardened and tempered, thus ensuring long life. An indent plunger locates the upper bracket (carrying the main scale), in the zero position, and it is in this position that the majority of angles are measured. The price, packed in a steel box with instruction card and table of suggested tool angles, is £6 5s.

Ex-Government Radio Equipment

THE Clydesdale Supply Co., Ltd., have just issued their new list (No. 7) of Ex-Government electronic and radio equipment. This handy list, which runs to 236 pages, includes such items as accumulators, amplifiers, cathode-ray tubes, chokes, condensers, television equipment, metal rectifiers, transformers and a host of other components in demand by experimenters. The list, which is priced at 6d., is obtainable from the above firm at 2, Bridge Street, Glasgow, C.5.

A CYCLIST'S "BIBLE".

The 84 pages of indexed place-to-place road routes are invaluable to the tourist, rendering maps unnecessary.

Just Published

The Handiest Pocket Book for Cyclists

A New 400-page Pocket-size Reference Book, Road Guide and Technical Handbook for Cyclists, Written by F. J. Camm

EVERY Cyclist's Pocket Book, just published at 7/6, or 7/10 by post from George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2., contains 400 pages and 118 illustrations, is a pocket book in the real sense. Measuring only 5in. by 3½in., it contains facts, figures, formulæ and data never before published, on almost every aspect of cycling.

It is a technical pocket book and a general pocket book, the need for which has been felt ever since the author's previous volume, *Every Cyclist's Handbook*, a best seller, went out of print over 12 years ago. This present volume, which will be a constant companion to the cyclist, the cycle tourist, the cycle mechanic and the technician, is packed with information not to be found in any other one book, It deals with every part of the bicycle, including maintenance. overhauling and re-enamelling.

Apart from the technical information *there are no less than 84 pages of indexed place-to-place road routes*, which will save a great deal of map hunting, and, in fact, for ordinary touring purposes render maps unnecessary.

The book is lavishly illustrated, and the following list of section headings indicates its truly comprehensive nature : Bicycle Measurements ; The " Gear " of a Bicycle ; Frames ; Standard Frame Angles ; Handlebars ; Saddles ; Brakes ; Pedals ; Chains ; Chain Wheels and Sprockets ; The Variable Gear Hub ; Derailleur Gears ; Tyres ; Rims ; Clothes and Equipment ; Tandems ; Lamps ; Cyclometers ; Adjusting Bearings ; Re-enamelling a Bicycle ; Overhauling a Bicycle ; Wheel Building ; Calculating Spoke Lengths ; Summary of Cycling Law ; Touring ; Touring by Numbers ; Map Reading ; Road Routes Simplified ; Cycle Camping ; Touring Abroad ; Interesting Cycling Facts ; National Clubs and Associations ; Railway and Cloakroom Charges ; Calculating Speed from Pedal Strokes ; Table of Gradients ; Constants for Reckoning Speeds ; Table Showing Speeds per Hour ; Gear Table for Single-speed Machine ; British Standard Cycle Threads ; Cycle Threads for Spokes and Nipples ; Lighting-up Variations ; Road Records and Routes ; Records and Standards ; Women's Road Records ; Principal Road Routes of Great Britain ; Road Statistics ; and Bicycles in Use Throughout the World.

The technical information includes: The Proportion of Cycle Screw Threads ; Chain Sprockets and Chain Wheels ; Spoke Lengths ; Speed in Miles per Hour ; The Three-speed Hub ; etc. etc. A fascinating section is that entitled " Interesting Cycling Facts."

The author of this volume needs no introduction to cyclists. He has been intimately associated with the industry, pastime and sport all his life. Famous as the author of many standard text-books on engineering, radio, mathematics and television, and as editor of an important group of technical journals, he has served on many important cycling committees, was founder-editor of *The Cyclist*, founder of the Cyclist Road Club, founder member of the Roadfarers' Club, Famous Time-keeper and expert on Horology. He still maintains an active interest in cycling as a pastime, as his articles in *The Cyclist Supplement* to this journal indicate. His shrewd criticisms are valued through cycledom, and his advice on all cycling topics is keenly sought.

The publication of this book is an event because it represents the accumulated knowledge of a lifetime, and makes good a serious gap in cycling literature.

The handy size of this 400-page pocket book, packed with hundreds of facts and figures, is apparent from this illustration.

QUERIES and ENQUIRIES

A stamped, addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 8 (THE CYCLIST), must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Matt Black Finish on Zinc

I WOULD like to produce a matt black finish on zinc, such as is obtained on brass, by heating, dipping in copper nitrate and immediately re-heating.

I have tried dissolving zinc in nitric acid to obtain zinc nitrate and proceeded as for brass, but no blackening took place. Any advice you can give me will be appreciated.—A. Leone Ganado (Malta).

ZINC will not behave chemically in the same way as brass because it is an altogether different metal. Zinc does not chemically blacken very well, so that it might be advantageous, if you want a very good job, to copper-plate the zinc, and then to blacken the copper deposit by immersing the article in a weak solution of sodium sulphide.

If, however, you want a direct chemical black staining of the zinc, immerse it in the following solution at a temperature of about 100 deg. F. (38 deg. C.) until a black colouration of sufficient intensity has occurred:

Nickel chloride	2oz.
Ammonium chloride (sal ammoniac) ..	3oz.
Ammonium thiocyanate (ammonium sulphocyanide)	1oz.
Zinc chloride	½oz.
Water	½ gallon

Cementing Rubber Sheeting to a Concrete Floor

CAN you give me any information concerning the adhesive to be employed to stick rubber sheeting to a concrete floor ?—K. C. Pugh (Stretford).

FOR cementing rubber sheet to a concrete floor you can use either a compounded rubber solution, which, we think, you will be able to obtain in your district from the Greengate Rubber Co., Salford, or from Messrs. F. Reddayway and Co., Ltd., Pendleton, or, alternatively, you can employ a bitumen solution, which would be cheaper and quite as efficient.

Assuming that you elect to employ a bitumen solution. This, you may be able to obtain from Messrs. James Beard, Ltd., 16, Great Ancoats Street, Manchester. You can either use such material or one of the black bituminous paints supplied by Wailes Dove Bitumastic Co., Ltd., Collingwood Buildings, Newcastle-on-Tyne.

To 1 part (by vol.) of the bitumen solution, add 3 parts of paraffin or white spirit. Brush this liberally on to the concrete floor and let it dry to the tacky stage. Treat the underside of the rubber sheet in a similar way. Then, to each of the contacting surfaces apply the full-strength bitumen paint, thinly but quite evenly. Let these dry to the tacky stage. Finally, lay the sheet down in contact with the floor, and, preferably, use a heavy roller so that air pockets are not left between the floor and the sheet.

This procedure will give good contact, and after a few days the rubber flooring will be found to be cemented firmly in position.

It should be borne in mind, of course, that rubber sheeting cemented by this means is very difficult to take up again without damage. If, for any reason, it should ever be required to remove the sheeting from the floor, you would have to rely on the solvent powers of hot paraffin.

"Decarbonising" Solutions

WHEN decarbonising my two-stroke motor-cycle I find it easy enough to clean the piston and cylinder head of carbon, but experience great difficulty in cleaning the exhaust and silencer. The baffles in the silencer prevent me from scraping the carbon, etc., out. Can you suggest a simple method ?—F. H. Duggins (Birmingham).

DISSOLVE in a bucket of water ½lb. each of sodium metasilicate and trisodium phosphate. Dismantle the silencer and immerse it, with other necessary parts, in the solution for two or three days. This will remove the oil and grease and will loosen the carbon deposit. Alternatively, you can use in the same volume of water ½lb. caustic soda. In this case the solution must not be placed in a galvanised bucket because the caustic solution would dissolve the zinc coating of the bucket.

There is no ordinary substance which has the slightest solvent effect on carbon. Hence, practically speaking, carbon cannot be dissolved away, despite all statements to the contrary. The grease which accompanies the carbon deposit, however, acts as a binder, and when this oil and grease has been dissolved away, the carbon is usually in a loose condition so that it is easily dislodged by knocking or scraping.

Naturally, every trace of the solution must be removed from the parts by thorough rinsing before they are reassembled.

If the silencer is highly plated outside, it is not advisable to immerse it bodily in the solution. In this case you will have to fit a bung to one end of it and then fill it up with the solution so that the latter does not make contact with the alkaline liquid.

Not all highly-finished platings are susceptible to strong alkalies, but many are. Hence, it is best to be cautious about the matter when applying such alkali treatment.

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

Preventing Tarnish on Drawing Instruments

CAN you suggest a method of removing and preventing tarnish on drawing instruments ?—G. W. Mayes (Northampton).

WE cannot give you a "general" method for removing and preventing the tarnish on drawing instruments. It all depends on the metal from which the instruments are made. Assuming, however, that these are brass and steel, you can only remove the tarnish by fine glass-papering, because a chemical solution which would remove tarnish from brass might blacken the steel, and vice versa. Hence, with these instruments, it is not safe to use any chemical treatment.

To prevent the re-formation of the tarnish, the metalwork, after rinsing and drying and final polishing, must be lacquered. A good and simple lacquer for this purpose can be made by dissolving film scrap (clear celluloid) in a mixture of equal parts of acetone and amyl acetate until a solution of varnish consistency is obtained. About 5 drops of castor oil should be added to every eggcupful of this solution so that it will dry with a non-brittle, flexible film which will attach itself well to the underlying metal, and will not peel off.

Apply the lacquer to the metal by means of a camel-hair brush. Two thin coats are better than a single thick coat. The lacquer dries within an hour or two and will harden overnight. Have the metal very slightly warm before you lacquer it, and do not hang it up to dry in a cold, damp room. Remember that the lacquer is inflammable. It must be stored in a corked bottle, otherwise it will rapidly evaporate.

You can buy lacquer of this type from Messrs. Wm. Canning and Co., Ltd., Great Hampton Street, Birmingham, the price being about 7s. 6d. per pint.

Fixing Graphite on Porcelain Tubes

PLEASE advise me how to fix blacklead on the porcelain tubes of resistors by spray gun or brush.—G. Rampartap (Kampala, Uganda).

TO fix a conducting blacklead (or graphite) to a porcelain tube, first of all dissolve 10 parts of gelatine in 90 parts of hot water. Brush this on to the tube. When the coating is nearly dry, dust the finest blacklead on to it. The blacklead will adhere to the tube and form a continuous layer with a conducting upper surface.

This method only applies to unglazed porcelain tubes because the gelatine solution will not spread evenly on a glazed porcelain surface.

In this case you must brush a clear cellulose lacquer over the porcelain surface. When this lacquer is nearly dry, dust the graphite on to it as before, and then wait until the lacquer has become properly dry. The lacquer will now hold the blacklead particles firmly, down to the tube so that the graphite surface so formed will have an upper conducting surface.

Damp-proof Whitening

WHAT are the ingredients by which I could make a really good whitening ?

I wish to paint an old ceiling, and also the walls of a basement, and would like something which is damp-proof, and that will not rub off.—B. Anderson (Kirkdale).

YOU require a flat oil paint for your ceiling and walls. First of all, prepare and clean the surfaces. Then brush over them a solution of hot size made by dissolving five parts of glue in 95 parts of hot water. Let the size dressing dry out thoroughly. Then apply a flat white paint made according to the following formula:—

Pigment	70 per cent. (by weight).
Linseed oil (raw) ..	15 " " " "
Thinner (white spirit)	15 " " " "

The linseed oil must have mixed with it about 10 per cent. of liquid paint driers. This means that every nine parts of raw linseed oil which you use must have mixed with it about one part of paint driers. If you omit the driers, the paint will dry very slowly.

For a white pigment you can use white lead, zinc oxide, barytes (blanche fixe) or titanium white, and the pigment which you select can be "extended" or diluted by admixture of up to half its volume of whiting. The ingredients of the above formula are all mixed very thoroughly together, the pigment being quite dry before mixing. The resulting paint (which should be of ordinary paint consistency) is then brushed on to the surface. It should dry within 30 hours. Two thin coats should be sufficient. It will resist water and will not rub off.

If you want a cheaper water-paint, dissolve 10 parts of glue in 90 parts of hot water. Then, using this solution, make a cream with whiting. Use this for painting, as you would ordinary whitewash. This will form a sort of distemper which will not rub off, but which will not withstand water. Do not add any blue to the paint. It tends to give the whiting a dirty grey cast.

Fixative for Colour Drawings

IS there a method of fixing or preserving the surface of a finished "pastel painting"—say, by spraying or some such method—to prevent the picture being smudged and spoilt, yet have a flat, glossless surface which will not reflect unwanted lights ?—R. A. Smith (Bristol).

FIXATIVE liquids for spraying on to pencil, pastel and watercolour drawings are made by most firms of artists' materials manufacturers, and may be obtained from any retail dealer in these products.

You can make such a fixative liquid by dissolving four parts of gelatine in 96 parts of hot water. This liquid, when sprayed on to the paper surface, will effectively "seal" the pastel painting or drawing, and will not produce a glossy surface. Increased "sealing"-power of the liquid can be obtained by making the gelatine solution stronger, but in this instance there is some risk of the paper acquiring a semi-matt finish.

Instead of gelatine, you may use a solution of five parts of polyvinyl acetate resin in 95 parts of isopropyl acetate, but, in our opinion, the gelatine solution is as good as any other. Please note that if the gelatine solution is to be retained in good condition for more than a week, it must have a few drops of clove oil or other antiseptic added to it, otherwise it will go mouldy and will become acidic.

In giving this information, we feel bound to say that many artists consider that fixatives have the effect of

robbing a picture of a certain amount of its beauty and brilliance in that the highlights and the whites look dull afterwards. This is certainly true if the fixative solution is too strong, but with a weak solution we do not think that such would be the case.

Stripping Cellulose from Car Bodywork

CAN you inform me if there is any rapid method of stripping cellulose from car bodywork preparatory to re-spraying ?

I have tried one brand of chemical remover, but this is not very effective, and great difficulty is experienced in neutralising it before re-spraying.—W. H. Timperley (Derby).

THE reason why you found the chemical paint-stripper unsatisfactory for dealing with your car bodywork is that these strippers usually contain wax to retard evaporation of the solvents. Hence, after stripping, the car bodywork would have a film of wax adhering to it. You could remove this wax film by going over the bodywork with a cloth charged with benzole, after which we think that you would find the surface quite suitable for re-spraying.

If, however, you elect not to use a proprietary paint-stripper, you can remove the cellulose by wiping over it a cloth charged with a mixture of two parts acetone and one part amyl acetate. This may be diluted with about 25 per cent. of its bulk of benzole.

To be of maximum efficiency, the stripping solvents should be "matched" to the exact type of cellulose medium used in the original cellulosing of the body-work. You have, however, no means of knowing this. Hence, the above can only be regarded as an "average" solvent mixture, but we think that you will find it quite satisfactory.

Preventing Colours Fading

I REQUIRE some means for preventing the sun fading articles inside my windows, and wondered if there is any other system than that of the orange Cellophane blind one sees in shop windows.

If no other satisfactory system exists, could you give me the name and address of the suppliers of these Cellophane blinds ?—J. A. Johnson (Penzance).

IF an article is intrinsically fadeable, the only possible way of preventing it from fading is to prevent the actinic rays of the sun from impinging on it. It is, mainly, the ultra-violet, the violet, and, to some extent, the blue components of sunlight which are responsible for the fading of colours. By filtering the sunlight through a yellow or an orange screen, these actinic rays are held back. Consequently, the fading does not take place.

There is no chemical substance with which you could treat the glass of the window or the articles themselves. Hence, the use of some sort of light-filter, such as a yellow or orange screen, is essential.

Any of the following manufacturers of outdoor window and sunblinds should be able to supply your needs :—

Messrs. J. Avery & Co., Ltd., 81, Great Portland Street, London, W.1.

Messrs. John Unite, Ltd., 291, Edgware Road, London, W.2.

Messrs. F. W. Watkins & Sons, Ltd., Sandy Lane, Camp Hill, Birmingham.

Messrs. G. Luffman & Co., Ltd., Colston Yard, Colston Street, Bristol.

If you merely want the coloured Cellophane material itself, send your inquiry to Cellophane, Ltd., Bridgwater, Somerset.

You can obtain coloured "Perspex" sheet, which perhaps you might find more durable, from Messrs. R. Denny, 15, Netherwood Road, London, W.14.

Varnishes for Field Coils

I WISH to make some insulating varnish suitable for impregnating the field coils of small electric motors, and have been advised that shellac is unsuitable due to possible acidity. Could this acidity be removed, or, alternatively, could you give me the formula for another suitable varnish, using cellulose or some bitumen compound ?—H. W. O'Connor (Dublin).

THE acidity of ordinary shellac is usually very slight, and even a single coating of ordinary shellac varnish will not break down under 450 volts potential. Any possible acidity in organic varnishes will not affect any wires which are thicker than 0.02 in. diameter, and even in the case of smaller wires than this the corrosive action seems to cease as soon as the varnish becomes dry.

The drawbacks to shellac varnishes are (a) that they tend to absorb moisture, (b) that they are brittle. Brittleness can be decreased to a large extent by mixing in a few drops of castor oil per tablespoonful of the varnish.

Linseed oil varnishes are good, but only the surface dries rapidly. The inner layers remain semi-dry for a very long time afterwards.

Bitumen varnishes are excellent as regards moisture resistance, but they tend to soften at raised temperatures. You can, however, make such a varnish by dissolving a mixture of 3 parts Gilsonite and 1 part of medium soft asphaltum in naphtha to the consistency required. This will have a maximum flexibility.

The bakelite varnishes are very good. You can obtain these from Messrs. Smith & Walton, Ltd., Haltwhistle, Northumberland, or perhaps you may be able to obtain particulars of the special impregnating varnishes direct from Bakelite, Ltd., 18, Grosvenor Gardens, London, S.W.1.

It is essential to ensure that the windings are perfectly dry before applying any type of varnish, otherwise the insulation may tend to break down owing to ionisation caused by the entrapped moisture. A good type of cellulose varnish is made by dissolving scrap film in a mixture of equal parts of acetone and amyl acetate. The solution is attained by shaking the ingredients in a bottle until the right consistency is obtained. The solution should be plasticised by the addition of a teaspoonful of castor oil per pint of the varnish.

Hot-water System

FOR economical reasons I have to install my own hot-water system. Your comments on the enclosed diagram would be greatly appreciated. In particular I would like to know if the pipe sizes are correct, the effect of varying size cold-water tanks, i.e., 30, 40 or 60 gallons, and the causes and cure of airlocks.

The cold tank is in the loft, hot tank, bath and basin on the first floor, and boiler, gas copper and sink on the ground floor.—A. Green (Walthamstow).

YOUR hot-water system layout is quite correct. The pipe sizes are quite satisfactory, and there is no effect on the efficiency of the system of a cold-water tank. Provided that the capacity of the tank is sufficient to fulfil the immediate demands of the hot tank and of the direct cold water demands which may be made on it at any given moment, the working of the system as a whole will not be influenced. In modern times, there has always been a tendency to install smaller sizes of cold tanks in preference to the 60 or more gallon lead-lined, wood-cased tanks which were formerly common.

In your area, keep the pipes as large a bore as possible

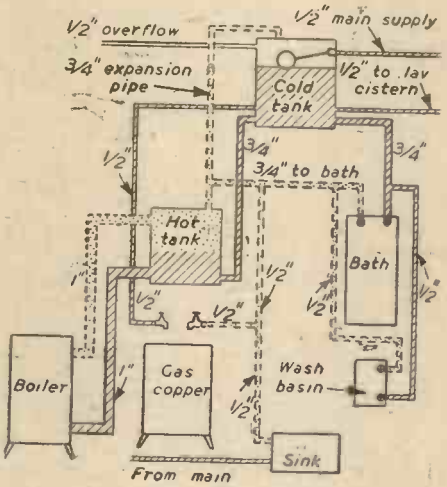


Diagram of a hot-water system (A. Green).

in order to minimise troubles arising from furring and deposition. This precaution would not be necessary in a soft-water district.

To discourage airlocks, make all the pipe rises as gentle as possible. This does not mean that you should eschew vertical pipes, but always, whenever possible, do not have a horizontal pipe suddenly turning into a vertical one. Make the approach to the vertical pipe as gradual as possible. When you have a straight horizontal pipe, make it gradually rise, or gradually descend, or else perfectly straight. Do not adopt the switchback principle. Eliminate sharp loops, bends, or any other formation which will prevent the free flow of water, for it is at such areas (in the hot pipes) that gases collect, furring becomes greater, and pressure differences occur. Such careful construction will eliminate airlocks. If, in an existing installation, you are troubled by airlocks, search systematically for such causes and, having located them, put them right so far as you possibly can by giving a better run or local curvature to the pipe in question.

A useful book for you to study would be: "Standard Plumbing Details for Architects, Engineers, Plumbers and Students," by L. Way.

Quick-setting "Putty" for Aquariums

CAN you supply me with the formula for making a quick-setting cement for glazing aquarium steel frames (painted) ? I understand there is a kind of bitumen putty for this purpose which is used by aquarium makers.

As I am likely to be glazing a large number of aquarium frames it would be necessary for me to get this putty or cement in relatively bigger quantities than is usually sold on the market in tubes or tins.—W. G. McKendry (Glasgow).

THE quick-setting "putty" to which you refer is black in colour, although when pigmented with iron oxide it is brick-red.

It is made by dissolving bitumen in any volatile organic liquid and then by absorbing the resulting solution into whiting.

A mixture of acetone (2 vols.) and amyl acetate (1 vol.) is a suitable solvent mixture, although a very light petroleum oil (such as a high-grade petrol) also makes a good solvent. About 30 parts of bitumen are dissolved (by shaking) in 70 parts of solvent. The bitumen used should not be too hard. That which is described as "65 penetration bitumen" (obtainable from any firm of asphalters) is about the best because it adheres well.

The putty is made by working together into a thick mass about 70 parts of common dry whiting (the whiting must be dry) and 30 parts of a medium thick bitumen solution prepared as above. The preparation is a very messy task when done on a small scale. Furthermore, it must be done very quickly, owing to the volatility of the bitumen solvents. The product must be stored in tubes or else in tins with tightly-fitting lids. In the latter containers it will not keep for very long without going hard. Note that tar and/or bitumen-tar mixture must not be used. Tar usually contains very poisonous constituents which would be fatal to all aquarium life. Bitumen, on the other hand, is quite innocuous.

Painting Asbestos Sheets

I WISH to paint some newly-erected asbestos sheets. I have been told that ordinary paint will not do. Is any pre-treatment necessary, or can a special paint be bought ? The job is indoors.—T. E. B. Wardle (Sark, Channel Islands).

WE presume that your asbestos sheets are of the hard asbestos-cement variety. These have an alkaline reaction, and the alkali tends to saponify the oil of the paint, thus bringing about the deterioration of the latter. The best treatment is first of all to brush on to the asbestos sheets a 10 per cent. solution of glue, the solution being used hot. When this has dried off, give the sheets a thin coat of any priming paint—white lead, red lead or grey priming paint. Over this apply a thin coat of aluminium paint. Finally, apply one or two coats of the finishing paint of your choice. For this purpose a cellulose paint or enamel is rather better than an oil paint for indoor use. So far as we are aware, there are no paints formulated specially for asbestos sheet work. Any good quality paint can be used for the above purpose, but the paint must be of really good quality.

Producing Nitrogen from Air

I UNDERSTAND there is a "Brinn's process" for the extraction of oxygen from the air. Could this method be used to supply a reasonable amount of nitrogen quickly in a small apparatus ? If so, would you tell me : What kind of apparatus is needed or what book describes it ? Is barium oxide (baryta) easily obtained, and where can it be bought ? Would nitrogen combine readily in the presence of fire or heat with other substances and produce another poisonous or explosive material ?—A. Littlejohns (Cobham).

BARIUM oxide is readily obtainable from any chemical supply firm, such as Messrs. Vicsons, Ltd., 148, Pinner Road, Harrow, Middlesex. It is not poisonous, nor is it in any way dangerous to handle. It is produced in the form of a white powder. In the Brinn's process it will last quite indefinitely and will not need renewing.

The Brinn process, however, is quite unsuitable for the production of nitrogen. Even for the manufacture of oxygen, for which it was originally designed, it is now obsolete. It is unsuited even for the small scale production of oxygen, because it merely removes a portion of the oxygen from the air and leaves some oxygen still remaining in the residual air, as well as carbon dioxide and other gases ; the use of this process would not produce even an approximately pure nitrogen. We do not advise you to consider this process for nitrogen production.

If you wish to produce a fairly pure nitrogen from air, the following is an outline of the method :—

Pass a slow current of air through a wash bottle containing a solution of sodium hydroxide (caustic soda) to remove carbon dioxide, and then through a wash bottle containing strong sulphuric acid to remove moisture from the air. The air is then passed through a 2ft. or 3ft. long glass or porcelain tube containing copper turnings. The tube is heated to red heat. The heated copper combines with the oxygen of the air to form copper oxide, and the removal of the oxygen from the air is complete, provided that the tube is long enough (2ft. minimum) and that the current of air is not fast.

The gas issuing from the tube will now be "atmospheric nitrogen." It will contain about 99 per cent. of pure nitrogen—the remainder being chiefly argon, with traces of other inert gases, such as krypton, neon, xenon.

You will usually find detailed illustrations of this method in any textbook of inorganic chemistry, as, for example, in J. W. Mellor's "Modern Inorganic Chemistry" (Longmans, Green & Co.).

Gaseous nitrogen is extremely inert. It does not, as a rule, combine with anything, even at red heat. Hence, in experiments with gaseous nitrogen there is no danger of explosion, or of the production of poisonous materials.

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Comments of the Month

By F. J. C.

The C.T.C. and Motorised Bicycles

IN view of the attitude of the C.T.C. towards motor-*assisted* bicycles, what is to happen to the hundreds of members of this club who own them? According to the C.T.C. they are motor-cyclists, and the fact that the machine is capable of human propulsion does not discourage them from labelling it as a motor-cycle.

They further argue that no one institution could defend a cyclist and a motor-cyclist involved in a collision if they were both members of the C.T.C. *Then what would happen if two cyclists, members of the C.T.C., were in collision and each sought the aid of the "legal department" of the C.T.C.? It could not defend both, especially if a case against one of them was brought by the police.*

Incidentally, we should like to know a little more about the Legal Department of the C.T.C. What is the name of its resident lawyer? How many cases does it investigate each year? In how many does it succeed? In how many does it fail? In how many does it take no action because investigation shows that its members are to blame? C.T.C. members glibly talk about "licensed libertines" (a phrase which caused us to rebuke a contemporary and its contributor) and "murderers," and write of the "callous and immoral attitude of motorists," and an answer to these questions would enable us to judge whether they are entitled to presume that the motorist is always wrong, and the cyclist is always right. Investigation of road accidents by impartial bodies, including the police, has shown that most accidents are due to carelessness on the part of pedestrians, cyclists and motorists. The C.T.C. has no right, therefore, to presume that cyclists are any more careful as road users than pedestrians or motorists, and as there are more cyclists than motorists there must be more careless cyclists than motorists. We also notice that the secretary of the C.T.C. has not answered our very pertinent question asking him to name the statute which says: "It is not merely common sense but the law of the land that the protection of cyclists cannot be combined with an interest in the welfare of motorists." As the C.T.C. has a legal department, which presumably approved the above remark which was published in a contemporary, it should not have been difficult for him to locate the statute! But then perhaps the secretary of the C.T.C. takes a safe line of refusing to be drawn; for he knows that he could not name such a statute, and that his argument is pure bunkum. The C.T.C. is so blinded by hate that it has developed a vocabulary of splenetic words which it trots out in furtherance of its self-appointed campaign of "fighting for cyclists' rights."

The C.T.C. should at once call for the resignation of every one of its members who owns a motor-assisted bicycle and refund a proportion of the subscription. *What attitude would the C.T.C. take if one of its members was pedalling a motor-assisted bicycle and become involved in a collision?* C.T.C. members, wielding their Excalibur of opprobrious terms, have become, as we have pointed out elsewhere, a gang of peripatetic George a'Green gangrels perpetually drawing attention to road accidents and the dangers of cycling instead of doing what it is paid to do, namely, encourage cycle touring—or is that its object? As we pointed out last month, the C.T.C. does not seem to know what purpose it is supposed to serve, for its secretary has also stated that *the chief object of the club is not to promote touring but to protect cyclists.* We should have thought that it was in the best interests of the club to confine its activities to drawing attention to the undoubted pleasures of cycle touring instead of to the dangers of it. It gleefully announces to the world at large the results of any case in which it has obtained damages for one of its members. We hear nothing of the cases it loses, or the cases it does not bring. By its irresponsible and reckless language the C.T.C. has shown itself to be a body incompetent to represent cyclists, and its latest boneless-wonder gyrations on the subject of motor-assisted bicycles show the measure of its incompetence. When did the C.T.C. conduct an independent investigation into the causes of road accidents which enables it to draw the conclusion that everyone is out of step except C.T.C. Little Willie? Its attacks on magistrates and coroners are largely based on information supplied from press cuttings which, being abbreviated, omit vital evidence.

Once again we appeal to the C.T.C. to purge the Augean Stable and to confine its attention to enhancing the hobby of cycle touring. By so doing it might increase its membership, instead of so frightening parents that they decline to buy their children bicycles. It might also command the respect of the industry, which is by no means solidly behind it, as we have reason to know. When is this National Committee going to issue a statement disclosing its attitude towards motorised bicycles?

A Bicycle is a Carriage.

SINCE the case of Corkery v. Carpenter was decided by the Divisional Court in July, 1950, doubts expressed by text-book writers are removed. It will be remembered that this case concerned a case of being drunk in charge of a carriage, the carriage in this case being a bicycle. So far as the Licensing Act, 1872, is concerned, a bicycle *is* a carriage. It declares that "Every person who is drunk while in charge on any highway of any carriage commits an offence," and the court has interpreted "carriage" as including a bicycle.

Lord Chief Justice Goddard said in the case quoted: "Since the object of the section is the protection of the public and the preservation of public order, the word carriage in it can include any sort of vehicle, certainly a vehicle capable of carrying a person. A bicycle is a carriage because it carries. A drunken man in charge of a bicycle on the highway is dangerous whether he is riding the bicycle or pushing it. If he is pushing he has not proper control over it and can push it into anybody or cause vehicles to swerve, and he is a danger to himself."

Lord Chief Justice Goddard need not have gone to such lengths to argue the point, because the bicycle and tricycle became carriages and entitled to all the privileges of vehicles on the public highway by virtue of a clause in the Local Government Act of 1888—the Cyclists' Charter.

The GEORGE at HUNTINGDON

The famous North Road coaching inn, with its fine galleried courtyard.

Paragrams

Castleton, Derbyshire. The great Keep of the Peak Castle dating from 1176. Mam Tor, 1700 ft. dominates this ancient village, famous for its remarkable caves.

Ninety-seven Years Young

JOHN THOMAS, of Immingham, North Lincs, is 97, but he is still a cyclist, although he does not ride as hard or as far as he did when he first learnt to cycle as a lad of 70. At a time when the average man has been retired for some years, young John bought himself a bicycle so that he could ride a total of 22 miles a day to and from his work. He can't do it now, but he can manage a few short trips now and again. The other day he kicked off at a local football match, but he really doesn't have much time to spare for sport as he is "too busy in the garden these days."

Nine-speed Cycle

THE ordinary three-speed cycle can now have nine speeds by the attachment of a special gear kit produced by an American firm, which is of the derailleur type. The single sprocket on the three-speed hub is removed and replaced by a triple-sprocket assembly, and a second gear change lever is mounted on the crossbar. The two levers are operated in conjunction to provide any gear required for any gradient. One would imagine, however, that for a time the rider has to think very carefully before he changes gear, and would often find his machine in a gear which was a complete surprise to him!

Mechanised Pied Piper

BECAUSE the so-charmingly-named "rodent operative" employed by Rushden (Northants) Urban District Council is finding it difficult to fit in all his clients, the council is to mechanise him. He is to be supplied with a tradesman's cycle, with a capacious box in which to carry his traps and poison, or maybe his lunch. So long as the local children don't think the rat catcher is the "Stop Me and Buy One" man, everyone looks like being quite satisfied—with the possible exception of the rats.

The Two White Lines

"I DO not think there are many people who know that," commented a member of Towcester (Northants) Road Safety Committee when the police superintendent explained that when two white lines on the road, denoting three traffic lanes, converged into one single continuous line, it means that it is unwise to overtake until the two lines re-appear again. Several members of the committee said they had never heard of this fact and they suggested that there should be more publicity about it.

Leicester Speedway President

COUNCILLOR HARRY BOWERMAN, father of Alec Bowerman, a former Leicester Speedway motor-cyclist, has accepted the invitation from members of the Leicester Cycle Speedway Association to become their president. Councillor Bowerman is a keen all-round sportsman, having for 35 years been a judge for the Leicester Amateur Athletic Association, of which he is now vice-president, and he says that if he can do anything to help the young riders by becoming their president he is very pleased to do so.

Diesel-driven Cycles

A GERMAN engineering company, the Lohmann Company, of Bielefeld, has turned to the production of a lightweight Diesel engine for attachment to bicycles, as a change from the more usual petrol engine. Weighing 11lb., the engine runs on anything from heavy fuel oil to paraffin, and on one filling of the ¼ gallon tank can travel 100 miles. The engine simply clamps below the bottom bracket of the cycle and a friction roller drives the rear wheel. It is only .6 h.p. but it is claimed that it gives a speed up to 12 m.p.h. without difficulty and can take any normal hill without showing signs of strain.

A Dual-purpose Cycle

A BRIGHT inventor has thought up a new type of cycle which can be taken in half. The front wheel is removed, complete with forks, handlebars and half the frame, and the rear half of the cycle is then attached to a two-wheeled box carrier, which can be used for carrying anything from the baby to the week's groceries or a sack of coal. A swivel coupling between the back part of the cycle and the truck enables the truck to be steered in the ordinary way.

Too Narrow After 600 Years

HUNTINGDONSHIRE County Surveyor has been instructed to prepare a scheme for the widening of the 600-year-old bridge standing on the main road between Huntingdon and Godmanchester. The old bridge is scheduled as an ancient monument, and although the roadway is to be widened to 18ft. with 6ft. footpaths on either side, the present design of the bridge will be retained. The bridge was finished in the year 1332, and, no doubt, there were a few harsh words spoken about the foreman in charge of the job, for while the bridge was being built from both ends simultaneously someone slipped up and the two ends did not meet properly in the middle, which resulted in the roadway having a permanent kink in it.

Pedal-driven "Water-cycle"

WITH an eye to combining the pleasures of cycling and bathing, an inventor has built himself a "water-cycle" upon which the rider lies at full length and pedals with his hands. Two aluminium pontoons, about 8ft. long, are connected together by stays and support the pedals and the mechanism through which a screw propeller is driven. To stop or reverse, the pedals are simply turned backwards. The whole machine weighs only 50lb. Lubrication in sea water would, however, appear to be a difficulty.

Televised Cycle Hints

MR. RONALD ENGLISH, of 11, Barrowby Road, Grantham, who took part in a ten-minute talk and television demonstration to help cyclists to enjoy a day's outing, has for many years been a keen cyclist himself, and is cycling contributor to the "Boys' Own Paper," whose editor assisted the producer in preparing the programme. Mr. English showed viewers how to prepare a cycle for a day's trip, what to pack and the quickest and best way of mending a puncture. A Grantham-born man, Mr. English is a postal and telegraph officer at Grantham Head Post Office.

Peterborough Riders Want Track

DURING Regatta Week at Peterborough, local cyclists held their first serious track events, and it is hoped to hold such events each year during Regatta Week. Unfortunately, the city has at present no facilities for training track cyclists, and local riders are urging that some land should be made available for training purposes. It has been suggested that, temporarily, the track used during Regatta Week should be made available for training purposes and that a proper stadium for sporting events should be provided as soon as possible.

Efforts Show Fruit

DURING the last year, since there has been police examination of cycles ridden by Chesterfield schoolchildren, a considerable improvement in the condition of the cycles has been noticeable. Out of 505 machines examined, 247 were in good order, and there were only minor defects in the remainder. Of the 238 cycles examined during the previous period, only 82 were found to be in good order. Five additional schools have recently asked to be added to the list of schools to be visited by the police for cycle checks.

Grimsby Rider's National Record

RIDING in the Kesteven Aces junior 25-mile trial at Grantham, open to riders under 18, 17-year-old Malcolm Paling, of Grimsby Clarion Club, was first with a time of 1 hr. 1 min. 20 secs., setting up a national record.

CYCLORAMA

We greatly regret that H. W. Eley's regular feature "Cyclorama" is unavoidably held over, owing to the recent printing trade dispute.

The Social Three-wheeler with dual control referred to on this page.

Around the Wheelworld

By ICARUS

Fahting for Sahclists' Rahts

I DO not know whether that is the correct pronunciation as used by the more rabid sections of the Northern cycling public, and no doubt I am being very hig, but isn't it time that the C.T.C. and the other bodies ceased talking about accidents and *fahting for sahclists' rahts*, and emphasised the great advantages of cycle touring? Parents are not likely to be encouraged to put a bicycle in their children's Xmas stocking if they are led to believe that cycling is a dangerous pastime. The C.T.C. has broken away from the Royal Society for the Prevention of Accidents because it thinks that the Society favours drivers.

"Propaganda by the Royal Society had encouraged leniency by spreading the idea that victims of accidents are themselves to blame, and that it is not altogether reasonable to expect drivers to accept the responsibility for avoiding accidents," say the C.T.C.

They add: "The consequences of that attitude have now reached the dimensions of a national scandal.

"Vigorous action is called for, and the club hope to collaborate with other like-minded organisations in a campaign to restore safety, law and justice to the roads.

"Such a campaign would be impossible while we remained a member of the Royal Society."

The Society replied:

"The assertion that the society's propaganda aims at victims and not at drivers is wholly inaccurate and made without knowledge of the facts.

"If anyone doubts our impartiality we invite him to visit our H.Q. or our training centre at Hyde Park Corner to see for himself how all-embracing our propaganda is."

Numbering Machines

I AM glad to know that bicycle manufacturers are considering the suggestion from the National Committee on Cycling to have the frame numbers stamped on the lug under the saddle pin. There should be some standard location for this number. It will not, of course, stop the cycle thief from filing it off, but it will enormously aid the police. By the way, Sir Harold Bowden, Bart., has been re-elected president of the National Committee on Cycling; Major H. R. Watling, chairman; Mr. G. Herbert Stancer, vice-chairman; and Mr. Robert Williamson, secretary.

The Next Cycle Show

THE 26th International Bicycle and Motor Cycle Show will be held at Earl's Court in November, 1951. I am glad that they are not following the lead of the radio manufacturers and holding it in Birmingham, which is quite unable to accommodate a large influx of visitors. As a result attendances were poor.

50,000,000 Tyres

IN the five years since the war ended 50,000,000 bicycle tyres have been made at Fort Dunlop, which is proof of the ever-increasing popularity of the modern Giant's Boots.

Registration of Bicycles Going Abroad

H.M. Customs have accepted the special arrangements for effecting overnight registration of bicycles going to the Continent and machines will now be accepted, on Friday evenings only, from 8 to 10 p.m. Owing to the limited number of vans thus far equipped the arrangement will meantime be limited to the Newhaven-Dieppe service.

Cycle Exports

EXPORTS of the bicycle and motor-cycle industries were £15,139,449 for the first half of the year, Mr. H. R. Watling, director of the Manufacturers' Union, told a conference of export managers in Coventry. The total shows an increase of £165,892 over the first half of 1949. Leading buyers of motor-cycles were Australia (£1,217,017), U.S.A. (£520,445), Canada (£357,337), and Switzerland (£300,214); and of bicycles, Pakistan (£875,138), Malaya (£864,944), British West Africa (£735,506), Eire (£507,507), Brazil (£450,647), British East Africa (£417,491), Iran (£399,720), and the Belgian Congo (£304,547).

Mr. Watling, who has just returned from talks with more than 100 trade and Government officials in Canada and U.S.A., took an optimistic view of the future, particularly of the prospects in Canada.

New Philidyne Twin-bulb Dynamo Set

THE De Luxe type L.C., Philidyne twin-bulb dynamo lighting set has just been marketed by Philips Electrical at £1 18s. 6d. It is similar to their G.C. model except that the headlamp is of the twin-bulb type, streamlined and chromium plated. It accommodates a space for a battery for use when the machine is stationary. A two-way switch is incorporated on top of the lamp, each switch being in circuit with the rear lamp. Two 6-volt .5-amp. bulbs are used, while the rear lamp of polished aluminium has the lens prismed internally to serve as both reflector and rear light.

Prof. A. M. Low, cyclist. Our contributor has been a regular cyclist for many years.

Social Three-wheeler

THE photograph on this page shows a tricycle with side-by-side seating for two adults and one child. It is being made by Paris Cycles, of London, N.16. The drive is by three sets of pedals through chain-wheels, chains and rear sprockets to two coaster hubs mounted in two small wheels at the rear. Dual steering is employed. The cost is about £48 10s., not including purchase tax.

Our new Every Cyclist's Pocket Book (7s. 10d. by post), reviewed on page 30, is a veritable cyclist's "bible" of facts, figures, formulae and information on all aspects of cycling. It includes 84 pages of indexed road routes.

Wayside Thoughts

By F. J. URRY

The Veteran Cyclist

THE response to these glorious days of summer makes me delighted to be a cyclist. That simple statement contains a multitude of actions and reactions which manifest themselves almost unconsciously as I go on my way rejoicing. It is glorious to be alive and largely that delight is enshrined in the activity to go silently away from the crowd and once again realise the loveliness of this much inhabited country. Often enough I go lonely, for the younger generation does not always approve of my gentle roaming, although it does not say so very vigorously, but rather persuades me to hurry a little faster ; which I suppose is natural enough, so I am becoming more and more in love with my own company unless I can find a companion near my age and blessed —or otherwise—with my inclinations. Recently I had to go on a business trip to Lampeter of all places, and took rail to Hereford, ate my lunch in the Upper Wye Valley, climbed Plinlimmon Pass, glanced at Devil's Bridge, and rolled quietly over the fierce little hills to Tregaran, where tea (rather late) was very refreshing, and in the evening rode miles on a golden-dusted highway where the laburnums had spilled their bloom, and the bird song was as glad vespers to a departing day. It was a mere incident of a journey with a return by way of Llandovery and Brecon, where I stayed a night, and was home again by 7.30 on the third day. I wish that sort of thing occurred more often, for it would suit me admirably to pretend I was at work and thoroughly enjoy the wandering. I have heard people say that stretch of road from Tregaran to Lampeter is tame, and it most assuredly can be if the mists are low and the scenes thereby limited ; but given the right climatic setting those wide stretches of lowland with the distant encircling mountains have a charm distinctly reminiscent of Ireland's West Coast.

Why Don't You ?

THE fragrance of the hours we spend along the road are beyond the telling. Perhaps they carry a rarer perfume for older riders, as they certainly have more leisure in the travel, more time to linger and make good all those things we missed when young because of the haste and urgency informing our fitness. Why people, and especially older active people, don't ride a bicycle amazes me. It is so ready for use, so informal, and so charged with the potentialities of magic, all of which are lost to the folk who travel with noise. I have no desire to crab anyone else's form of enjoyment, or be critical of the manner and substance of their leisure, for I realise that if we were all cyclists the way of our goings would be rather crowded. Yet here is a pastime for any odd hour of time, an exercise of supreme value, and a movement the silentest on earth. Because the pastime is cheap in comparison with others it is astonishing it is neglected by the people who love value for money. On that rather sordid count, cycling is marvellous, but in its higher values, health and individual satisfaction, it enters into the mystic realm of things that are beyond price. Or so it seems to me, a veteran who has been riding for over sixty years, and is still enamoured with the game, still as thrilled at the prospect of a tour or a week-end, and still as confident such experiences will bring to him the full flavour of its delight. I am aware these are old thoughts on the subject, but in this sunshine of summer days they are as bright, brighter indeed because of all the polishing of years, as they were when first I went tripping along A5 and saw the pinnacle of the Brieddens arising above the Severn flood. I go more slowly than was once the case for obvious reasons, but that I go more gaily I am certain, and always I feel as the miles slip by and the hills draw near that the best is still to come.

The Magic Works

THERE is so much in this game of cycling that is un-premeditated as it were, and that is part of the quality making it so tempting to the fairly fit man with a countryside to fill his eyes with pleasure. The idle hours —good for us all if they are not too frequently indulged—need be but little less if they spend them aboard a bicycle, strolling rather than with the deliberate attempt at riding, through the glory of the lanes during spring and early summer—or at any other time as far as that goes. It happened to me one evening after tea ; I wanted to do something but not very strenuously, that restlessness which an armchair attitude on the lawn or in a car would not cure. So I took my bicycle up the road, intending to travel a very short distance in a very long time, satisfied the exercise and change would dismiss the doldrums and bring me home gaily. In the ultimate I rode nearly thirty miles, led quietly on by the ever-changing beauty of the devious lanes. I think it must have happened I was almost unconscious of the riding amidst the turns and twists of the Warwickshire lanes I have known so long, until finally it became urgent to make tracks before the late evening caught me lampless, and that journey into the eye of the sunset was the culmination of a very happy interlude. And on the way home the thought struck me that if sunsets only occured once or twice in a lifetime how marvellous we should deem them, and how genuine would be the appreciation of their beauty. The crimson light flooded the land over which I quietly rode and few people, if any, seemed to notice the metamorphosis in the mystic ending of another day. These are the things that connote the pleasures of cycling ; they are ever with us if we will let them be and their variance and emotions are innumerable.

Why Wonder ?

A FRIEND of mine connected with the industry expressed surprise to me on a recent occasion that the modern cyclist is prepared to buy at top prices for the right article. He had just marketed a certain product, more as a matter of prestige and reputation than on strict commercial lines, and had joyfully discovered the call for it among the knowledgeable people had made his factory exceedingly busy, and at the moment unable to meet the demand. Why is it that the heads of the industry imagine all riders are seeking the cheapest means of travel, have no pride in their possessions, and prefer the cheapest to the best ? I think the answer is to be found in the fact that all too few of them are cyclists, coupled with the idea that no one would ride a bicycle if they could possibly afford a car. Thank goodness I know dozens of fellows who perforce have to use a car in pursuit of business, but are good cyclists whenever the chance of indulgence comes their way. Personally, I am always glad when things happen to prove "the impecunious cyclist," broadly applied to all of us, is a misnomer, and would, I think, often be nearer the mark if the dejected adjective was presented to some motorists, judged by the condition of their vehicles. Some of us, as cyclists, may be poor and simple, but, believe me, we know a good thing when we see it, and if we can stand the price we buy it.

Good Machinery

DURING the last few weeks I have been riding a "Silverthan" machine made by the Thanet Co. (L. Cassell, of Bristol), the bicycle with the bottom bracket held in the jointure of the down tube and seat tube, with the chain stays running underneath it and extended to the forward end of the bracket. It is a very good bicycle, slick, comfortable and lively ; in fact, as good as any machine I possess, and better than some. I ordered it in October and got delivery in June, which suggests a busy demand for this expensive machine. It is, of course, equipped for an old rider, with 1¾in. tyres, a big Brooks saddle and a four-speed Cyclo with twist grip change giving me approximately 40in., 50in., 60in. and 70in., quite enough for my comfort. The twist grip is good, and it is surprising how small is the movement needed to click from gear to gear. What a change from the old days of the derailleur, when the late A. W. Rumney persuaded me to import a gear from France, and when a dealer friend and myself had fitted it to a Dawes machine, we both thought it was the ugliest thing we had seen—but it worked ! Louis Camillis—the managing director of Cyclo Gear, Ltd.—saw it, got my impression on the notion, took up the French agency here, and later started its manufacture, an adventure which has now blossomed into a fine factory turning out excellent gears. That story, however, is by the way, but only goes to show that romance in industry is not yet dead. This combination of bicycle and gears will probably take me thousands of roaming miles before the last colours of autumn fade, and then I shall know more about it ; the first impressions are good, but a thousand miles of travel is too slight a distance to claim my superlatives, and I want to test it against my other possessions. I certainly like the four-change Cyclo.

Shock Absorbers for Bicycles

New System of Damping Out Road Shocks—Important Advance in Bicycle Design

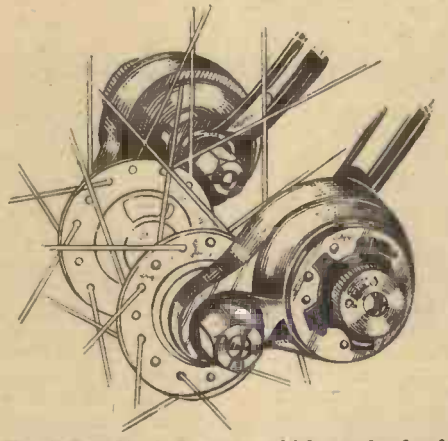
By F. J. CAMM

THE bad roads, the solid tyres, the bad design, the weight and the unwieldiness of bicycles in the early days of the safety, set the minds of many inventors to work on the subject of reducing road shocks to the rider. Many attempts were made to market devices which claimed to do this. There were spring seats, sprung front forks, leaf-spring handlebars, divided wheel spokes with springs between, spring tyres, and even rubber suspension. They all failed for one or more of a variety of reasons. The chief of these was that they did not damp the shock at the point at which it is generated, but transmitted it almost in full to the hands and body of the rider.

To-day we have sprung saddles and rubber handlebar grips as standard equipment, but every cyclist knows that they do not eliminate or damp shock. Rubber handlebar grips help and so do saddle springs, but they are not the complete answer, any more than the sprung cushions of a motor-car would in themselves be sufficient. In the early days of the motor-car, when the latter were made without road springs of any sort, this point was soon realised and so leaf-springs were introduced. This, however, did not completely answer the problem of shockproof driving, because it was found that the springs continued to bounce for some seconds after the road shock had been imparted to them.

It was many years later that the problem was finally solved by means of shock absorbers so called, but which are properly described as shock dampers. These take various forms, but they generally fall into two classes—frictional and hydraulic.

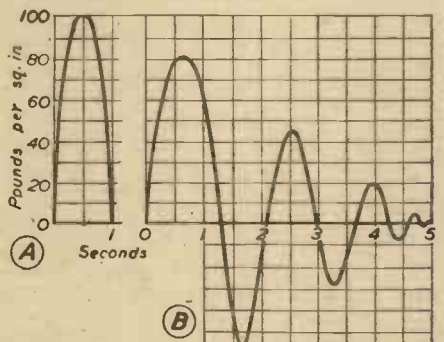
Surprisingly enough until comparatively recently bicycle manufacturers have not taken advantage of the research which has made the motor-car of to-day the comfortable vehicle that it is. Now, however, Palco, of 221, Knightsbridge, London, S.W.7, have marketed the Palco shock absorber at 19/6 per pair for the light weight, and 27/6 per pair for the heavy duty type. Weighing only about 4oz. each, and being adjustable to the rider's weight, they vastly improve the comfort of cycling, especially over rough roads and on long tours. Apart from the comfort to the rider they prevent crystallization of the frame due to shock inertia, they prevent



The Palco Shock Damper, which can be fitted in a few moments to any make of bicycle.

broken spokes, protect the filaments of the bulbs, increase the life of tyres and chains, and enable one to ride more miles with less fatigue.

They are of aircraft-alloy construction; the front and rear absorbers are interchangeable; they may be fitted in a few minutes by an unskilled person; they are noiseless in action, and are suitable for all types of braking. The producers of the Palco shock absorber have been associated with devices for absorbing or rather damping road shocks for many years, and they claim that their device improves the efficiency of the brakes, relieves the stresses imposed upon the bicycle itself, in addition to transforming the bicycle from a jolt transmitter to a comfortable vehicle. I support these claims.



Shock diagrams, showing effect of unsprung bicycle compared with Palco-damped bicycle.

The bicycle fitted with them is more stable on wet roads. Tyres can be inflated to a higher pressure, thus improving their life. They can be fitted to any make of bicycle.

The diagrams on this page show that the wheel is removed from the forks and the shock absorber is fitted in its place. The wheel is then secured to the forward limbs. This slightly increases the wheel base, and this improves steering as well as stability. The other diagram shows what happens when a road shock is received on an unsprung bicycle. It will be observed that the whole shock, sometimes of great intensity, is transmitted to the body in full over a short period of, say, 1 second. With the shock absorbers the initial blow, due to, say, riding into a pothole, is received by the rider at a much lower intensity and it is damped out over a longer period as shown in the right-hand part of the diagram.

It seems such an obvious item of equipment that one wonders why it has not been thought of before. It certainly improves not only riding comfort but the appearance of the bicycle. Four of them only weigh 1lb. One should not have to rely upon special handlebar grips and saddle springs, which receive the road shocks at the wrong point. They should be damped out at their point of generation, namely, between the road and the wheel hub, and this is what the Palco shock absorber so successfully does.

The Palco Shock Damper undergoing a severe test.

My Point of View

By "WAYFARER"

The Impossible Happens

WHEN visiting Warwick recently I observed that the impossible had happened. Two motor vehicles—a coach and a lorry—lingered in close embrace at the intersection of two roads which were provided with automatic signals. These signals were in perfect working order. How, then, did the impossible happen? One supposes that both drivers "took a chance." Of course, one man may not have seen the signals—it does sometimes happen!—in which event he would be to blame for the collision. Normally, however, it was probably a case of both parties making use of the amber light, which provides a "clearing" period, the man who has just lost the green having the right of way. Possibly, however, in the case under notice (and this very often happens), the other party did not bear in mind the army sergeant's oft-reiterated command: "Wait for it!" I believe that it pays every class of wheeled road-user to implement that injunction.

"Rain: No Play"

THESE words are all too familiar—sadly familiar—to followers of cricket. They have their significance, too, with other leading outdoor pastimes; they have little significance so far as cycling is concerned, for our great game goes forward despite the idiosyncrasies of the climate. A wet day presents a not always unpleasant variant of the pleasures of our game—or is it a fine day that does this? Anyhow, without making a virtue of necessity, we can still enjoy our frolics awheel despite the activities of Jupiter Pluvius. While the cricketer or the tennis player disconsolately surveys a depressing scene from the platform of the pavilion, and while the exponents of certain other pastimes do likewise, the cycling game goes on. Enclosed in his cape (and perhaps his leggings), the cyclist splashes his way forward, unmindful of and indifferent to the sympathy of protected passers-by. It is not all "beer and skittles," but the enthusiast's pleasure in this aspect of his chosen pastime is not simulated. He makes the best of a "bad" job. He settles down to enjoy himself. The rain may ultimately trickle along his spinal-cord (unless he wears a sou'-wester), and he will earn a pair of wet feet for his pains, but in 99 cases out of 100 he will be none the worse for his experience. Nay! that is a negative way of expressing the position. Rather he will be all the better, for, superimposed on the advantages accruing from his exercise, there will be a feeling of satisfaction that he has triumphed over his difficulties and had a jolly good time in spite of the aforesaid J.P.

Recent Reading

MAKING good use of some recent unexpected idle moments, I have been reading two books which appealed strongly to me. In each case there happens to be a slight—very slight—cycling flavour, but the attraction was mainly topographical, with a personal bias in one instance.

I am a great admirer of John Buchan (the first Lord Tweedsmuir), a man of wide interests and almost infinite versatility. If ever a death could be called "untimely," it was his. In a sudden burst of hero worship, I once went out of my way, on a cycle journey, to look at his home, Elsfield Manor, near Oxford, a roadside house, which John loved, opening on to the village street and looking across "some 30 miles of woods and fields to the dim ridges above Stow-on-the-Wold." Here, surely, was inspiration for some of those exciting stories whose scene is laid in the Cotswolds. His sister, Anna Buchan, who normally wrote under the name of "O. Douglas," has given us, in "Unforgettable, Unforgotten," what is at once an autobiography and a biography, which is most readable. But almost my only justification for mentioning the book here is because one village which figures in it rang a bell in my mind. Many childhood holidays were spent at Broughton, near Peebles, the old home of Miss Buchan's mother. Broughton? Surely the name meant something to me? I went off to my maps, and again the bell clanged in my mind, because one July Sunday, now many years ago, I experienced one of my most exacting cycle rides. A friend and I, who had been attending a meeting in Edinburgh, set forth for home. Down came the rain: cold blew the wind—in July, mark you. We had a most difficult journey. A chance lunch at Broughton turned out to be very satisfactory, but my hands were so chilled that it was impossible for me to manipulate a knife and fork. So I remember Broughton—though the place was in no wise to blame for my parlous condition.

The other book of which mention has been made is "Green and Gold," by Mary Hamilton. It was so well reviewed—though, normally, I view book reviewers and their work with the gravest suspicion—that I had no hesitation in buying a copy. It is a very pleasant book to read, and to possess. It is about an Ireland which no longer exists—an Ireland dominated by "the Castle," an Ireland of big houses, well populated and well staffed, with a live hunting and social programme—an Ireland containing a respectful, if possibly serf, tenantry, dependent for everything on "the big house." Here is the Ireland I never knew personally. It was already disappearing when I commenced my long series of cycle tours in the "Island of the Saints," but it is good to read about. This, of course, is not the place to express any views as to the merits, or otherwise, of the Ireland which no longer exists, in so far as those views might cross the boundary of party politics. All I will say, then, is that I was not—and unfortunately not—familiar, in person, with that joyous, careless, happy-go-lucky land, of which "Green and Gold" provides so pleasant a series of pictures.

Good Effort

ALTHOUGH very disinclined to take sides in connection with an industrial dispute, I do feel that the action of the 2,500 French strikers in cycling—or, rather, as my newspaper significantly puts it, "starting to cycle"—38 miles in order to hold a protest meeting is highly commendable. We are told that "many dropped out" (serve 'em right for not keeping fit!), but it is to be hoped that the survivors felt all the better for their (perhaps) unwonted exercise. History does not record how the remnant of the 2,500 fared on the way back home—nor what proportion of them fell by the wayside, no doubt singing the French equivalent of the well-known hymn: "Here we suffer grief and pain."

No Mystery

I WAS reading the other day the report of an inquest on a motor-cyclist and his wife who crashed into the rear of a stationary lorry at night and were killed. "The reason for the crash," stated the coroner, "will remain a mystery." Is there really any mystery about such an accident as this? I do not think so. It may be, of course, that there was no rear light, but, if we are proceeding wisely—and by "we" I mean you as a cyclist, or a motor-cyclist, or the driver of a motor vehicle—and relying on our own headlighting, then this sort of accident ought not to happen. We must look where we are going and refrain from going if we cannot see. We must remember that, in spite of the spate of lighting, there are still unlighted and unlightable objects likely to be encountered on the roads—animals, objects dropped from lorries, fallen trees, etc. And we must bear in mind that rear lights are fickle, and that there have been dozens of instances, especially in the case of lorries, of the red glow going out. Sometimes there is a crash even when the driver is trying to make the thing work again. All my experience cries aloud to me as to the safe way of travelling in the dark. If that way were adopted universally the accident toll would be slashed to bits. Does it not seem worth trying?

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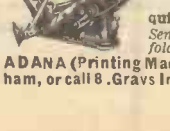

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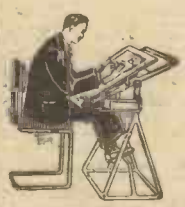

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