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NEWNES PRACTICAL MECHANICS

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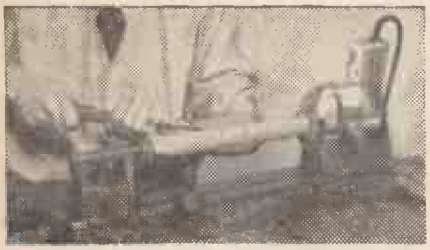
EDITOR: F.J. CAMM

MAY 1955



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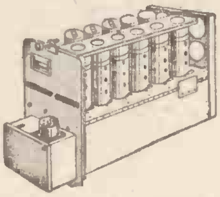

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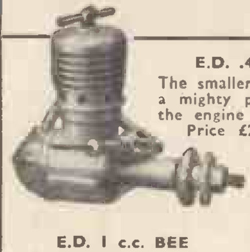

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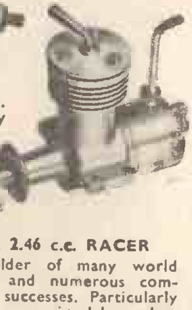

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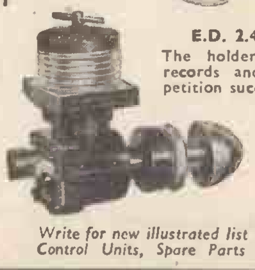

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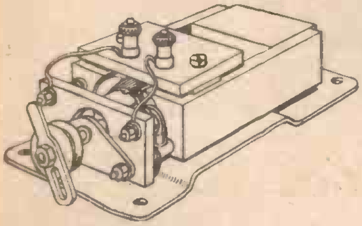

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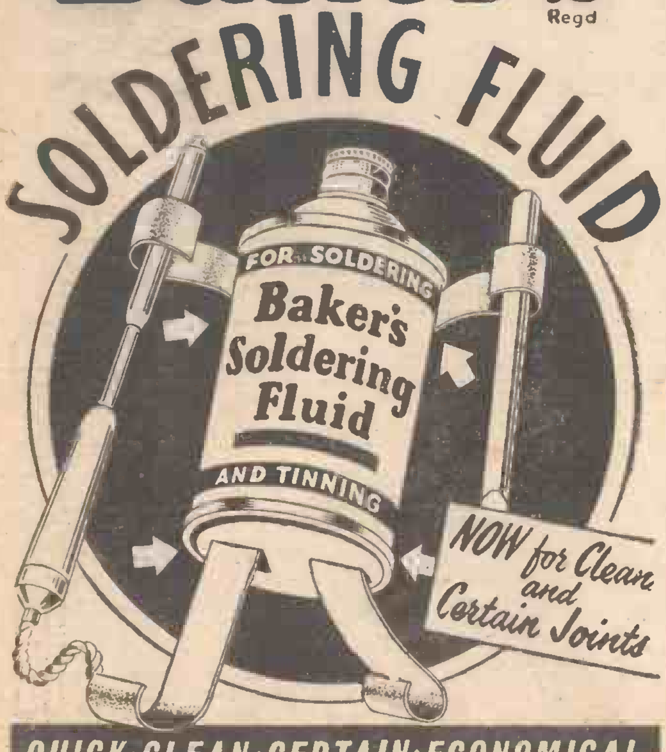

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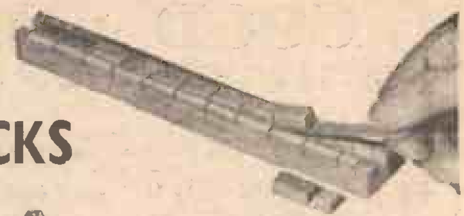

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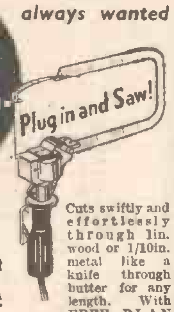

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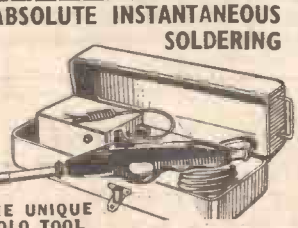

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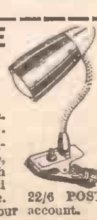

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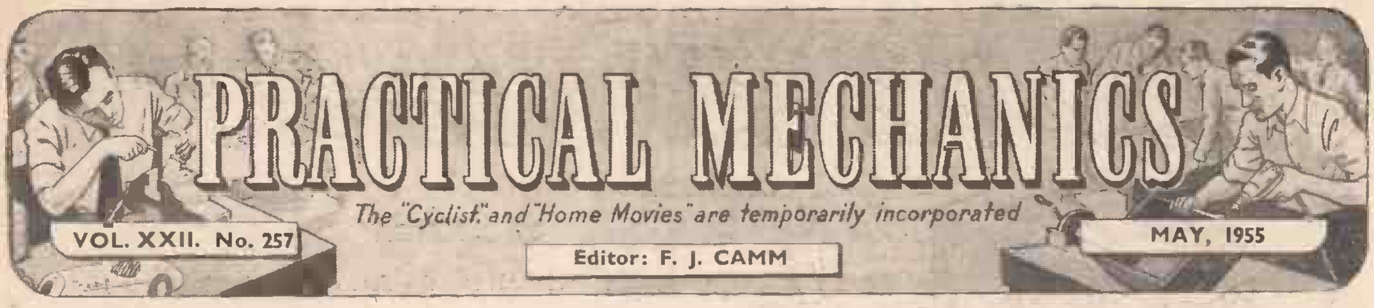

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By
The Editor

The Advance of Craft Interest

UNTIL the advent of the cinema, and to some extent the development of road travel, every man and boy in this country had a practical hobby of some sort. Woodworking predominated, since such does not require a great amount of equipment, but even so larger numbers of people owned lathes, equipped small workshops, and spent their leisure hours watching some creation of their mind come to life, one of the most joyous experiences of the human being. Some made furniture, others models, some built full-size boats, built cameras, or made home equipment.

The counter interests of the cinema and road travel caused a gradual cessation from interest in craftsmanship over the years, and the later introduction of radio and television added to the decline in interest in the practical crafts. It is true that radio and television in themselves created other hobbies. The shortages of labour and materials during the war, however, has caused a return to interest in hobbies which fall under the general heading of "do-it-yourself." In America large numbers of firms now manufacture special tools and parcels of materials and patterns for hundreds of thousands of people who prefer to make, repair and maintain their home and its equipment. The high price of labour coupled with labour shortage is not the only reason why more and more people prefer to do a job themselves; they are finding that it is fascinating and that in many cases a better job results, on the principle that if you want a job done properly you should do it yourself.

That is one reason why this journal, which has not an English competitor, is in greater demand than ever before. PRACTICAL MECHANICS is taken not only for the quality and diversity of its articles, but also for the valuable advice on practical problems which it dispenses through its free advice bureau. That is why its questions and answers pages have always proved such a popular feature of this journal. In its pages are crowded a selection of each month's replies to queries—only a very small selection from the hundreds of letters we answer every week. It is obvious from those queries that there is a reawakening on a vast scale of interest in practical hobbies. The hundreds of new readers who join our ranks issue by issue are reminded of this service, but we would ask them to co-operate with us by being brief and writing queries on different subjects on separate sheets of paper. Do not enclose an order for an index or a book with your queries. They should be sent to the Publishing Department; do not comment on an article and in that same letter ask a query. Experts on various subjects handle the queries within their special fields, and it makes for speed when the queries are written on separate sheets of paper, each containing the name and address of the sender. Don't omit to enclose the query coupon, a crossed 6d. postal order and a stamped and addressed envelope.

Radio Controlled Models

THE advance of interest in radio control was responsible for the formation of the International Radio Control Model Society, which this year will hold its Annual International Contests for radio-controlled models in the North of England, on July 30th, 31st and August 1st. This was found to be necessary owing to the large number of entries last year. The contest for radio-controlled model boats will be spread over the first two days, and it will be held at Saltwell Park, Gateshead-on-Tyne, and will be split into three classes—model boats with any form of power, model yachts, and internal combustion or steam-driven model boats, points being awarded for steering only, with bonus marks for speed.

The radio-controlled model aircraft competition will be held at Croft Aerodrome, near Darlington, on Monday, August 1st, in conjunction with the S.M.A.E. Northern Gala and will split into classes for power-driven aircraft and gliders. In the power-driven class, a separate class, a separate prize will be offered this year for aircraft controlled through a single channel, i.e., not tuned reeds, audio or similar systems. This is planned to encourage those competitors who have not progressed to the more complex systems.

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P.M. and M.C.—First Birthday

THE May issue of our companion monthly journal, *The Practical Motorist and Motor Cyclist*, which in the short space of one year has broken all sales records for motoring periodicals, celebrates its first birthday and to signalise the event a 24-page detachable booklet entitled "The Beginner's Guide to the Motor Car and Motor Cycle" is included with every issue. If you own a motor cycle or motor car, this is the ideal periodical for you. Its contents are entirely devoted to upkeep, overhaul and repair. There are no road tests, no touring articles, no racing reports. For a shilling a month, you can save pounds on repair bills. This journal teaches you also how to run your car economically, and how to tune it up. Like all other journals in our Practical Group, it is backed by a free advisory service. You save money by spending a shilling a month on this important addition to our Practical Group.

This Atomic Age

THE announcement that atomic power generating stations, which will provide atomic energy for peaceful purposes, are to be erected, is an indication that atomic power is passing from the experimental stage to the practical. Atomic power is likely to be costly in its initial stages, but of course it is inevitable. The plan is that atomic energy will eventually provide the major part of our electricity throughout the national grid system. Other problems will arise, of course. Radio-activity is a major concern of the medical profession at the moment. In all new developments snags arise, but scientists nearly always find a solution.—F. J. C.

A FROZEN FOOD Cabinet

Constructional Details of a Small Home Freezer

By C. MONDAY

THE trend towards frozen foods has been very evident in the U.S.A. for some years and is increasing rapidly in this country. Advantages are claimed in flavour and keeping properties of meat, fruits and vegetables over alternative canning and bottling methods.

The purchase of even a small home freezer involves the outlay of a considerable sum of money and yet the work is well within the capabilities of the average handyman. The high cost of the factory product is mainly due to the expensive tools necessary to achieve quantity production and the use of expensive insulation to keep down bulk and weight for transport.

A home-built freezer can be made more simply and fitted into any convenient space, while at the cost of some increase in bulk can be built with cheaper forms of insulation.

General Design

A design for a small freezer is shown in Fig. 1, the internal dimensions giving a storage capacity of about $8\frac{1}{2}$ cubic feet. Greater capacity can be obtained by increasing the sizes, but convenience of access determines the maximum width and depth. It should be possible to reach into the bottom of the storage compartment without excessive stretching or standing on a chair; the weight of a large lid may also be inconvenient. In practice it is not desirable to increase either the width or depth and extra capacity is obtainable by adding to the length.

For the external construction, timber has been chosen for ease of working, although, of course, metal sheeting is used on commercial cabinets and is eminently suitable. The inner line to which the evaporator coil is attached is made from galvanised steel sheet for durability. The external dimensions will depend upon the thickness of the insulation which is to be used.

Insulation

Heat will always flow by conduction, convection or radiation from a point at any given temperature to one at a lower temperature and there is no known substance which will prevent this flow, although insulating materials are used to reduce it as much as possible.

There are many forms of insulation, varying considerably in efficiency and cost. Cork slab or "Onazote" are among the most effective but both are expensive. Regranulated cork is nearly as good and costs less than slab. Fibreglass mats of the type made for ceiling insulation in houses are very efficient and reasonably priced, while various forms of mineral wool for loose filling are available, these also being suitable. Among the less effective insulating materials are wood shavings and wood wool, whose chief merit is cheapness.

Owing to the varying conditions of temperature and the amount and type of food stored, it is difficult to calculate insulation thickness and it is more usual to base the amount upon experience and general practice. A minimum thickness of about 4in. of corkboard, Onazote or Fibreglass mat would be satisfactory, while about 6in. of granulated cork or mineral wool and at least 12in. to 18in. of wood shavings would be necessary.

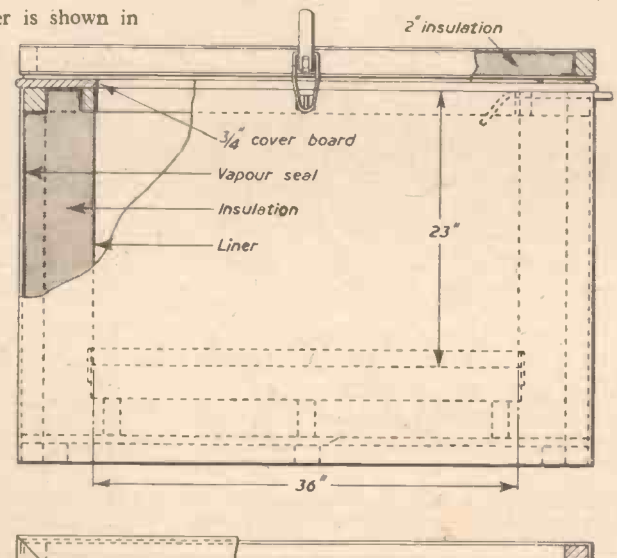
It is desirable, when possible, to increase the amount of insulation beyond these figures, as the contents of the freezer are kept in better condition. The refrigeration plant consequently has less work to do, will last longer and uses less electricity.

Having decided upon insulation thickness, the first constructional step is to make up the base, which is formed from a frame of 4in. x $1\frac{1}{2}$in. with a single $1\frac{1}{2}$in. x $1\frac{1}{2}$in. stiffener, and is covered with $\frac{3}{4}$in. boarding. The four corners are notched 2in. x 2in. in which the uprights can be secured. The construction of the sides and ends is straightforward, the framing being 2in x 2in. with a covering of $\frac{1}{2}$in. waterproof plywood or $\frac{3}{8}$in. tongued and grooved boarding.

Vapour Sealing

At this stage the vapour seal is inserted and this part of the construction is most important if satisfactory results are to be obtained. When the freezer is operating the temperature of the contents will be at about 0 deg. F., while the outside air may be anything up to about 90 deg. F., with high humidity in the summer.. The difference between the external and internal vapour pressures under such conditions may be as much as 28 mm. Hg., quite sufficient to cause an appreciable amount of vapour to be driven into the cabinet insulation. At some point condensation will occur and the insulation will become saturated and its efficiency reduced disastrously. It is essential, therefore, that an effective barrier to moisture penetration is inserted as near as possible to the warm side.

There are several forms of vapour seal, such as bitumen applied hot or various cold-setting compounds, but one of the cheapest is a waterproof paper similar to sisalkraft. Any good heavyweight grade may be selected or two layers of a lighter one used. It must be sealed in place with bitumen and not nailed or otherwise fixed by penetration, and the joints should be overlapped by 2in. No tarry material may be used in either paper or sealing, as otherwise stored foodstuffs become tainted. A special odourless and taintless bitumen is made especially for this type of work. The paper is brought out about 6in. at the top all round to allow for folding over the insulation after the latter is installed. No particular neatness of construction is called for at this stage and odd



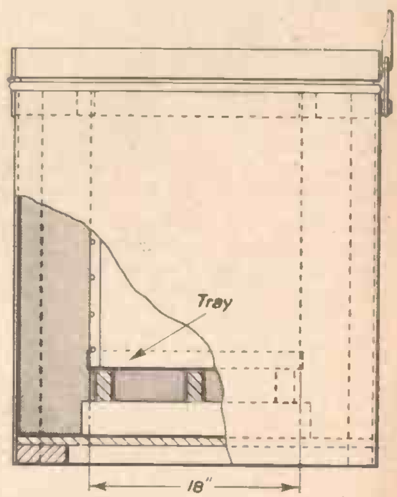
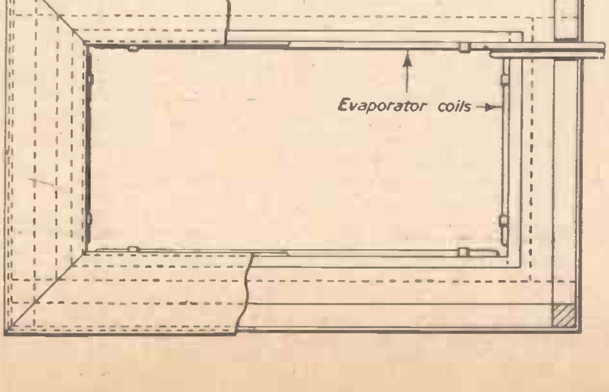


Fig. 1.—Design details of a small freezer.



pieces stuck over tears or at awkward joints are quite permissible.

When the vapour seal is complete the bearers for the liner are fitted. Three transverse members of 3in. by 1½in. are used, with longitudinal pieces of 3in. by 1½in. jointed to them. The assembly is set in the sealing compound to avoid penetrating the vapour seal with nails or screws.

The lower part of the insulation is now introduced. It is filled up to the level of the top of the bearers, packing loose filling material firmly but not tightly. Whatever material is chosen it must be as dry as possible when installed as otherwise condensation and freezing will occur.

The metal tray forming the base of the storage compartment is 2in. deep and made from 22 to 26 s.w.g. galvanised sheet, the corners being overlapped and soldered. It is an easy fit over the inner liner and can be fitted as soon as the bottom insulation is in place. Small plates soldered to the sides allow it to be screwed to the bearers without being pierced for fastenings.

The inner liner is also formed from galvanised sheet 22in. deep, made up into rectangular shape 36in. by 18in., with a soldered seam.

Evaporator

For the evaporator coil, ½in. outside diameter soft copper tube is used, a refrigeration quality being best, as it is dehydrated and sealed after manufacture. The arrangement of the coil is shown in Fig. 2, which depicts the liner and evaporator opened out for clearness. There are seven runs of pipe in the depth of the liner, the centre to centre spacing being 3in., which is a convenient bend for this size of pipe. If any difficulty is experienced in bending, a steel spring made especially for this purpose is obtainable to slip over the pipe at the bend. This effectively prevents kinking and helps to make a neat job.

The end of each lower run of pipe is brought up at a corner of the liner and bent to form the top run of the adjoining wall. As the two ends occur at the rear right-hand corner they are bent up to emerge just below the cover board, as seen in Fig. 1. Copper pipe is supplied in coils of 20ft., and joints may be brazed, the end of one pipe being belled out to take the other. As an alternative, soldered sleeves are available and are perfectly satisfactory. The pipe ends should be kept sealed to exclude moisture, except when joints are being made.

The completed evaporator is mounted inside the liner and secured to it, as shown in Fig. 3, by two shaped supports screwed to each wall. A few ¼in. dia. holes are drilled in the liner between pipe runs to allow the little moisture remaining in the insulation to pass into it.

Fitting the Liner

The trimming at the top of the liner is shown in Fig. 3, an internal trim of waterproof plywood being screwed through the sheet into an external framing of 2in. by 1½in. timber. Waterproof paper is attached to the framing and allowed to project upwards about 6in. This can be nailed in place as the fixings are in a cold zone where moisture will not be present.

A notch about 2in. wide by ¾in. deep is marked and cut in the top of the cabinet frame to admit the two pipes to the evaporator.

The liner is lowered into the cabinet and rests inside the bottom tray. It will be held by the cover board eventually, but one or two temporary supports nailed to the external and internal framing may be used if required. The vapour seal paper must be folded down under these and also under the two ½in. dia. pipes.

When the liner is in place the space between it and the cabinet is filled with insulation. The latter is packed in up to the top and then the two projecting paper sheets are folded over each other to cover it. The notch cut for the evaporator pipes must be sealed with bitumen and loose insulation.

One this is done the cover board is fitted, a mastic compound or cold bitumen adhesive being used between the board and external frame to prevent moisture ingress. It is attached by countersunk screws to the external and liner framing and the cabinet construction is then complete.

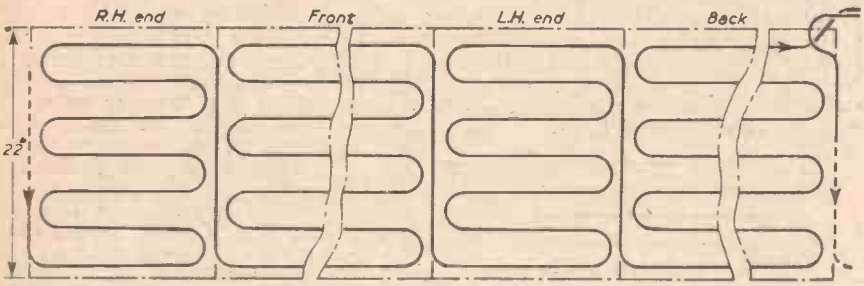


Fig. 2.—The liner and evaporator opened out for clearnesss, showing shape of coil.

Lid

The lid frame is made from 2in. by 1½in. timber. This is faced with waterproof plywood top and bottom, with 2in. of Onazote or Fibreglass insulation inside. Vapour sealing is carried out at the top and sides. A small quantity of good insulation is used so that the unit is not too heavy. The lid should extend to the full dimensions of the cabinet and a soft rubber gasket is nailed to it to form a seal between lid and cover board. A second gasket 2in. or 3in. inside the first is valuable, as a pocket of air, itself a good insulant, is trapped between them.

Two strong galvanised or non-ferrous hinges are screwed to the back, and some form of fastener is fitted to the front. An over-centre clamp of the type shown is desirable as it enables the gaskets to be compressed and so ensure that the air trap is sealed off.

Finishing

The completed freezer cabinet can be sandpapered and then painted with any normal type of paint suitable for woodwork. Most freezers are finished in white or cream, and the use of a light colour does help to reflect heat to a certain extent. No internal painting of the evaporator or liner is desirable.

Refrigerating Plant

The refrigeration plant selected depends upon the size of cabinet and the amount of freezing that is to be done. The refrigeration load consists of three parts: (1) heat ingress through the insulation; (2) heat generated by the stored produce; (3) heat to be removed from produce for freezing. The first and last of these are the heaviest.

Heat ingress cannot be prevented and the flow is determined by the formula Q = UA by Td., where Q = heat transfer in B.Th.U/hr., U = coefficient of transmittance, A = external surface area in sq. ft., and Td = difference in temperature between outer air and air in freezer in deg. F.

The term U comprises a number of different factors, but sufficient accuracy for practical purposes can be obtained by ignoring all but the one relating to the insulation. The formula can then be simplified to $Q = \frac{kA}{t}$ by Td, where k = resistance coefficient of the insulation, and t = thickness in inches.

For cork, Onazote, Fibreglass, and mineral wool a k of 0.3 to 0.35 is sufficiently accurate and the heat flow can then be calculated as the other factors are known.

The freezing load depends entirely upon the type and quantity of produce that it is desired to freeze at one time. To reduce a package of food from room temperature to 0 deg. F., sensible heat between 0.25 and 0.6 B.Th.U. per pound (specific heat) per deg. F. must be removed until it cools to 32 deg. F. At this temperature the latent heat of fusion, amounting to between 35 and 120 B.Th.U. per pound must be removed, after which further cooling at approximately the previous specific heat occurs from 32 deg. F. to 0 deg. F. The figures for most foodstuffs fall within the range given, those with the largest water content having the highest specific and latent heats.

It is not practicable to construct a home built or commercial freezer which can be fully loaded with produce to be frozen in bulk. The plant required would be out of all proportion to the size of cabinet. A compromise is thereby made so that the plant is adequate to keep the produce down to temperature, operating under loads (1) and (2) above, by running about 12 to 15 hours a day according to conditions, leaving some additional capacity for freezing. Manufacturers supply B.Th.U. extraction rates for their units based upon standardised temperature conditions and these can be obtained upon request.

For normal service a freezer with 8-10 cu. ft. capacity would need a refrigeration unit of about 1/5 to ¼ h.p.; a cabinet of 15-30 cu. ft. about ¼ to ⅓ h.p. and larger ones approximately ½ h.p.

Working Principles

Refrigerating units comprise an electric

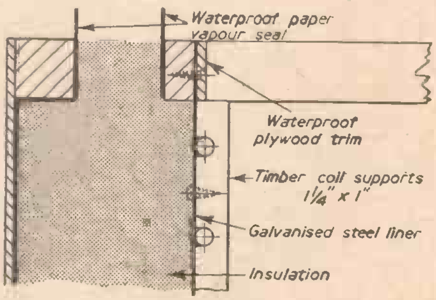


Fig. 3.—A section through wall of cabinet showing method of attaching evaporator coil.

motor, a compressor, condenser, and liquid receiver. The motor and compressor may be separate units, linked by a vee belt or combined to form a sealed unit. Servicing of the former is simple but the main disadvantage is the presence of a shaft seal to make a gas-tight joint where the drive shaft emerges and this sometimes gives trouble after much running. The sealed unit has no such gland but any service work usually entails a return to the maker.

The function of the condenser is to remove the heat from the refrigerant gas leaving the compressor and cause it to condense and pass to the liquid receiver where it collects before recirculating in the system. Practically all condensers for this type of service are air-cooled, as the additional complication of water cooling is not necessary.

The unit may be mounted at any suitable place within about 15ft. of the freezer, the only connections required being two copper pipes to the evaporator coil. It should be away from any major source of heat and the condenser must have an adequate supply of cool air to work properly.

An expansion valve is inserted in the pipe line from the liquid receiver to the evaporator while the return or suction pipe goes direct to the compressor. The function of the expansion valve is to meter the liquid refrigerant through a small orifice and to create a pressure drop in the evaporator. This causes the liquid in droplet form to boil at low temperature and thereby absorb heat from its surroundings, in this case the inside of the freezer. A thermostatic type is best for this application as the refrigerant flow is automatically adjusted to suit the load. In nearly all small household plants the refrigerant used is Freon 12 or Arcton 6.

There is nothing very complicated in the refrigeration circuit shown diagrammatically in Fig. 4 or in the connection, charging and operation of the plant. The difficulty for the amateur is that a good deal of expensive and specialised equipment in the form of high-pressure cylinders, gauges and tools is necessary. If this is not available it is better to entrust the work to a refrigeration service engineer. Many small firms would be willing to do this and also supply the unit, expansion valve and other items. The connection and charging of a plant of this size is only the work of an hour or two.

Air, moisture and dirt must be kept from the system. Air is non-condensable at the temperatures and pressures encountered in the refrigeration circuit, and the presence of a small quantity will cause unnecessarily high pressure in the compressor, although the plant will still work at reduced efficiency. Moisture is carried round the system and eventually freezes at the expansion valve causing a blockage. Dirt will also lodge in the expansion valve or other restriction. If a service engineer is employed to connect up the plant the only precaution necessary for the constructor is to see that the evaporator coil is clean and dry internally.

A thermostat should be provided which is set to switch on the unit at about +3 deg. F. and off at −3 deg. F., which should ensure

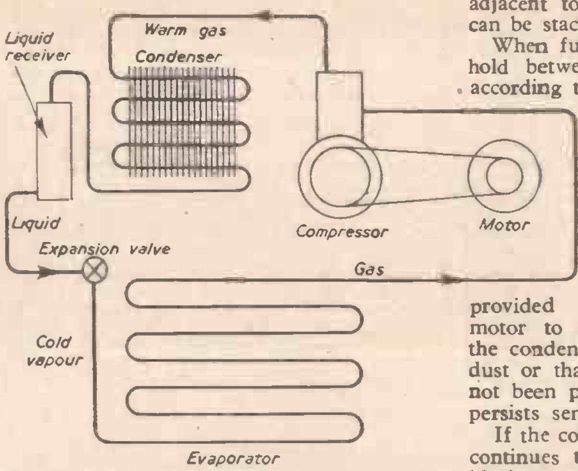


Fig. 4.—A simple refrigeration circuit shown in diagrammatic form.

reasonable operating cycles. The thermostat is attached to the outside of the freezer and the phial protrudes through into the storage space. Proper sealing of the opening to exclude moisture is necessary. A thermometer can also be fitted if desired.

The plant will be left running by the serviceman and at first, even with the freezer empty, the unit will operate continuously for a considerable period until the evaporator coil, liner, internal air and part of the insulation is down to working temperature. After this the unit will alternately run and stop, the relative lengths of the cycles depending upon the load.

It is not possible in this article to give details of the preparation of foods for freezing. Most meats, fruits and vegetables are suitable, and there are a number of books available dealing with the subject, while articles on frozen foods also appear in papers and magazines.

Packaged foods for freezing should be placed in the freezer in contact with the coil. In a freezer of the size shown an average of about 20 to 25lb. may be frozen at any one time although more may be put in on a cold day with the freezer nearly empty than on a warm day with the storage compartment nearly full. As the frozen foods stored build up, a space should be left adjacent to the coil so that fresh packages can be stacked against them.

When fully loaded a 9 cu. ft. cabinet will hold between 230 and 300lb. of produce according to the type and package.

Maintenance

As regards maintenance, little is needed except to watch for overheating of the unit and defrosting of the evaporator. The former may be due to overloading, and on most modern units a thermal overload is provided which automatically stops the motor to avoid damage. Make sure that the condenser is not blocked or choked by dust or that too many fresh packages have not been put in the freezer. If overheating persists send for a serviceman.

If the coil ceases to frost up while the unit continues to run it is usually a sign of a blockage. Frost appearing on the pipe line from the liquid receiver to the expansion valve indicates a block somewhere near the point where the frost starts. Otherwise wrap a warm cloth round the expansion valve. If this causes frost to re-form on the evaporator then moisture is in the system and a serviceman should be called to fit a drier. This item is often fitted as standard practice and may save a lot of trouble.

Deliberate defrosting of the coil is necessary occasionally, perhaps about every three or six months. Excessive frost formation reduces heat transfer to the coil and results in additional load on the plant. It is best done when the storage compartment is nearly empty. Remove the packages and store them in the coldest place available, wrapped in newspaper. Switch off the unit and open lid. Most of the frost can be scraped off with a piece of wood and some will thaw and drip off as water. It will all collect in the tray whence it can be removed. Restart the unit and replace the frozen foods as soon as possible.

A DRY MOUNTING PRESS

T. W. CLEMENTS

Details for Converting a Letter Press Received in Answer to a Letter in Information Sought.

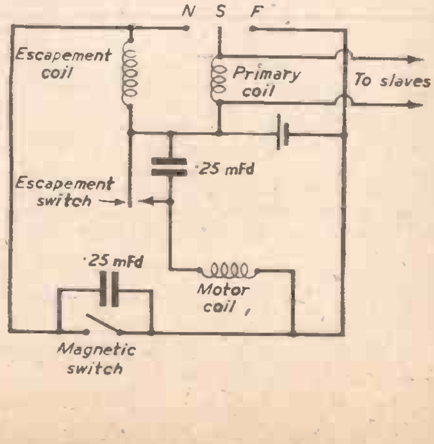
THE press was approximately 15in. by 12in. and a piece of ¼in. steel plate was obtained the same size as the top plate. This was drilled at intervals of about 2in. near the edges and at suitable points over the surface, the holes being countersunk to accept ⅛in. BSF countersunk bolts. This plate was clamped to the top plate of the press and ⅛in. BSF tapping holes drilled through the top plate. Four 450 watt electric iron elements were obtained, and positioned on the plate so that each element had an equal area to heat. Holes were drilled in the top plate to allow the connecting strips of the elements to be pushed through; if sufficiently large holes are drilled no insulation will be found necessary. A quantity of mica sheet was obtained (old iron elements) and pieces were placed on the plate to provide distance pieces between the top plate and steel plate so that the sandwich of top plate—elements—steel plate could then be screwed up dead tight without bowing or buckling, also ensuring that the elements were clamped really tightly over their whole area. This is important, otherwise the elements overheat and burn out. Finally, after connecting all elements in parallel with asbestos-covered wire and fitting a mains lead, a box form cover was made from 18 g. sheet iron.

This device was used professionally for dry mounting for a number of years with every success. The even heating of the elements left nothing to be desired, and a 12in. by 10in. print could be mounted at one pressure of about 12 seconds.

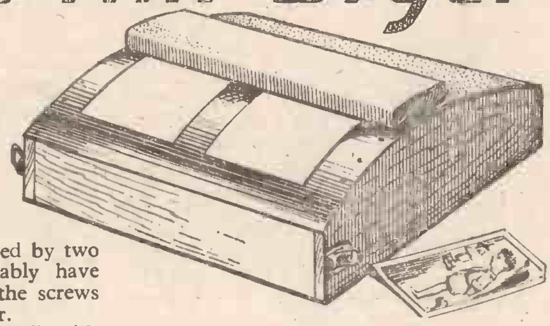
It was never necessary to fit a thermostat, although this would be a refinement. After a time I fitted a thermometer by drilling a ¼in. hole through the sandwich and cementing the bulb in with Pyrumit fire cement. The thermometer stood vertically so that it was necessary to drill the sheet iron cover in order that it could poke through. This press took about 20 minutes to heat up to the required 170°, and could then be switched off and used continually for about 20 minutes without further heating. This represents a great deal of mounting if the prints are already tacked on the mounts. The thermometer mentioned can be obtained from Morris Allison and Co. Ltd., 4-6, Theobalds Road, London, W.C.1, for a few shillings.

A Free Pendulum Electric Clock Correction

We regret that, as pointed out to us by readers, there was an error in Fig. 2B of the article A Free Pendulum Electric Clock, which appeared in our February edition. The author has redrawn and corrected the circuit below.



A Photographic Print Dryer and Glazer



A Handy Unit for the Home Photographer

By J. C. LOWDEN

MOST home photographers face one serious problem—a successful evening in the darkroom produces a tray of sodden prints, all of which must be dried with the utmost care. The usual practice is to dry off the surface moisture between sheets of expensive fluffless blotting paper, and complete the process by lengthy air-drying, preferably upon muslin stretched between battens.

These methods work very well in spacious premises, but in ordinary, busy homes they have serious drawbacks. Attention is then turned to the purchase of a drier. A small commercial drier costs about £5, and increases with the print size.

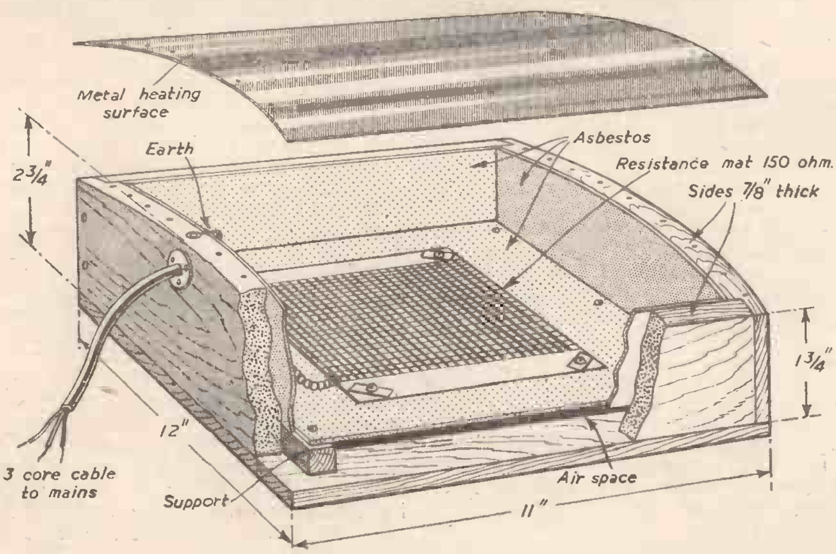


Fig. 1.—Constructional details of the drier and glazer. The apron and accessories are not shown.

It is possible, however, to solve this problem at a cost of only a few shillings. The requirements are simple, and the construction of a simple drier is well within the capabilities of the handyman.

Construction

The first step is to prepare the front and back of a shallow wooden box. Two pieces of wood, 10in. by 2in. by ⅞in. are prepared. Measurements are not critical nor is any special timber called for.

The sides of the box are now prepared. Similar timber is used, and two pieces are cut to 12in. by 2¾in. A pencil trace is made across the timber at a height of 1¾in. from the base. A smooth, even curve is then drawn from one end of this trace to the centre of the upper edge, then down to the pencil trace at the other edge. This is the most important piece of woodworking in the job, and a little care with the spokeshave or smoothing plane will be amply repaid. The other side is then curved in a similar manner, and the two pieces smoothed off together to present a reasonably symmetrical profile.

The four pieces are then joined to form a simple box. In the original a simple halving-butt joint was made, secured by two screws. Dovetailing would probably have made a more attractive joint, but the screws are concealed, as will be seen later.

The box is then neatly "floored" with stout hardboard, plywood or, better still, a scrap of asbestos tiling as used in garage construction; this is screwed to the base of the box.

Once the box is secured it will be noticed that the outer edges of the front and back pieces present sharp corners above the curved profile of the ends. Trim these to shape with the plane.

Insulating Inside of Box

First obtain a few pieces of timber about 1in. thick, and secure these on the asbestos or plywood base, and the walls of the box. These are merely to act as supports for the true insulation, and to provide an airspace between it and the floor. Do not use adhesives for the job—nails or screws are more reliable.

Next procure from any household stores a couple of fair-sized oven mats. These are pure asbestos and ideal for the job. Carefully remove and preserve the tinplate edging. Using large-headed cobblers' rivets, carefully line the inside of the box all around with the asbestos sheeting. If properly done your box will be virtually fire-proofed from the inside. Now, cut a sheet exactly to size to form the floor of the box, but do not secure.

The Heater

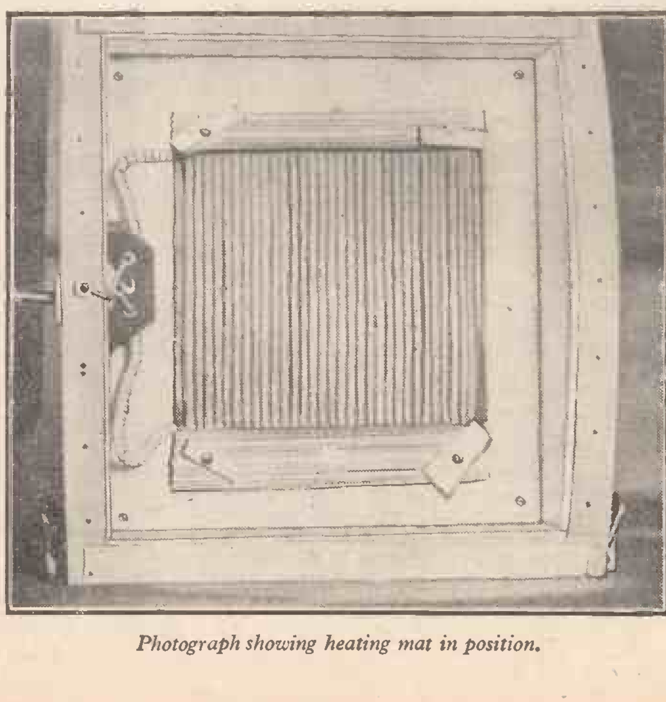
A large, even spread of heat which can be easily controlled and safely handled is needed. These requirements were satisfied by a resistance mat, supplied by London Central Radio Stores, 23, Lisle Street, Leicester Square, London, W.C.2, and are supplied in three powers. The 150 ohm mat was chosen and works well. The price was 2s. 6d., plus postage.

The mat measures approximately 8½in. by 6½in. The weight is negligible. It is made up of heater element interwoven with asbestos thread. Four securing holes are provided, and two generous, well-insulated connecting leads.

Secure the resistance mat to the asbestos floor sheet, which has been cut in readiness. Use large-headed paper fasteners for the job—if necessary, extend the grip of the head by pushing the fasteners through a scrap of asbestos before securing.

Testing the Heater

Now make a preliminary test of the heater mat by coupling the mat to the mains and switching on. A cautionary note—if you are unskilled in using mains electricity it would be wise to have this test, and the final wiring, carried out by a competent electrician.



Photograph showing heating mat in position.

Once satisfied that the mat is in working order and stoutly secured to its asbestos base, fit it into the box and nail it *firmly* to the "joists."

Now for the metal top, which is a sheet (12in. x 12in.) of stout, but flexible polished alloy, costing 1s. 9d. at a Government surplus store. This was trimmed to fit over the curved top. A line was scratched at ½in. inside the edge, where it met the curved edge. A series of nine holes, approximately 1½in. apart, was drilled with centres along the scratched line. A further series was then drilled along the opposite edge, being carefully spaced and located opposite to each other. A dozen and a half round-headed screws, about ⅜in. or ½in., were required next.

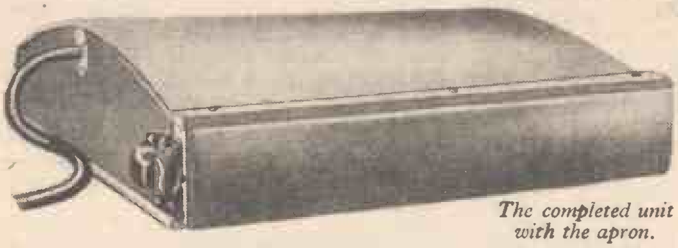
Before securing the metal top, however, it is necessary to complete the final wiring. Use about a yard and a half of 3-core tough rubber-covered cable. Connect the power wires to the resistor mat leads, and, as an essential safety factor, connect the green earth wire to the metal top. Wire up to a 3-point plug in the usual way. (Note: qualified electrical advice or assistance is desirable.)

Now screw the metal top to the curved ends. Begin at the centre screws and work outwards to the edge. Drive each screw in turn, and the metal will fit firmly to the curve.

The Apron

A further detail remains—some means of holding the prints firmly in contact with the drying surface. An "apron" is employed and this is made from a piece of material the exact width of the metal sheet, and 6in. or so longer. Closely woven canvas, well stretched deck chair seating or even a piece cut from an old raincoat will serve. It should be stout, clean and free from any form of dyeing, waterproofing or other substance which will run or stain under heat.

Fix one end of the apron firmly to the back of the box. Use a plywood batten about 1in. wide, and screw the cloth and batten to the back of the box. Now prepare a further plywood batten about ½in. wide and a stretcher bar of softwood. Make this bar the length of the box, and plane it to 1¾in. x ¾in. or ⅞in.



The completed unit with the apron.

Stretch the apron tightly and evenly over the curved metal surface, and place the stretcher bar firmly over the end of the material. Draw the material up to the top of the stretcher bar. Then secure it with the second plywood batten. If you have done the job firmly your apron will be drum tight and wrinkle free.

The Clips

It now only remains to provide a method of holding the apron in contact over the print while the heat is "on." Buy two toolbox clips. Screw the tongues on the ends of the stretcher bar. Screw the female end of the clips on the body of the heater. When the two halves are united the apron is firmly held.

To operate, lay the washed print face uppermost on the metal surface. Clip the apron down and switch on the heat. The drying time for one print 8½in. x 6½in. is about 2½ minutes.

Glazing

A stainless steel or chromium glazing sheet is essential, since the sheet alloy used does not have the mirror finish necessary to glaze the print surface. These are not unreasonable in price —a 10in. x 8in. sheet can be bought for about 10s.

After soaking the prints in glazing fluid, according to directions on the bottle, squeegee or roll on to the glazing surface. Place the sheet, print upwards, on the heating surface —clip over the apron and switch on. Do not overheat, and keep on drying until the print springs off the glazing sheet of its own volition. Glazing time for print 8½in. x 6½in. is about 10 minutes.

A Compensated Pendulum Bob

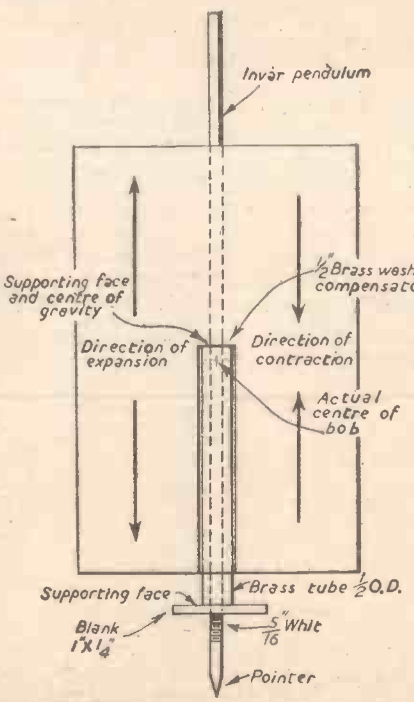
By J. A. ROBERTS

THE best material for the bob itself is a piece of mild steel or cast-iron rod 6in. long x 3in. thick, which, after machining, can be finely ground and either lacquered in its natural colour, grey, or painted. The local garage or engineer's shop might supply and machine this as similar pieces of about this size are often seen lying about. A piece of window sash counterbalance weight might also suit, though a piece longer than 6in. would, in this case, have to be cut, as these weights are usually less than 3in. thick, and a length of over 6in. might be difficult to machine.

Failing this, the bob could be cast in lead at home. The material, whichever is used, is drilled through its entire length 5/16in. clearance to accommodate the pendulum rod and then redrilled ½in. clearance for a distance ½in. greater than half its length, or, in the case of a 6in. length, 3½in., the "blind" end then being faced up with counterbore or D-bit.

A thick ½in. brass washer with a 5/16in. clearance centre hole is dropped in, and a 4in. length of brass tubing ½in. o.d., the ends of which have been machined true, is pushed up to the end of this ½in. passage which it should fit snugly, with about ½in. left protruding. Naturally, if any other than a 6in. length of bob is chosen the brass tube will be of a length to suit same, but none of these dimensions is critical as long as the ½in. passage is drilled about ½in. deeper than the actual centre of the bob. This is to move the centre of gravity as high above where the actual centre would be before drilling out the ½in. passage.

The pendulum rod is then fitted, and the brass blank shown run up the threads, which should be full and well cut as upon these is supported the whole weight of the assembly, via said blank, the brass tube, compensating washer and faced end of passage.



Details and dimensions of the pendulum bob.

A similar blank could be run up the threads after the unit is assembled to act as a grading ring, but I have obtained finer limits of timekeeping by adopting the commercial practice of adding small numbered weights to the top of the bob or the supporting blank, or a small tray could be fitted above and below the bob if this looks more businesslike.

By this method of supporting the bob any expansion or contraction of the same is equal above and below the centre of gravity, the effective length of the pendulum thus remaining constant. It will also be seen that the bob is raised and lowered by the expansion of the brass washer to the same degree that the suspension spring itself expands and contracts, so that all three components of the pendulum are fully compensated.

The thickness of the washer will depend upon the length of the suspension spring and the actual dimensions must be found by trial and error.

Building a Home Workshop

Basic Details of Design and Hints on Construction

By "TUBAL CAINE"

THE word workshop gives the impression that a separate building is necessary, and this is where the home mechanic makes his first mistake. The best workshop is inside the house and not tucked away in some remote corner of the back garden; but let us consider the facts before accepting this statement because seldom is much thought given to the planning and layout until after weeks have elapsed and construction is already well under way.

The greatest disadvantage of an outdoor building is the heating of the structure, and with this climate of ours it may need heating even in July. Most of us, however, start to build when the light evenings commence, and usually the building is a wooden shed, perhaps of the prefabricated type, with little attention paid to the fit of doors and windows, and a makeshift floor consisting of plain boards laid edge-to-edge.

With the advent of the colder evenings, the interior is cold, and soon becomes damp; draughts enter from all directions, including the floor. Heating with oil stoves or an electric fire does not help much, and soon enthusiasm wanes and the tools stand neglected and perhaps rusting.

A building within a building is the answer to this problem. Use only tongue and groove boards as these are good draught excluders and well worth the extra money paid for them.

The Floor and Base

Fig. 1 illustrates a cross-section through the floor of a workshop, with the concrete pillars set in the ground about 9in. above the garden level. Make these items about 24in. to 30in. long. A long box, square or rectangular in shape, is used for the casting process, or alternatively a similar impression cut in the ground to these dimensions will do just as well.

This drawing shows the floor having two "skins." The lower which rests on the pillars is first nailed in place on the 2in. x 2in. wood frame and the assembly turned over. The spaces between the frame-members are filled with wood shavings, sawdust or fibre-glass—the latter, of course, being the most expensive. Next nail the actual floor, taking care to pack the filling as you go. A plan view of this assembly is not shown, because the size will depend on the site available and the size of workshop required.

Intermediate cross supports are necessary to take the weight of the machines when they are installed, and these give added support to the floor where it is subject to continual walking.

Set the floor down on the pillars in the manner depicted in Fig. 1. The spacing of these pillars is important in relation to the finished size of this building, so check their position carefully when bedding them in the ground.

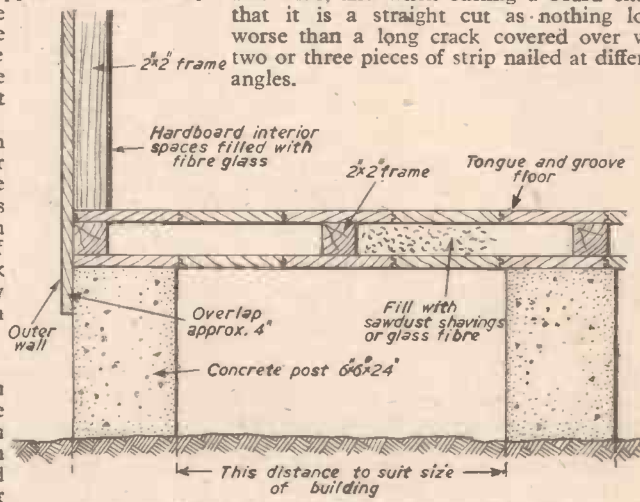


Fig. 1.—A cross-section through the floor of a workshop.

The Walls

Rainwater shed from the roof would, in the normal way, run down the walls and collect in pools at the bottom and so cause the lower portion to rot, despite the generous application of a preservative. To avoid this, cut the wall boards about 4in. longer and nail them to overlap the floor frame; the water can then run off without affecting the framework. A twice-yearly application with a good preservative is then enough to stop the boards rotting. No dampness reaches the floor, and this does not require further treatment.

Complete the walls and roof, using 2in. x 2in. timber for the frame and tongue and groove boards. When satisfied that the boards fit properly and that no cracks exist, prepare to add the inner skin. Use good seasoned timber —if the present day supply is suspect, find a woodyard that deals in second-hand material; often some of this, though useless for internal work in the home, is still admirable for the job in hand. In the framework do not forget to add plenty of supporting pieces on which to nail the inner wall—one every 2ft. is generally ample.

Timber or hardboard is used for all walls —the wood, of course, being the same tongue and groove boards as used for the floor and outer wall. The exclusion of draughts is the reason for this. Hardboard, however, looks well, and will take a coat of paint easily, the result being rather a better finish than the boarded wall. As you finally nail the pieces in position, do not forget to insert the filling in the same way as carried out with the floor. If hardboard is used, cover the cracks at the joints with strips about 1in. wide, and when cutting a board ensure that it is a straight cut as nothing looks worse than a long crack covered over with two or three pieces of strip nailed at different angles.

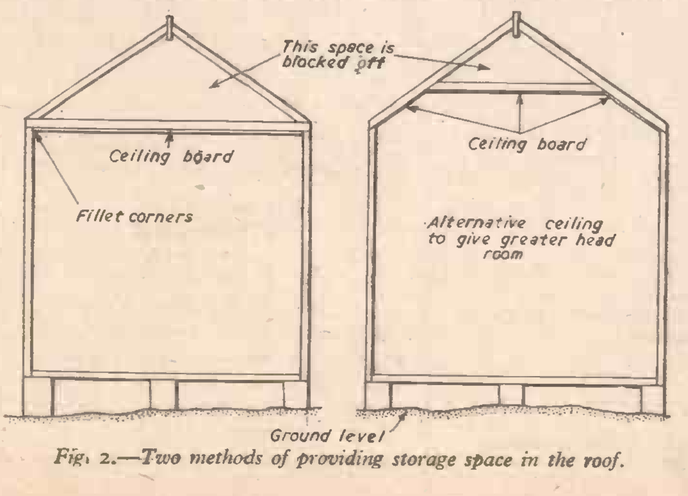


Fig. 2.—Two methods of providing storage space in the roof.

The Roof

There is one more item to which it is suggested you give further thought, because when the workshop is empty working inside is much easier. Usually one is content to leave the roof space with just the inner skin, forgetting that here is a considerable space which requires heating and so tends to make the shop colder; so why not add a ceiling? It cuts off the hip roof and gives you an opportunity to provide a white overhead roof which is far more attractive. Whitening will lighten the interior—a useful factor, especially when there is only one window. Again you can use hardboard or ceiling board if you can get it. If a storage space above is considered an advantage, then board the ceiling and add a sizeable trap-door at one end—you can make this fit in an identical manner as the loft in the roof of your house.

Paint the walls a very pale green—the matt emulsion paints are useful, and I would suggest white ceilings. The panel strips would look pleasing in a darker shade. So far the workshop will look as is shown in Fig. 2.

An Air Lock

Another factor which is well worth the

extra work is an air lock, built over the door to retain the heat and to help to exclude draughts. Fig. 3 depicts how this is added to the building; it should be built outside rather than inside the workshop. This is, of course, to economise in space as most amateur shops are usually about 8ft. long by 5ft. wide and space is at a premium after a few months. Have the main door in one corner as depicted in the plan view, and place the outside door at right angles to it. Slope the roof slightly to shed the rain—either backwards or sideways but never forwards, as water will drip down your neck. Overlap the boards as already described above. An anti-draught lock of this design will retain a surprising amount of heat, and will prevent the drop in temperature to almost freezing when anyone opens the main door.

Ventilation

Though the interior is apparently hermetically sealed, some air will still penetrate through the doors and windows, even though they are closed. This is enough for normal breathing, providing a large number of people are not present for any length of time, but an occasional venting of the air is often welcome. It is therefore advised that a small ventilator high up on one wall, similar to the air bricks seen indoors in bathrooms and bedrooms, be fitted. This gadget requires adjusting and completely closing when not required. Make it circular and fit a disc behind, which, on being rotated, will open and close to regulate the flow of air.

A ventilator 6in. diameter is sufficient for the average shop, and if fitted in a corner does not look unsightly.

The Shop Layout

This is naturally of some importance and what is actually produced will govern to a large extent how the plant is installed. I had two windows in my workshop, where they are depicted in the plan, Fig. 3, north being roughly in the direction shown.

Along this side was installed the lathe and fitting bench and, for newcomer's benefit, this way is the best because it gives the steadiest light free from the glare of the sun when it does shine. Though some individuals may prefer to work on the west side, the former direction is the one most mechanics prefer especially when carrying out such processes as marking out and turning details on a lathe. Rather a long window was installed on this side to provide light for using the lathe and still leave plenty of room for a bench alongside it.

On the west side there is a smaller window, and just to one side is bolted down a small pillar drilling machine. By its side is installed the milling machine—the light, of course, being about evenly distributed between them. The arrangement of the machines was not made without some thought, as the glare from the late evening sun through the west window is obviously a factor to take into consideration. The lathe and bench vice are in almost continual use, consequently the reader will work on the north side for longer periods. Admittedly when using the milling machine he may have to work in the glare, but probably not for many hours at a time.

On the opposite wall to the lathe is fitted another bench which is to be used chiefly for the storage of chucks and tools; there are a series of cupboards underneath for a similar purpose. Finally, the bench continues round near the vice and this part is used entirely for the assembly of a model or apparatus. Linoleum on bench tops and floor is an asset.

Generally

For those contemplating a workshop, or the re-organisation of an existing one, this design, though it may not attain the ideal for some of you, is nevertheless a light, warm building, and of a size which gives plenty of room for the general run of model engineering. You cannot expect, with the present-day prices of timber, etc., to make this workshop for only a few pounds, but the cost is money well spent.

You must have the approval of the local authorities before you commence to erect any type of structure, but as a rule this is not difficult to procure.

Never make your shop from asbestos sheets, never have a concrete floor and finally avoid corrugated iron sheets. All these materials are suitable for the garden shed or garage, but they are cold and damp materials, totally unsuitable for the purpose of a workshop where warmth and dryness are the chief factors.

The Indoor Workshop

Those of you who have a suitable spare room in the house are strongly advised to use it instead of the outside building. Suggestions that some degree of smell arises from the cutting oil and that dirt and swarf are more easily carried into the living quarters are greatly exaggerated. One feature with the indoor workshop is that you are in a continually warm atmosphere. Again, a room need not become a jumble of machines and tools, but a place where other members of the family can come while you are at work.

Layout depends entirely on the shape and floor area. Those who must necessarily move on to the floor above, should consider very carefully the question of weight before embarking on this project. Provided, however, you are satisfied with a 4in. lathe, a small pillar drill and perhaps an equally small shaper, together with a reasonable selection of hand tools, then the floor joists will stand the strain easily. Do not secure the bench to the wall, but rather fix it by means of angle brackets to the floor joists, as any holes drilled for screws will not show if subsequently the space is needed for living quarters once more.

Linoleum on both the bench and floor should be used. Lino on the floor is particularly useful when such things as 10 B.A. screws are dropped. These tiny items are renowned for falling into any crevice. Use a cheap plain material, brown or dark green in colour for preference. You must, of course, treat it with respect and not carry out heavy hammering operations on it, but with normal wear it should last several years.

Tidiness

Some amateur workers have a habit of trying to work with the bench littered with various files, hammers and wrenches, spending many minutes looking for a particular tool and so wasting valuable time. Keep each item in a known place—on racks or cupboards where they are immediately to hand—by doing so you can increase your production and make far less mistakes. Hang up your files and hacksaw and do not throw them in a drawer with a variety of other equipment, this is just one instance where you can keep the workshop tidy.

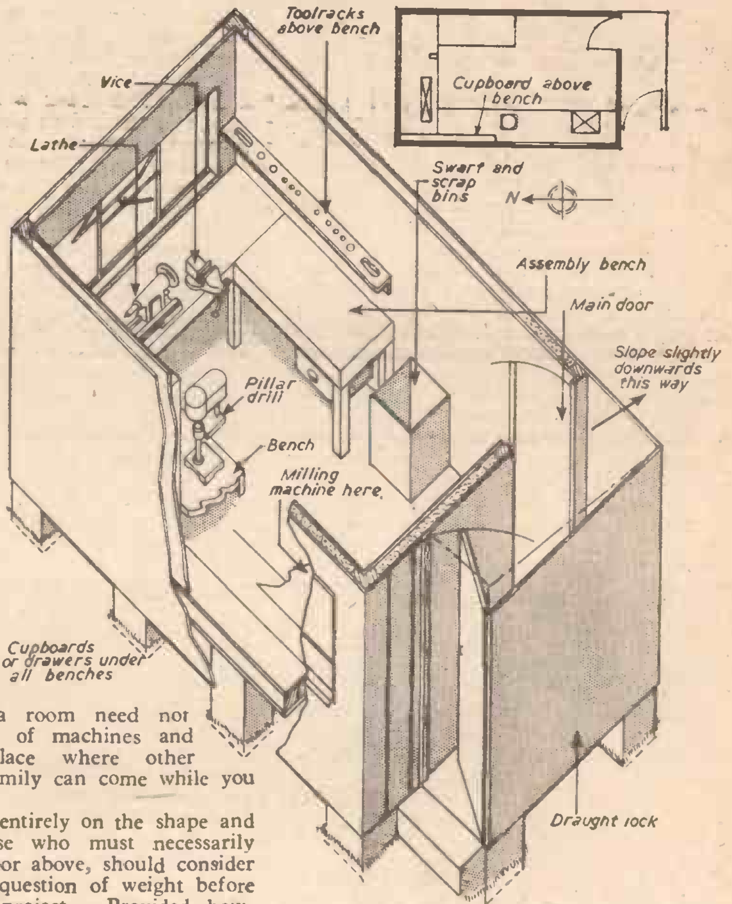


Fig. 3.—Details of the layout of the workshop.

OUTDOOR 'O' GAUGE MODEL RAILWAYS

By E. W. TWINING

Constructing a Layout in the Garden for Steam Operation

OUT-OF-DOOR railways call for a totally different treatment from those which can be laid indoors when the gauge and scale is as small or smaller than the standard "O" gauge, which is the size I have adopted in this article. The gauge, or width between the rails, is 1¼in. only and whilst electrical propulsion and, in fact, electricity is employed wholly and solely on indoor tracks it is almost impossible to use it safely out of doors. So much leakage can occur in damp and especially in wet weather that it would not always be safe to switch on the current. It is proposed, therefore, to adopt steam locomotives for working the trains and the signals and points can be mechanically worked; thus the system would be mechanical throughout in the same way as a normal railway is in full size.

For the layout of the system a garden, or a portion of a garden, measuring 42ft. by 25ft. is necessary. This is as small as an "O" gauge conveniently may be. The reader may, however, enlarge the plan to suit the accommodation which he has available, or he can reduce it, though such reduction is not advisable for continuous running. For instance, he can increase the scale, adopt ½in. to the foot and double the size or, if he can find the space to do so, he can use the same layout for 3½in. gauge and ride behind the engine, hauling trucks carrying passengers. A well-made Pacific (4-6-2) engine of 3½in. gauge will easily haul from six to eight children, perhaps more.

Layout

Fig. 1 shows an "O" gauge railway which is practically of figure eight in form having the upper loop of the figure doubled back over the lower half. There is, therefore, no crossover on the level or on the same plane: one side of the figure being tunnelled under the other at the intersection and crossing over by means of a viaduct and bridge at another point.

The items coming into the scheme are: two tunnels having portals A1, A2, A3, and A4. The last two are at either end of a long tunnel and it will be necessary to provide an access opening to the middle of this to meet the emergency of a derailment inside the tunnel. This will be provided by a collection of rocks, or better, by pieces of coal, carefully painted after being cemented together and forming a movable wall which will look like a rock cutting supporting the track above it. This portion of the upper track will actually be carried upon a board which will serve as a roof to the tunnel. The rock access is marked R.A. in the plan. There are a few other points on the upper level line where rock cuttings occur, and these are lettered R.C.

As may be seen the top of the plan shows the outside of an industrial district: S is a large through and terminal station whilst near this is a goods depot G and a small marshalling yard. Farther along the line, to the left, is the locomotive depot L with its turntable T, water tank W, and the coal dump C. There is another small terminal station on a branch off the main line in the right-hand top corner, whilst on the left-hand side is shown a small country station. There are at least two signal boxes B, though it will be advisable to put another, or perhaps two more, on the lines near the bottom of the plan as well as upon the left-hand side. In these boxes will be the levers which should work the signals and points. V is a viaduct and overbridge.

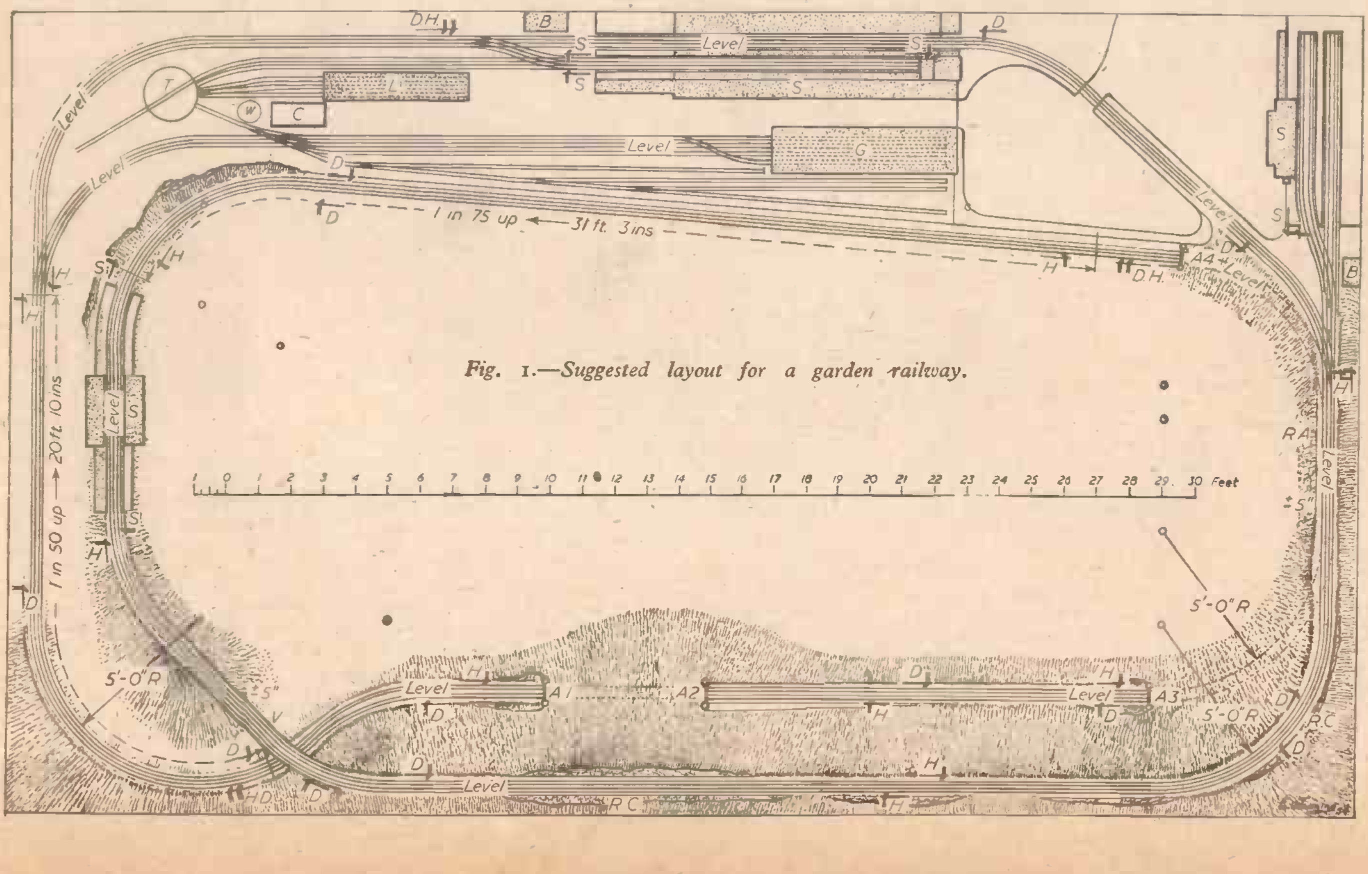


Fig. 1.—Suggested layout for a garden railway.

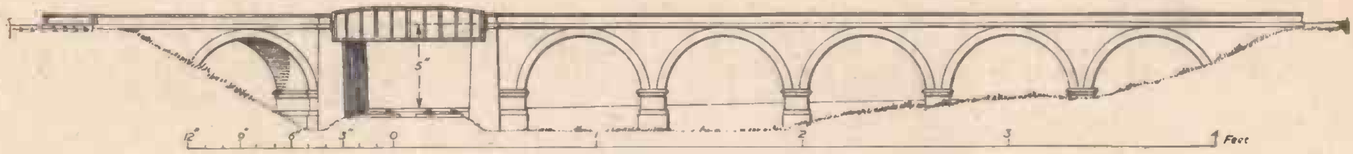


Fig. 2.—The viaduct and bridge.

The Levels on the Site

The reader will be able to understand the lay of the land in the plan shown in Fig. 1, but to some extent this will depend upon what is found to exist on the site on which the railway is to be laid. At any rate, the land must be levelled as much as possible and the 1 in 50 gradient shown in Fig. 1 must not be exceeded. It will be obvious that it will be caused by the plus and minus 5in. at the crossovers. On the long side of the rise the gradient is 1 in 75. This is an incline 31ft. 3in. in length, whereas the 1 in 50 gradient extends for 20ft. 10in.

All the rest of the track is level, independently of how the ground rises and falls, but if there is a general gradient, in one or other direction, it would be advisable to level it first all over, and then to form the little hills where the rock cuttings occur. If this is not done, there may be such deep cuttings on one side that the trains would be hidden from view during the greater part of their journeys along that side, whilst on the other, where the station and depots are, the ground may have to be deeply made up with soil from some other parts of the garden. It will be best if the garden where the railway is to be situated is on fairly level ground, then all gradients will be artificial. All artificial making up of ground, especially that occupied by the track, should be well rammed down in order to avoid the possibility of subsidence. Note that there is a retaining wall between the 1 in 75 grade and the marshalling yard. This commences at the end of the long tunnel and finishes at a point in line with the coaling station marked C in Fig. 1. From this point, to the top of the gradient, there is a slight rock cutting about 4ft. in length.

The Track

When the ground is prepared to receive it the track may be laid. The rails are best made of steel. Messrs. Bassett-Lowke Ltd. specialise in steel "O" gauge and advocate it for out-of-door use. It is not of stainless steel but is galvanised finely, and is intended for out-of-door construction; there is some in use which has been laid for five years and is still sound. The rail is specially for use on garden railways operated by steam traction.

For actually putting the rails down some preliminary work will be needed, drainage must be provided for, and so it will be necessary to go over the whole site for the railway and form a bed of coarse gravel of such a width as will exactly enclose the railways, that is to say: let the gravel, where there is an up and down road, be as nearly as possible 6½in. wide by 2in. deep, then on the top of this use coarse sand or Bassett-Lowke's fine stone chips. Sand may be the easiest to obtain in the large quantities which will be called for here, but the stone chips make beautiful ballast and look well. Put ½in. of this on the top of the gravel and finish off smooth with a long wooden straightedge.

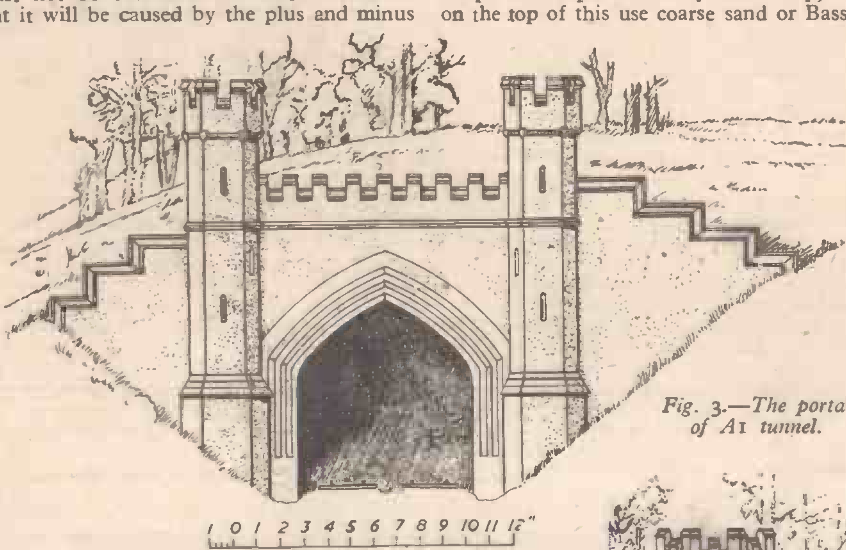


Fig. 3.—The portal of A1 tunnel.

With this same straightedge settle the two gradients of the inclines. This can be done by nailing or screwing on to the side of the upper edge of the straightedge an additional straight piece of wood as long as may be convenient; let this extra piece make an angle with the straightedge exactly equal to the gradient being dealt with. For instance, suppose the long grade of 1 in 75 is being dealt with, cut the extra piece, already planed true on its upper edge, 37½in. long. Screw it on to the side of the straightedge so that its upper edge, at one end only, is flush with the upper edge of the straightedge which must have both its upper and lower edges parallel. At the other end screw it on the straightedge so that it stands up proud by ½in. If now the whole tool is laid on the ballast, on its edge, and a spirit level be put on the extra bar, when the incline is exactly at 1 in 75 the spirit level should be central because ½in. in 37½in. is the same as 1in. in 75. So in using this tool not only can you get the track bed straight, but you can, at the same time, get the gradient correct.

In dealing with the 1 in 50 gradient all that has to be done is to mark the extra piece of board at 25in., raise it until the mark is at ½in., rescrew it and it is set for the gradient of 1 in 50.

Both of these grades finish beyond curves, but this fact will not interfere with the use of the straightedge, the extra piece nor the spirit level upon them, although in working around each curve only one portion can be trued at a time. That is why the length and height in setting the gradient on the straightedge in both cases is halved.

Viaduct and Bridge

Having laid all of the track on plain portions the viaduct and bridge can be undertaken. If you want this to be absolutely permanent make it of concrete, casting it in Portland cement 1 part mixed with clean, washed sand 2 parts. I recommend that it be cast *in situ*, one pier with a half arch on each side at a time, using the same mould for each arch. This mould must be made up of four pieces, one for each outer face and two for the centring. The two facing moulds will not be arched and neither will the arches themselves. All can be solid and will be held together with screws, so that having cast one pier and two half-arches the mould is unscrewed and moved for the centring to fit into one half-arch already cast, the second pier is cast and so on until the viaduct is complete.

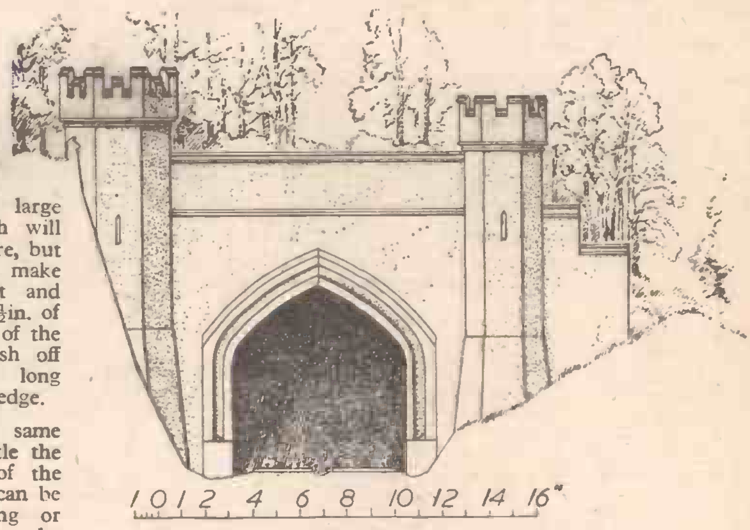


Fig. 4.—The portal of No. A2 tunnel.

The time between the casts must be governed by the weather and time of year, but it will be safe to let from 12 to 24 hours elapse between the casts. The cement does not require to be dry, only set. By having it so it is possible to work on it to finish the mouldings, etc., and to clean up and make good the joins in the centres of each arch. The abutments on either side of the plate girder bridge will each call for a special mould, and these should be dealt with last, using, so far as may be possible, the side faces which served for the other arches.

For the girder bridge, wait until the concrete is in on both sides and then make the bridge to fit ; the side girders in one piece with the bottom which will carry the rails, sleepers and their supports. Note that the height from the heads of the rails of one set of lines up to the tops of those which cross it is 5in. clear. This and all details of the viaduct are shown in Fig. 2.

The Short Tunnel

The tunnel entrances and exits are all lettered A in Fig. 1 and numbered 1, 2, 3 and 4 in the order in which they occur in moving around the track in an anti-clockwise direction. A 1, Fig. 3, is the first. This with A 2, Fig. 4, is the exact copy of a Gothic tunnel on the line between Bristol and Bath at Twerton. The shape and proportions are exactly the same, although the size is slightly smaller than scale, because the original was built to take the old Great Western Railway 7ft. gauge. A 3 (Fig. 5) is the western end of another tunnel on the same line, nearer to Bristol. This is not a pointed arch, but the flanking towers are either Norman or Edwardian in style. The opposite end of this is not copied, but it is a close imitation of the short Gothic archway, both ends of which are alike, and which follows on from Twerton tunnel, see Fig. 6.

Now there are several ways in which these tunnels can be formed, but I think that nothing can be more simple than first digging a trench, laying the drainage ballast, then the track, ballast it, and then build the tunnel over it in wooden boards.

Another method would be to arch over the line with stout gauge sheet metal, zinc or galvanised iron, though this may not exceed the life of creosoted wood.

Another method which is adopted by some railway model makers is to use drain-pipes of earthenware, but in this case the cross section of the tunnel will be circular and it must be of definite length if one wishes to avoid the cutting of a pipe.

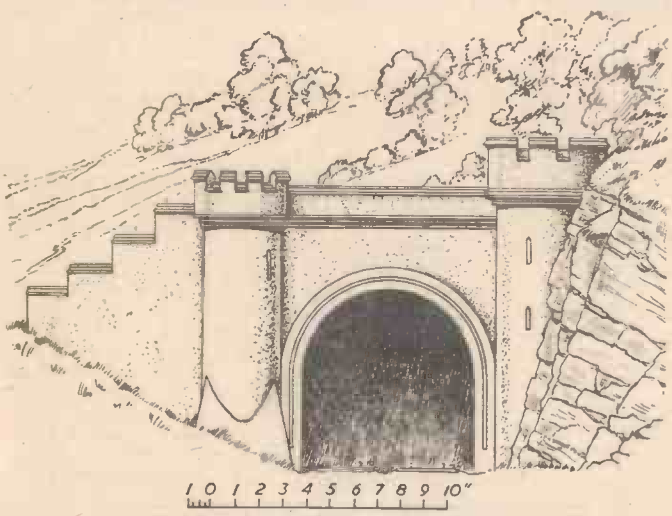


Fig. 5.—The portal of tunnel A3.

In the shorter tunnel concrete is recommended. Bend a piece of sheet metal to the required curve and pack concrete around it until it is from $1\frac{1}{2}$in. to 2in. thick, with at least a 2in. footing. Leave to set and dry, then wriggle the sheet metal downward, draw it together and remove it or, if it is not long enough to cast the whole tunnel, move it along to the next section and do the same thing again. The footings ought to go downward into the ground below the level of the rails, but much depends upon what weight of material is going to be put on the top.

The first tunnel is about 5ft. in length and is perfectly straight. The second, or long one, is curved at each end and has an opening on the inward side which is nearly as long as the straight between the curves. This opening is very necessary in cases of derailment in the tunnel. The access is normally closed by a retaining wall of rock which is removable in an emergency.

The Long Tunnel

For the construction of this long tunnel I can think of no better scheme than to creosote, thoroughly and well, wooden boards, and make the cross section of the tunnel square or a little rectangular, only having Gothic arches for about a foot at each end. These ends can be formed in concrete as was the short tunnel. For the rest of the curved portions, short pieces sawn off 6in. floorboards will be set on end on each side of the track, then similar pieces will be nailed down on the upturned ends of these. Where the emergency access opening occurs, a long straight board is used ; this is laid upon and nailed to short boards erected on the far side with, on the near side, next to the rock removable filling piece, two or three (or as many as may be required) slender uprights to prevent the long board from sagging.

The removable filling can be either actual rocks or better still one long concrete slab made on a flat surface and in which the pattern is impressed of pieces of coal. The coals must be carefully chosen so that the stratification is continuous and all slope in the same direction. In the rock cuttings the use of coal is recommended either by taking impressions in cement or by actually using coal embedded in concrete to represent rocks in miniature. This is the scheme illustrated in Fig. 7.

Tunnel Fronts

In my own railway, which had Gothic portals as Fig. 3, wood was used for the main structures, and for wing walls where these occurred, but all the dripstone mouldings and projecting string courses were cast in lead. These were cast in rings, the moulds for which had been turned in the lathe in hardwood. The rings were then cut, straightened, cut up to the required lengths and mitred when and where required. Fig. 8 will make the process clear ; this shows not only the sections of the mouldings but the circular mould being filled with molten lead poured from a ladle. It will be obvious that the length of moulding in one piece will depend upon the diameter of the circle turned in the mould. There is one mould made for the embattled tops of wall and towers and another for the string course. Others will be needed for the arched mouldings, but those drawn will be all that are needed for any or all of the models. Of course each bit of moulding will have to be drilled twice, since two pins will be used to fasten each piece of lead to the wood.

When each portal is completed, it is thoroughly painted with best white lead paint, at least four coats being given of paint having a stiff consistency with plenty of oil ; use oil rather than turpentine but add patent driers or Japan gold size to force the drying. In order to remove the brush marks the surfaces should all be stippled in each coat of paint ; this will give it a sanded or granular effect. Finally, give each tunnel front two coats of a greenish grey paint, darker in colour than the priming coats which were of pure white or very slightly grey. Very slight differences can be made in the last coat to represent some darker stones. The foregoing treatment should protect the wood for many years. Remember that the parts at and below ground level must be treated as carefully as those which are plainly visible.

(To be continued)

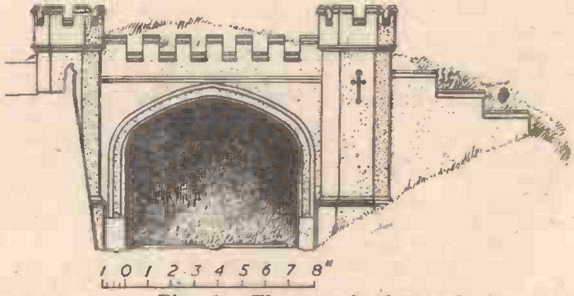


Fig. 6.—The portal of tunnel A4.

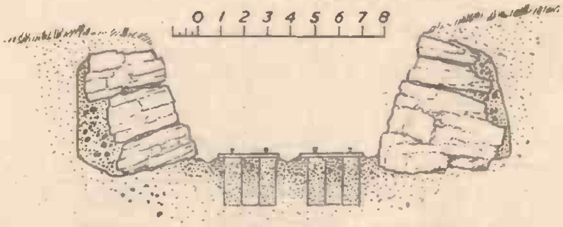


Fig. 7.—Section through a rock cutting.

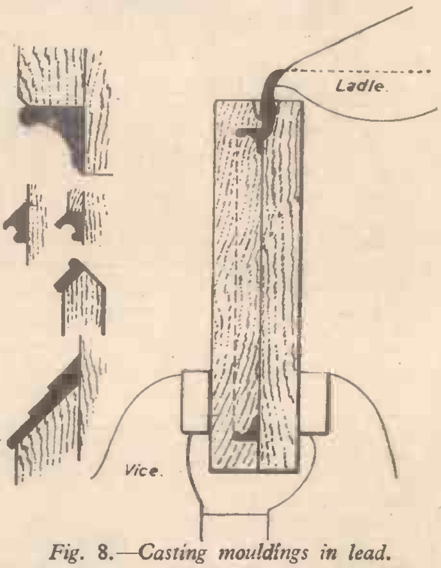


Fig. 8.—Casting mouldings in lead.

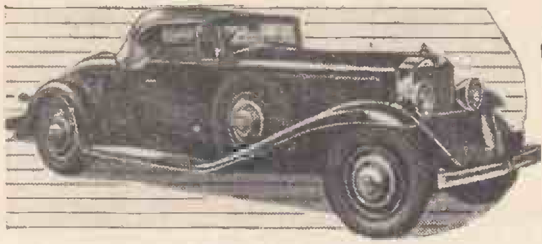


Fig. 12.—*Double E-14 model steam car.*

The DEVELOPMENT *of the* STEAM CAR

Basic Principles and Details of Development of the Steam Car

By G. W. McARD

(Concluded from April issue)

IN a smaller model of the Serpollet, the "Simplex," the designer cut out all extra refinements and replaced the donkey engine by a pump driven from an eccentric mounted on the rear axle. Fuel was fed to the burner by air pressure of around 2.5 psi. in the fuel tank, and the schematic arrangement seen in Fig. 14 gives an indication of the various components in the Simplex model.

The Stanley steam car was made in various powers and achieved great popularity except among members of motor clubs, at whose rallies it invariably shared the trophies with other steam cars, especially awards given for hill climbing and acceleration tests. The Stanley had a firetube boiler with approximately 300 half-inch tubes, steam pressure being from 450 to 600 psi. The engine was placed horizontally, and coupled direct by gears to the back axle. An excellent feature of these cars was the relatively low ratio of engine speed (rpm.) to car speed (mph.), this being in the region of 15/1.

The White steam car, which went out of production about 1915, had a 2-cylinder double-acting compound engine with piston valve for HP. cylinder and flat valves for the LP. cylinder, both controlled by Joy valve gear. The fuel to the burner on many White models was worked automatically by a "flowmotor," itself governed by the quantity of water flowing to the generator. Thus the fuel and feed supply were intimately related, and as steam pressure fell, the feeds to burner and generator were again started up. The water feed control was by means of the diaphragm type of regulator seen in Fig. 15. This fitting allowed the pump feed to pass via the flowmotor to the generator until the maximum steam pressure (650 psi.) was reached when the regulator by-passed the feed back to the tank.

In recent years a new steam power plant for use in automobiles was developed under the trade name of the "Planet." Fig. 9 shows the engine which had 4 cylinders each 82 mm. bore, and 83 mm. stroke. The steam generator fitted was of a modified "Derr" watertube type, capable of providing full steam pressure from cold in well under two minutes.

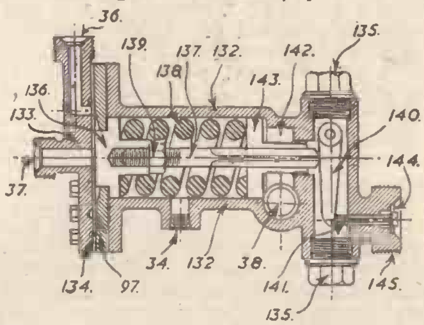


Fig. 15.—*Water feed regulator as fitted to the "White" car. Key: 34—Water by-pass. 36—Connection to steam gauge. 37—Steam pressure connection. 38—Spring adjusting worm. 97—Water regulator washer plate. 132—Main casting. 133—Water regulator cover. 134—Diaphragm. 135—Plug. 136—Diaphragm pad. 137—Plunger. 138—Spring. 139—Lock-nut for plunger adjustment. 140—Lever. 141—Water valve. 142—Spring adjusting worm wheel. 143—Spring adjusting pad. 144—Water valve seat. 145—Water connection from feed pump.*

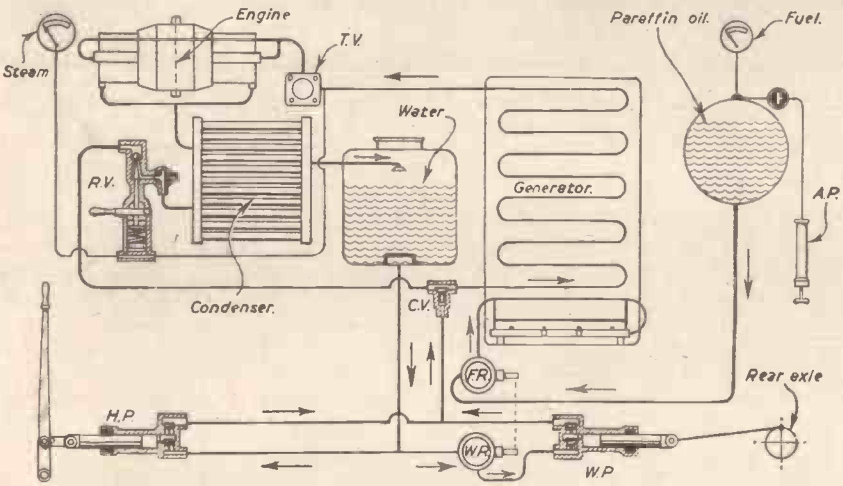


Fig. 14.—*Serpollet's "Simplex" car schematic* (1903/4). *AP—Air pump. HP—Hand pump. WP—Water pump. FR—Fuel regulator. WR—Water regulator. CV—Check valve. RV—Relief valve. TV—Throttle valve.*

A car which has proved very successful in service is the Doble seen in Fig. 12, a somewhat larger machine than the majority of steamers produced except the Stanley higher powered models. The engine for the Doble, seen in Fig. 8, lies horizontally forward of the back axle, while the generator, of the flash type (see Fig. 16), is situated under the bonnet, with the condenser in the position normally allotted the radiator in an i.c. car. Fuel is carried in a rear tank with the

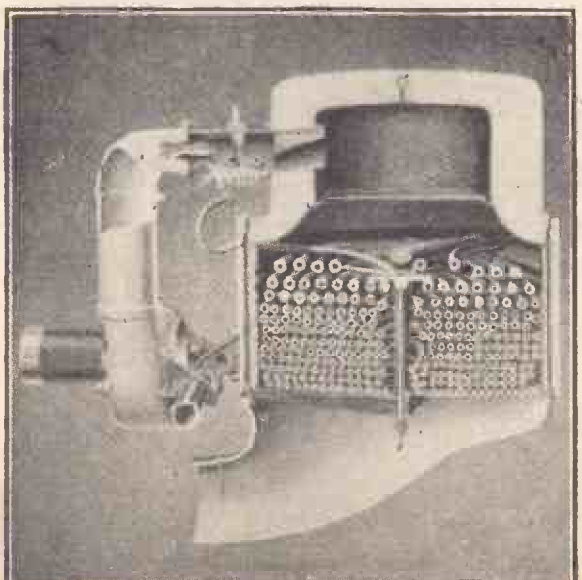


Fig. 16 (*Left*).—1921 *Doble Monotube Steam Generator. Blower motor and blower casing are shown at left, air is delivered up to venturi tube, where it mixes with the fuel and is ignited by the spark plug, thence into the combustion chamber situated above the coils. Water tubes are at the bottom, with exhaust gas flue beneath. Superheater section is nearest combustion chamber.*

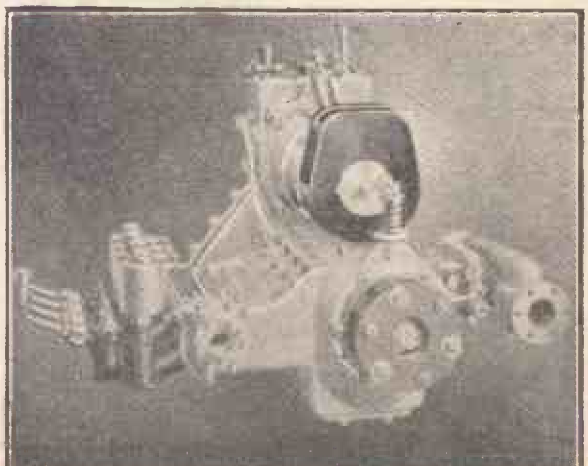


Fig. 17 (*Right*).—*Doble auxiliary unit.*

water tank situated approximately mid-way between front and rear wheels, and an auxiliary unit (see Fig. 17) combining feed and vacuum pumps, dynamo and lubriator, placed immediately in front of the water tank. In some models a belt-driven fan behind the condenser assisted the cooling action, while in others an exhaust steam turbine controlled the fan speed. Thus the greater the exhaust volume to be condensed the greater would be the draught. In this car steam pressure is controlled by a unit employing a diaphragm which is subject to the ruling steam pressure; this fitting regulated, by electrical means, the supply of fuel and air for the burner, supplies being cut off as pressure reached the top limit and re-started when pressure falls. The layout of components of one model of the Doble is shown in Figs. 18 and 19.

From time to time makers of steam cars exhibit their models at one or more of our big towns after subjecting them to exhaustive tests, and demonstrations are held in different parts of the country. Engineers who are interested in steam car design have excellent opportunities of studying the earlier models,

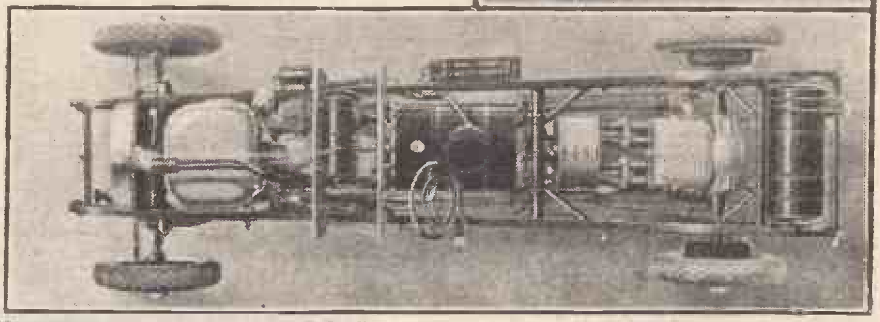
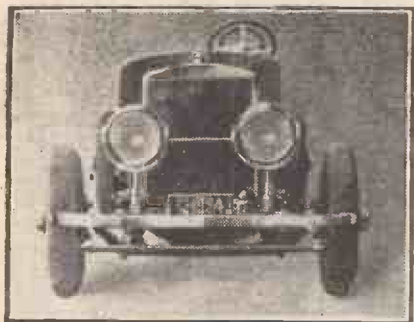


Fig. 19 (*Above*).—*Doble chassis—rear and overhead views. From left to right : Condenser, steam generator, auxiliary unit (to right and rear of steam generator),* 17 *U.S. gal. water tank (below steering wheel), engine (horizontal 4-cyl. compound, integral with rear axle),* 26 *U.S. gal. fuel tank.*



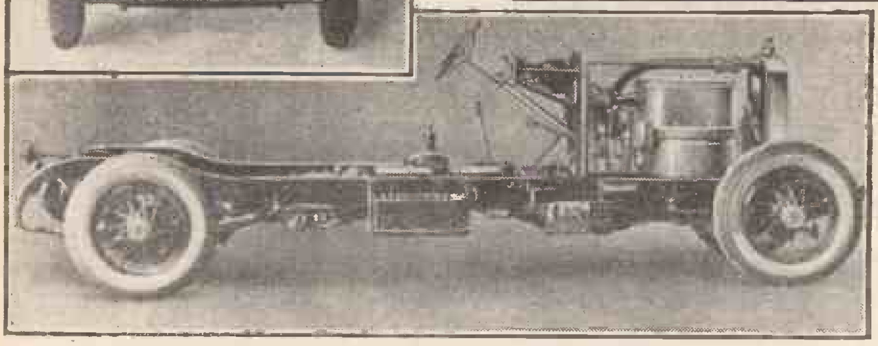


Fig. 18.—*Doble chassis—front and side views.*

including the Serpollet, in the special room set apart for this branch of engineering at South Kensington Science Museum, from which one always comes away with intense regret that such a wealth of design has lapsed for lack of ample financial backing.

The writer desires to make acknowledgments to the editor of " Light Steam Power " for his courtesy in providing the illustrations.

NAILS and their USES

The Various Types of Nail and the Individual Uses of Each

By E. N. SIMONS

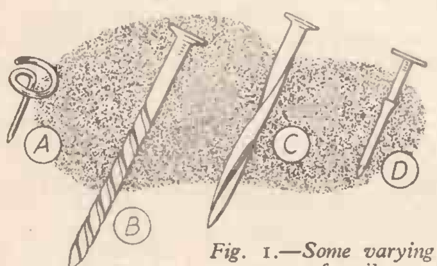


Fig. 1.—*Some varying types of nails.*

To most engineers a nail is merely a shaped piece of metal to be driven into wood or thin metal for fastening ; but technological progress has not left the nail unaffected, and there have been remarkable improvements over the past few years designed to give superior results and facilitate construction. Before dealing with some of these I should like to show the extraordinary variety in which nails may be found. Take, for example, the materials of which they are made. These include steel, aluminium, copper, brass, bronze, chromium alloy, nickel alloy, and an alloy of silver for special purposes. The " business end " may be either formed to a particular shape or rounded off.

The Nail Heads

There is equal variety in the heads of the nails. Some nails have, in fact, no heads. Others have heads that are oval, flat, rounded, cupped, slotted or chequered. Some heads are conical, countersunk, of hook form, brad form, double or spiral wire form. There is equal variety in the methods of treating nails, which include a blue finish, annealing, tempering, galvanising, different forms of plating, phosphatising and coating with resin. When we have enumerated all these, we have still not covered the tremendous range of sizes and types.

Choosing Nails

Certain important factors should govern the choice of nails for a particular job. In the first place, the nail should have a diameter large enough to prevent it from bending or crumpling when struck. The diameter varies in this respect according to the type of material from which the nail has been formed. For example, a hardened steel nail could be made in a smaller diameter than a copper or low-carbon steel nail. Normal practice appears to be to choose the length of a nail according to the type of wood on which it is to be used. If the wood is hard and close in structure, a shank penetration of approximately one-half of the nail length is allowed, which increases to two-thirds for soft woods. The object of the better nails designed of recent years is to reduce either the diameter or length of the nails without sacrificing any of their ability to hold. It should be noted, however, that roofing nails and those nails required for securing heavy materials have to be longer than stated above so as to provide adequate holding power.

Nail Materials

The steel nail, made from a hardened and tempered high-carbon steel, is used for materials such as extremely hard wood, concrete, or thin steel sheet. The ordinary nails are made from a low-carbon steel. Whenever corrosion or acid attack is likely to be encountered, it is desirable that the nails should be made from some material capable of withstanding this. Among these are nickel-copper alloys of the Monel type, austenitic chromium-nickel stainless steels, alloys lower in nickel and chromium than this, copper, brass and bronze alloys.

Resistance to Marine Atmospheres

Where it is essential to provide a nail able to withstand the effects of marine atmospheres, salt water, and similar atmospheres liable to cause corrosion, aluminium is being increasingly employed for nails, and it is also exceptionally good for work on aluminium roofing and sidings, asbestos siding and roofing.

Nail Points

We have referred earlier to the wide range of points available. The majority of common nails have points of diamond form, with a slow taper designed to facilitate penetration and minimise splitting when used on wood. If the wood is of the harder type, however, the nails are rounded off or blunted at the point, so as to penetrate rather than scatter the close fibres. The longer the point of the nail the more rapidly it may be driven and the less the effort required. On the other hand, the point should be round for work on softer materials, so as to avoid fracturing the fibres and merely spread them.

For the hardest woods it is better that the nail should have a chisel point, similar to that of a screwdriver, because this is less likely to split the wood than the point of the diamond, blunted type mentioned above.

Nail Heads

Many people pick up and use nails with varying forms of head without ever appreciating the purpose of the particular shape they use. The object of the head is to prevent the nail from being drawn through the material it is designed to fasten. The more likelihood there is of this the larger must be the nail head. Thus, materials such as asphalt roofing, gypsum, sheathing, insulating board and felt, call for the largest possible heads. Such materials, and particularly insulation padding, are now being nailed with nails having spiral wire heads, as shown at A in Fig. 1, because these can be manufactured at a lower cost than specially large flat-headed nails.

Nails with Minimum Heads

The nail with a head of the minimum size, so that it would almost seem as if the nail had no head at all, is designed for use where the type of work calls for as little nail visibility as possible. It is important in using these nails, however, that there should be a sufficiently high degree of friction between the shanks of the nails and the wood to prevent them from being drawn through.

Nails with duplex heads are being used to-day in scaffolding and framework in which it is essential to draw the nails after the structure is finished. Such a double head renders removal of these temporary nails simple.

Nail Shanks

Most of the modern developments in nail improvement have concerned the shank, and the experiments in this connection have concentrated primarily on economy in manufacture and maximum resistance to withdrawal. Another important aspect is the ability of the shank to support a load. One of the most useful modern advances is the nail with helically and annularly threaded shank, designed for use in building ships, securing the linings of automobiles to the bodies, and in making boxes, furniture and wooden pallets. In practical experiment it has been found, for example, that whereas nails with plain shanks would withstand a lateral load of 360lb. before being drawn, nails with annularly threaded shanks would withstand a load of 1,640lb. without a single nail drawing out or the material failing.

Cost Factor

The threaded nails cost more, but the slightly increased cost (about 33⅓ per cent., according to one authority) is more than compensated by the vastly increased strength of the construction in which they are used. It appears to be established that a correctly threaded heat-treated nail can be made ½in. shorter in the total length than an unthreaded nail of equal diameter. But, in general, it is preferable to compromise on ¼in. shorter shank and a slightly smaller diameter, because in this way a minimum splitting of the wood is achieved and thinner material can be used, with economy.

Etched Nails

Another modern type of nail is that which has a shank whose surface has been roughened by means of an etching agent. It is usually a round wire nail, and the object of the chemical action is to give the nail a greater holding power. It should be noted, however, that such increase in holding power is not permanent, because all wood contains a degree of moisture, and this may cause rotting of the wood fibres in contact with the nail surface.

Barbed Nails

There is some advantage to be gained by using nails along whose sides barbs or indentations have been made, but for this to be gained it is essential that the wood should be as dry as possible and maintained in this condition, or again there will be a danger of fibre-rotting.

Resin-coated Nails

A novel and relatively new nail is that which has been provided with a coating of resin. The frictional heat developed by the driving in of the nail causes this resin to liquefy, and it then constitutes a cement uniting nail and wood. Such a resin coating has great advantages when employed on woods of light character, but is not so good for the harder woods. Moreover, its cementing action may decline in time if the wood is only partly dry or actually green.

Nails of Tapered Form

Nails of tapered form have a rectangular cross-section and are primarily employed for floorboarding, but they are not now so popular as they were, their place being largely taken by the better wire nails produced at less expense.

Twisted Nails

Nails are also being produced with a square cross-section and with a twist from head to point designed to produce grooves that give the nail an improved holding power, see C, Fig. 1.

Nails with Threaded Shanks

The application and performance of these depend largely on the type of thread. Some have long pitch of thread, some have short pitch, and the threads may be either helical or annular. The theory behind their design is that the fibres of the wood slip over the thread and pass into the grooves, thus closely gripping the nail. Unfortunately, these nails do not appear to be widely used in Britain as yet, and it is the fact that their economical production has not yet been completely achieved. Nevertheless they have great possibilities and have already proved efficacious in a wide range of applications. One is shown at B, Fig. 1.

Clearance

These nails are sometimes made with unthreaded portions at the top between the head of the nail and the spiral threads. The object of this clearance is to enable the nail to rotate freely in the work as it is driven into the lower piece. This gives a firmer fastening. The clearance is specially useful when the unthreaded portion extends slightly beyond the material being secured and the threads begin in the second material. Such clearance is designed for joining an upper hardwood flooring strip to a softwood subflooring.

It is also possible to obtain threaded nails with a plain portion between the final thread and the point. The object of this is to give easier driving, and assuming the correct thread to have been given to the nail, there will be no decline in holding power.

Weight of Nails

There is great variation in the weight of nails, which depends, of course, upon their type and material. As an example, spike nails, 10in. long, weigh about 750lb. per 1,000, whereas wrought brads, ½in. long, weigh only 8oz. per 1,000. Wrought copper nails of diehead type, 5in. long, weigh 116lb. per 1,000, as against 1½in. brads which weigh 3lb. per 1,000.

Holding Power of Nails

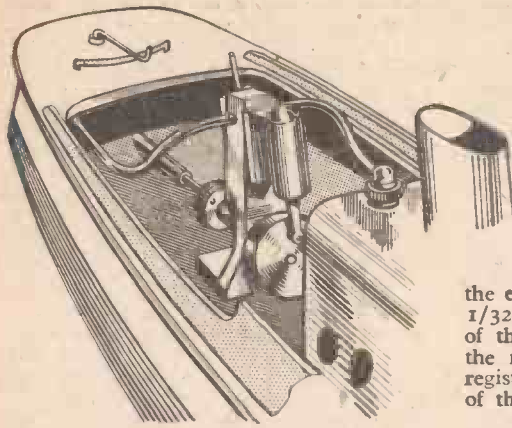
We have already given one example of the relative holding power of nails, but it may be useful to the reader to know that holding power varies approximately in proportion to the depth to which they are driven. For example, 6in. S.W.G. No. 1 smooth wire nails have been found to need about 1,000lb. per in. of depth for their withdrawal when driven into hardwood. The holding power is also affected by the condition of the wood, i.e., whether seasoned or unseasoned, being greater with unseasoned wood. The general holding power is, as we have seen, increased by giving the nail a screwed thread.

Slating Nails

For nailing slates on roofs, it is advisable to employ composition nails, which have greater rigidity than those of copper or zinc, and cost less to buy. They resemble brass in appearance. If, however, iron or low-carbon steel nails are used, it is better that these should be of galvanised type, though a useful alternative is to boil them in linseed oil. It is usual to employ two for every slate, 1⅜in. in length for the smaller slates and for the larger slates from 1½in. to 1¾in. long.

Nail Specification

There is a British Standard Specification for wire nails and cut nails for building purposes (No. 1202 of 1944). This provides a range of standard sizes and dimensions of wire nails and cut nails and includes a comprehensive list of round wire nails, as well as a shorter list of oval wire nails, any of which may be of mild steel or copper. The various surface finishes in which the nails are available are also specified. The requirements in regard to cut steel nails cover all those types normally employed and give the standard sizes available. In addition, the reader will find useful appendices giving the approximate count of nails per lb. in the case of both wire and cut nails.



REVERSING GEAR *for oscillating cylinder* STEAM ENGINES

Here are Details of Two Simple Methods

MANY model steam engines which are driven by one or two single-acting oscillating cylinders are non-reversible, that is, they can run in only one direction. The general arrangement of a single cylinder, and its steam block, is as shown in Fig. 1, steam reaching the cylinder through one of the ports (A) in the steam block; (B) the other port; (C) being the exhaust port. The direction of rotation of the engine is clockwise, as indicated by the arrow. It will be seen that if the function of these ports could be reversed, and steam admitted through port (B), the direction of rotation of the engine would be reversed. This condition can be brought about by the addition of a reversing plate, in the manner illustrated in Fig. 2. A new steam block would also be necessary, in place of the existing block, the only difference being the additional steam port in the centre, and the trued-up back face against which the reversing plate works. If the old steam block is wide enough the central port and side hole for the steam pipe can be drilled in it, and a new block would not be necessary.

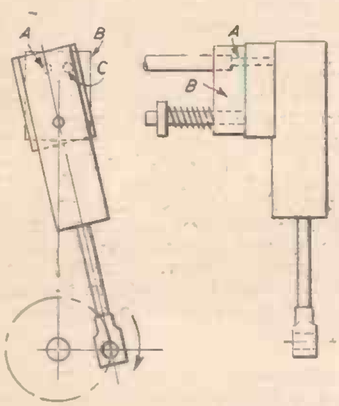


Fig. 1.—General arrangement of a single-acting oscillating cylinder and steam block.

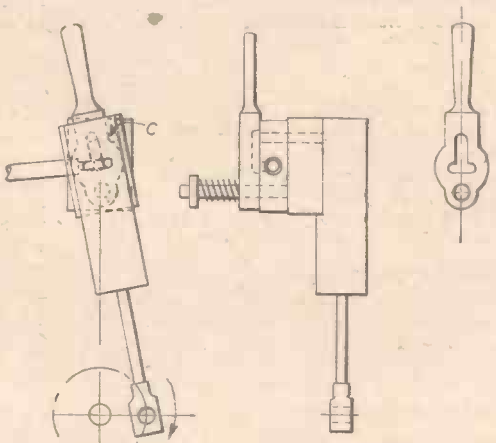


Fig. 2.—Showing the addition of a reversing plate to an oscillating cylinder.

Shaping the Reversing Plate

The reversing plate can be roughly cut out with a hacksaw from a piece of sheet brass 1/8in. thick, and filed to shape. The centre steam cavity, which can be drilled and chipped out with a small cold chisel, need not be more than half the thickness of the plate in depth.

It will be seen that when the reversing plate is in the position shown in Fig. 2 the engine will run in a clockwise direction, the cylinder exhausting through port (C) on the return stroke. When the plate is pushed over to the other position steam is admitted to port (C) and the engine will rotate in the reverse direction, port (A) then becoming the exhaust port. Short stop pins, cut from 1/32in. iron wire and soldered to the sides of the steam block, limit the movement of the reversing plate, and assure the correct registering of the steam cavity with either of the ports in the top of the steam block.

For Twin-cylinder Engines

Model stationary engines or locomotives driven by two oscillating cylinders can be reversed in a similar manner by a simple reversing plate, which changes the cylinder steam ports to exhaust, and vice versa, as required. In the illustrations, Figs. 3 to 6, the arrangement is shown applied to a simple locomotive, and for a stationary engine the arrangement would be similar, the only difference being that in the latter case the cylinders would probably be wider apart, thus necessitating slightly longer connecting pipes.

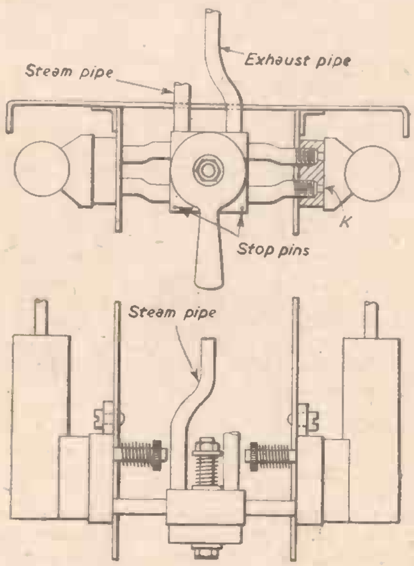


Fig. 3.—Elevation and plan of a reversing arrangement fitted to a double cylinder model engine.

A general arrangement of the cylinders and reversing plate, in elevation and plan, is given in Fig. 3, from which it will be seen that two pipes lead from each cylinder block of a central steam-distributing block, on the face of which the reversing plate works.

Steam-distributing Block

To make the steam-distributing block take a small block of brass and carefully file it up square to the dimensions given in Fig. 4. Scribe the two centre lines and centre-punch the centre of the block, after which lightly scribe a circle of 3/16in. radius and centre-punch the position of the four ports on the face of the block as shown. Mark the position of the holes for the steam pipes on one side of the block and drill these carefully right through the block with a 5/64in. twist drill, afterwards enlarging the holes for a distance of 3/16in. with a 1/8in. drill to take the ends of the connecting pipes. The four holes in the face of the block can now be drilled, also with a 5/64in. drill—the two marked S, E, right through the block, and the other two to meet the holes already drilled through the sides.

The holes S, E, should be enlarged at the back of the block and tapped out to take the screwed ends of the main steam and exhaust pipes. The centre hole to take the pivot-pin should be 3/32in. diameter, slightly counter-sunk on the face of the block.

The reversing plate and handle, R, can be filed to shape from a piece of brass 5/32in. thick, and the two grooves made in the face to the same radius as the holes in the block. Make the grooves the same depth as the diameter of the holes. The best way to form the grooves is to drill about five holes the required depth for each groove and finish with a small chisel. Drill the centre hole 3/32in. diameter and slightly countersink on the face of the plate, as indicated.

The working faces of the steam block and reversing plate must be prepared by rubbing them down with pumice powder and oil on a piece of plate glass, or a small surface plate, after which, clean out the holes to free them from any sediment. For the pivot pin, a 3/32in. Whitworth bolt can be used which is screwed for 1/4in. at the end. The spring can be of steel, or hard brass-wire, about No. 21 gauge, and this is tightened up with a nut and washer until the working faces of the block and reversing plate are pressed tightly together. To limit the movement of the reversing handle two pins cut from No. 19 gauge steel wire are pressed

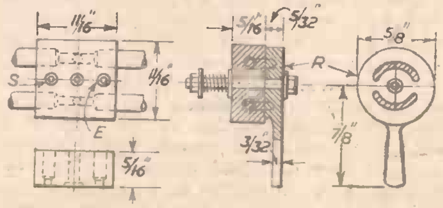


Fig. 4.—Details of steam-distributing block and reversing plate.

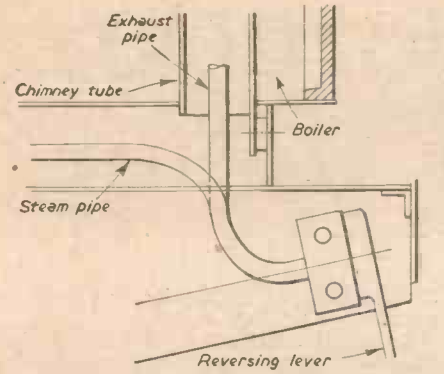


Fig. 5.—Sectional view of the front part of a model locomotive, showing the position of the steam-distribution block and reversing plate.

into holes drilled near the bottom corners of the block, as indicated.

Cylinder Steam Blocks

With regard to the cylinder steam blocks already fitted to the engine the exhaust ports have to be drilled out and tapped in the same manner as the other ports (see Fig. 3). For the connecting pipes cut four pieces of 1/8in. diameter brass tubing, one end of each piece being screwed for a distance of 3/16in. Anneal each piece of tubing by heating it in a gas flame and plunging it into water, after which they can be screwed into the steam blocks.

Bend each pipe lightly so that the projecting ends can be pressed into the holes in the reversing block, as shown in Fig. 3, after which the pipes can be neatly sweated in place.

The reversing of the engine is brought about in the following manner: when the reversing handle is over to the right, as shown in Fig. 6, one recess in the valve connects the two top pipes with the steam inlet port, S, while the other recess puts the two bottom connecting pipes into communication with the exhaust port, E. This allows the engine to travel in one direction, but on pushing the handle over to the left the top pipes will be connected to exhaust and the bottom ones to the steam inlet, thus causing the engine to run in the reverse direction.

Angle of Steam-distributing Block

It will be noticed, with reference to Fig. 5, that the steam-distributing block is fixed in an inclined position. This is necessary in order to bring the face of the block square with the

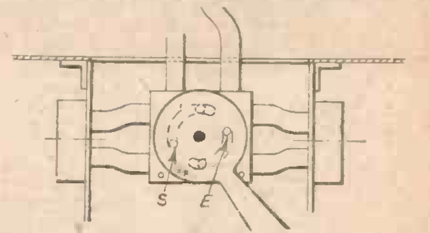
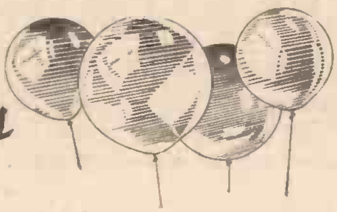


Fig. 6.—Front view of steam block and connecting pipes explaining the function of the reversing plate.

centre line of the cylinders and driving axle of the locomotive. In a model stationary engine the same angle must be maintained between the steam block and the centre line of motion.

HYDROGEN *Filled Balloons*



How to Inflate Balloons with Hydrogen Produced by Electrolysis

ELECTROLYSIS offers a simple means of obtaining hydrogen to fill balloons, and Fig. 1 shows a very simple method of arranging a hydrogen-producing plant of this kind. With its aid a number of balloons may be filled for amusement, though it must be stressed that the production of hydrogen by this means is not rapid, unless a powerful current is available. With the equipment shown $1\frac{1}{2}$ amps was used, and this resulted in the collecting vessel, $4\frac{1}{2}$in. in diameter and 8in. high, being filled in about 2 hours. It is thus necessary to set up the equipment and leave it until such later time as actual inflation is possible.

The Apparatus

The collecting vessel is best made of glass so that the production of the gas may be observed. It stands upon two wooden strips, which in turn rest upon a sheet of glass on the bottom of the vessel. The glass must not be omitted as it serves as an insulator between the negative electrode and metal vessel, and also prevents oxygen, evolved at the positive pole, rising into the collecting vessel. Though carbon is ideal for the electrodes, the positive electrode was obtained by taking one lead to the metal container itself, as shown. The negative electrode was a piece of aluminium about 3in. by 6in. curved to stand inside the collecting vessel.

The pumping valve was made up by having two ballbearings rest upon smooth holes in collars fitted in a larger tube, as shown. The cycle pump should have a second leather piston washer added, facing the opposite way to the existing washer, so that it can be used for both suction and pressure purposes. This can be done by removing

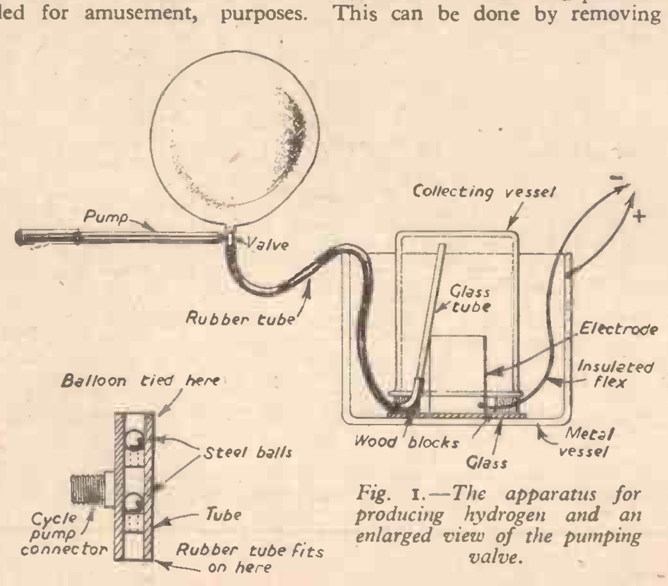


Fig. 1.—The apparatus for producing hydrogen and an enlarged view of the pumping valve.

the screw holding the washer in place upon the end of the inner stem of the pump. For convenience the pump was secured horizontally in a vice, the valve tube being vertical so that gravity allows the ballbearings to take up their correct position.

Operation

When the equipment is complete, the metal vessel should be filled with water to which a few spoonfuls of common salt have been added. Upon the pump being operated, the water should rise in the collecting vessel until it is as high as possible without flowing down the glass tube. A balloon is then tied securely to the upper end of the valve tube.

Current may be obtained from an accumulator or rectifier circuit. The higher the current, the more rapidly will hydrogen appear. With a 12V. supply the current was $1\frac{1}{2}$ amp, filling the vessel as mentioned.

When sufficient gas has risen into the collecting vessel, the pump is operated to transfer it to the balloon. If insufficient gas is available in one operation, then the balloon should be tied off and the apparatus left until the collecting vessel is again filled. Whether or not this is necessary will depend on the extent to which the balloon is inflated, and the size of the vessel.

Slightly inflated balloons will not rise. With the average-light balloon, buoyancy is reached when it is inflated to a diameter of about 5in. to 6in. This, however, will depend on the exact weight of the balloon, and the amount of air originally in the tubing, etc. After this point, further inflation will result in the balloon rising rapidly when released. As the lifting power of hydrogen is only a fraction of an ounce per cubic foot, all unnecessary weight must be avoided. The mouth of the balloon may be tied in a knot to avoid string, and care should be taken that no water is pumped up into the balloon, or its ability to rise will be destroyed.

In view of the inflammable nature of hydrogen the balloons should not be allowed near any naked flame. Large balloons will lift paper cut-out figures or other very light objects. If the lift is carefully adjusted, the balloon will rise when slightly warmed, and sink again as the gas cools.

Brush, Comb and Figure Graining

Methods of Imitating Hardwood Grain on Softwood

By CECIL JASPER

ANY reader may attempt the graining of wood providing they have some idea of how to set about the job. Simple comb and brush graining may be achieved quite easily, while figure graining needs more serious attention.

The object of graining is to imitate or copy the natural colour and grain of the various hardwoods—oak, ash, walnut or mahogany. To begin with the work must be primed and undercoated in the usual way, and then the foundation coat or ground colour is applied. This colour should be similar in tone to the lightest colour seen in the finished work. The ground colour can also be applied to an old painted surface, but it is important that the surface should be well rubbed down first to remove any irregularities. The ground colour for light oak is light buff, for dark oak dark buff, and for mahogany orange or salmon pink. Ground colours can be bought from reputable paint-makers, together with a suitable oil stain called "Scumble." The latter needs to be diluted with white spirits or turpentine to obtain the right consistency before application.

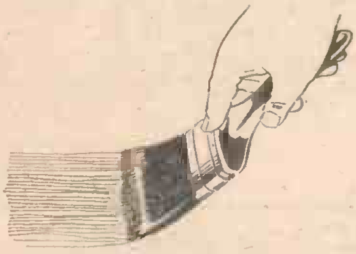


Fig. 1.—Brushing on the ground colour.

Fig. 2.—Steel graining comb.

Some grainers like to work on a glossy ground while others prefer a matt surface; it is essential, however, that the ground colour should be hard and dry before the stain is applied.

Ground colours for staining upon can also be mixed from paste white lead. To do this take about 4lb. of lead, three parts of raw linseed oil and two parts of turpentine; mix to the consistency of cream, then add one-eighth pint of goldsize to assist in drying off; afterwards colour the mixture with paste yellow ochre to make a buff colour. All ground colours should be well rubbed into the surface and brushed out well (see Fig. 1).

Brush and Comb Graining

Having mixed up the stain test the mixture on a piece of board. If it is too thin it will run, if too thick it will tend to dry out patchily, but a little practice will give some idea of how the stain should be brushed out. Use a stiff brush and stain edges first and flat surfaces last. Oil stain has a tendency to dry quickly, so it will be found best to finish off one part of a job completely before staining a fresh surface. Rub the stain in as quickly as possible, and brush out evenly, then while the stain is wet draw a stiff dry brush down the work in a straight or wavy manner to imitate the plain grain of oak. Having done this take a broad steel graining comb, as shown in Fig. 2, begin at the right edge of the panel and draw down the work till half of the panel is completed. Next take a fine comb and commence on the left-hand side of the panel, and join up to the broad combing. The latter may be done in straight or wavy strokes.

Figuring

The more ambitious readers may like to try figure graining. Examination of real oak reveals a plain grain running lengthwise and the figure crossing it. The plain grain is, of course, put in with a dry stiff brush and steel comb, as pointed out previously. In attempting figure graining rub the stain into the surface in the usual way, then, after brushing and combing, put in the figuring.

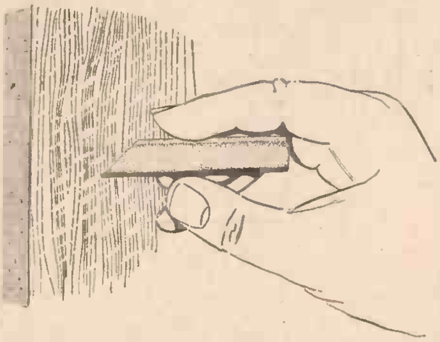


Fig. 3.—Putting in figure with rubber.

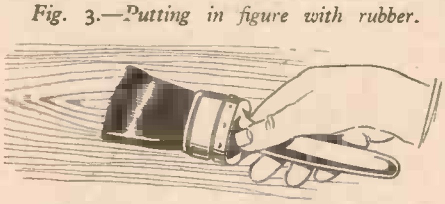


Fig. 4.—Feathering out the graining.

This is done with a piece of soft rubber cut to a chisel point, as shown in Fig. 3. Parts of the stain are wiped out to make rays, veins, rings and heart growth as seen in oak wood, afterwards a soft brush or mottling brush is lightly drawn over the work to give a feathering-out effect, as shown in Fig. 4. To grain mahogany, brush on stain, then put in dark streaks, feather and curl, and blend light parts into dark parts.

Overgraining

Overgraining always makes a better job of the work. To do this rub the work over with a lightly damped sponge rubbed in whitening; this prevents the overgraining stain from working up in small beads, called scissing. Next take very thin stain and lightly put in veins, rings and rays with a soft writing pencil or overgraining brush, as in Fig. 5. When a panel is completed feather the whole out by drawing a soft brush over the overgraining.

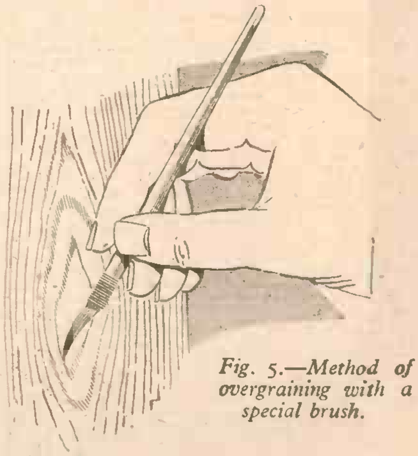


Fig. 5.—Method of overgraining with a special brush.

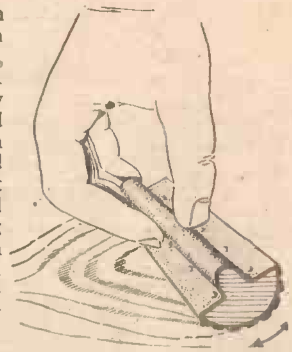


Fig. 6.—Using a graining tool.

It is essential to give all grained work a coat of good oil varnish as soon as the graining is dry as this affords protection and brings out the beauty of the work. The varnishing, however, should be done on a warm day or in a temperature of 75 deg. to prevent the varnish from losing its gloss and lustre.

Figure graining needs practice, yet it is within the reach of the persevering handyman.

Special Graining Tools

A set of rubber graining tools makes it possible to grain by mechanical means. Having prepared and stained the surface the tool required is selected. The corrugated or heart tools form a coarse grain or best heart growths, the veined tools produce finer grains and champs, or the quartered oak tool with comb and blender may be used. A straight grain is made by simply drawing the tool down the surface of the work, while a heart growth is obtained by rocking the tool back and forth as drawn along. Reversed grains may be obtained by running the tool off the panel and starting again at the opposite end. One of the tools is shown in use in Fig. 6. It is claimed that no two grains are exactly alike. It is essential, however, to bear firmly on the surface when working the grainers to ensure the correct impression. The grainers are able to grain both convex and concave surfaces. These graining tools are made by the Ridgely Trimmer Co., 117, Clerkenwell Road, London, E.C.1.

Making a Miniatu

BILLIARDS has for many years been one of the most popular indoor games, but many have been prevented from playing regularly by the large amount of room a full-sized billiard table occupies and its cost. The introduction of miniature billiards has brought the game within the reach of everyone and, what is more, anyone, even with only an elementary knowledge of woodworking, can make a billiard table on which a very good game may be played. It has not the heavy and expensive slate bed which is the main feature of the commercial table, but is efficient nevertheless. It is intended to stand on the ordinary dining-table, as shown in the heading picture. This system is satisfactory for ordinary home use, but if the reader wishes to set the table at the correct height, it may be necessary to construct a special table.

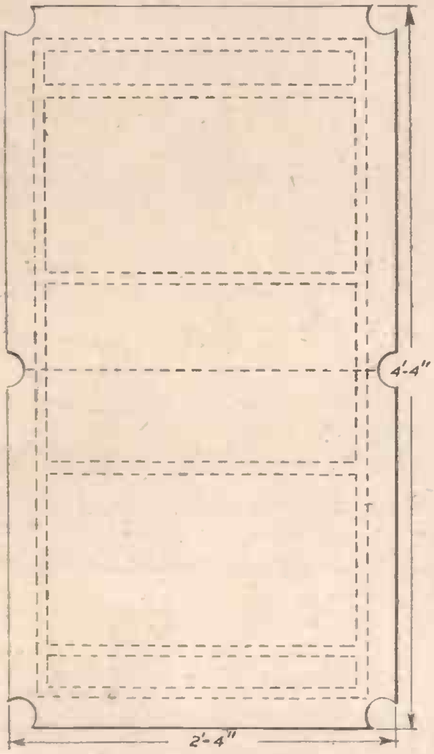
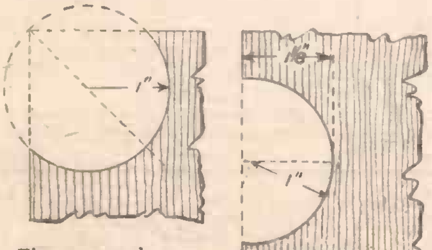


Fig. 1.—The top of the table.

Standard sizes for miniature tables are:—
4ft. 4in. by 2ft. 4in.
5ft. 4in. by 2ft. 10in.
6ft. 4in. by 3ft. 4in.
7ft. 4in. by 3ft. 10in.



Figs. 2 and 3.—How the pockets are made.

A table of the smallest size has been chosen for description but the conclusion of the article is devoted to modified instructions for building the larger sizes. Although it is possible to play a better game on a larger table, it should be remembered that a smaller one is less difficult and costly to make, and requires less room.

The table is made with a thick plywood top fixed to a strong frame. The top is covered with baize, the cushions are also covered with the same material. Four feet are screwed under the frame in such a way that the table may be adjusted and set quite level. Balls 1½in. in diameter should be used.

The Top

The plywood top measures 4ft. 4in. by 2ft. 4in., it should not be less than ¼in. thick, and is set out as shown in Fig. 1. It will be necessary to choose a good board, free from imperfections. The pocket holes, one of which is cut at each corner and the remaining two in the middle of the sides, are marked with a pair of compasses set to the radius of 1in. as shown in Figs. 2 and 3. The edges should be planed quite straight and square and the holes may be cut with a fretsaw.

The Frame

This is shown at Fig. 4 and is made with two sides 4ft. long by 2in. wide by ¾in. thick and six cross-pieces 1ft. 11in. long by 2in. wide by ¾in. thick. The cross-pieces are framed to the sides by cutting grooves ¼in. deep in the latter and fitting the cross-pieces in, fixing them with glue and nails. Care must be taken in setting out and cutting the joints, for the frame must provide a perfectly level bearing for the plywood top. On completion it could be tested for trueness with the eye, and a straight edge should be used to see that the sides and cross-pieces are level. If they are not, they should be planed.

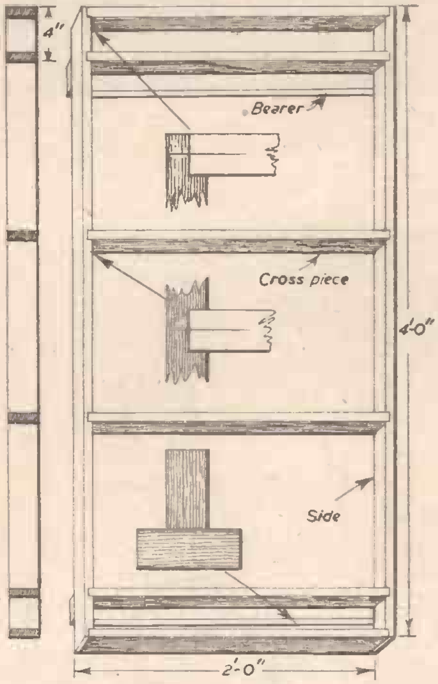
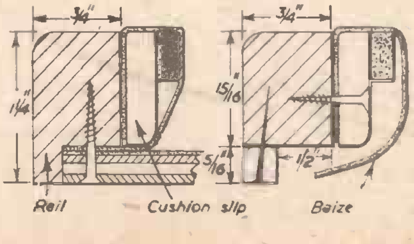


Fig. 4.—The frame.



Figs. 5 and 6 (Left).—Two methods of forming the rebates in the rails. Details of the cushions.

Constructional Details of the

To complete the frame, two bearers 2ft. long by 2in. wide by ¾in. thick are prepared and fitted under the sides and the cross-pieces next to the end ones, screws being used for fixing. The top is pinned to the frame, the latter being shown under the top by dotted lines in Fig. 1. If the frame is first placed over the top and its position marked in pencil, the lines will form a guide for driving in the pins. Brass pins with small heads are the most suitable to use; they should be punched in and the holes stopped.

Fig. 7.—The ... for the po...

The Rails and Cushions

The table is surrounded by rails, formed in six pieces and placed one at each end and two at each side. The end rails are roughly 2ft. 1in. long and the side rails 2ft. long by 1¼in. high by ¾in. wide. Rebates ½in. wide by 5/16in. deep are cut at the bottom edges of the rails for fitting over the plywood top, and the outer top edges are lightly rounded over, as shown at Fig. 5. If difficulty is experienced in cutting the rebates, the rails could be prepared 15/16in. high by ¾in. wide, and small fillets 5/16in. high by ¼in. wide glued and pinned underneath to

Fig. 8.—H... rubber is fi... the cushi...

A perspective view of the completed table.

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form the rebates, as shown in Fig. 6. The outer edges of the fillets are rounded over to break the joint.

The rails, when fitted in place, finish level with the edges of the pocket holes, and the ends are cut to an angle of 45 deg. across the width of the rebates, as shown at Fig. 7. The cushions are formed from strips of fairly soft rubber ⅜in. wide by 3/16in. thick and if strips of this size cannot be obtained, they may easily be cut from a sheet about 2ft. 2in. long by 3in. wide. The strips of rubber are cemented to cushion slips 15/16in. wide by ¼in. thick; the slips finish 3/16in. shorter than the rails at each end, and the ends of the slips are rounded, as shown at Fig. 8. The rubber should be held under pressure while the cement is drying and the ends should be cut to fit against the rails, as shown at Fig. 7. The baize which is used to cover the cushions should be cut in strips about 2ft. 3in. long by 3½in. wide. One edge is tacked to the back of the cushion slip, the latter is then fixed to the rail with screws, as shown in Fig. 6, and the baize is brought over and tacked under the rail, as shown at Fig. 5. The baize must be neatly fitted over the ends of the rails and fixed with a few small tacks to provide a smooth entry for the balls into the pockets.

Covering the Top

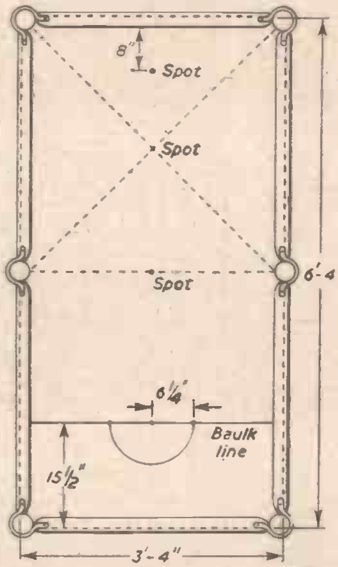
The baize covering should be just large enough to cover the top and it should be pressed with a hot iron before fixing. A few drawing pins could be used to hold it in place at first. It is then stretched tight and tacked around the edges, the ends are brought down over the pocket holes and fixed underneath and the rails and cushions are fixed with screws driven through the top, as shown at Fig. 5.

Finishing the Table

The pocket plates may be fashioned from 3/16in. round brass flattened at the ends and provided with screw holes for fixing, as shown in Figs. 9 and 10. The pocket nets could be purchased.

The plan of the finished table, Fig. 10, shows the position of the baulk line and spots, which may be marked with pipe-clay or a hard crayon.

Turned feet about 2in. diameter by 1in. high are fitted under the table, methods of adjustment being shown in Fig. 11. The simplest method is to drive dowel screws into the feet and screw them to the bearers of the frame, thereby providing height adjustment. Another method is to fix 5/16in. bolts into the feet, the heads of the bolts should be removed and the nuts let in flush with the top of the bearers, while holes are bored through the bearers and a short distance into the cross-pieces of the frame. A spirit level is necessary to ensure the levelness of the table when setting it up, the feet being adjusted as required.



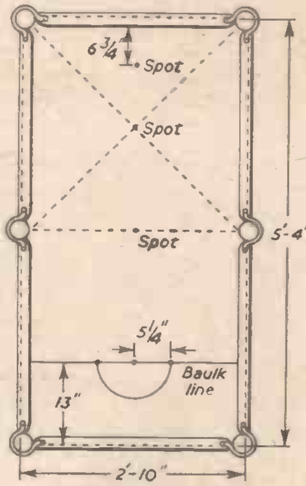


Fig. 13 (Left).—Marking out a 6ft. 4in. table.
Fig. 14 (Above).—Marking out a 5ft. 4in. table.

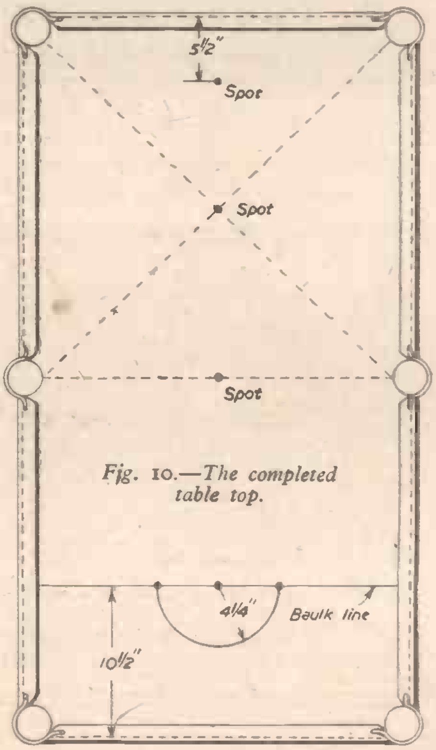


Fig. 10.—The completed table top.

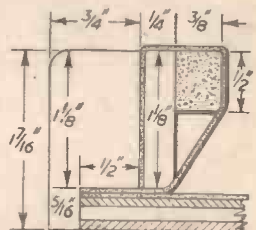


Fig. 15.—Details of the larger cushions.

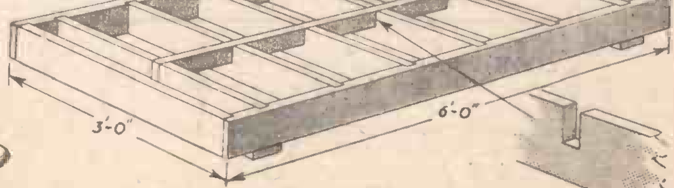
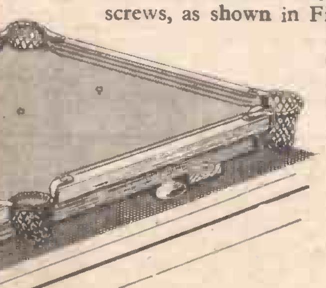
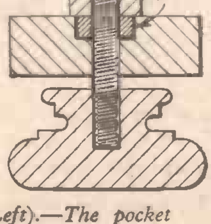


Fig. 12.—The frame for a 6ft. 4in. table.





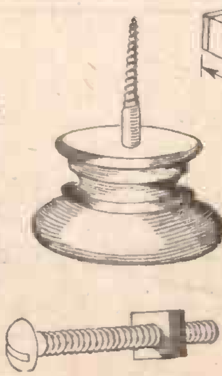


Fig. 9 (Left).—The pocket plates.
Fig. 11. (Right).—How the feet are made.

Larger Tables

The most important consideration with this type of billiard table is the levelness of the top and this depends upon the levelness of the frame which supports it. The larger table requires a stouter frame with additional cross-pieces and in Fig. 12 is shown the frame for a 6ft. 4in. table. The sides and cross-pieces should not be less than 3in. by 1in. The two end cross-pieces should be framed in and fixed first, after which the remaining ones are fitted and fixed, and the upper edges planed perfectly straight and true. Owing to the extra width, it will be advisable to provide a middle rail $1\frac{1}{2}$in. by 1in. to support the plywood between the cross-pieces. This should be fitted after the frame has been trued up, and it is then planed level with the cross-pieces. The 5ft. 4in. table could be made with or without the middle rail, but the framework need only be $2\frac{1}{2}$in. by $\frac{7}{8}$in.

The method of marking out a 6ft. 4in. table is shown in Fig. 13 and a 5ft. 4in. in Fig. 14.

Balls $1\frac{7}{8}$in. diameter should be used for the larger table and the pocket holes would be $2\frac{3}{8}$in. in diameter. The rails, cushion slips and cushions should be of the section shown in Fig. 15. For the small table the balls could be $1\frac{1}{2}$in. or $1\frac{3}{4}$in. diameter; if the former are used, the rails will be of the section previously given but the cushions could be $\frac{3}{8}$in. by $\frac{1}{4}$in. As before mentioned, the rubber for the cushions should be fairly soft and springy, and if they are cut from a sheet of rubber this should be obtainable from any nearby rubber warehouse.

Industrial & Process Heating

A New Copper Brazing Technique for Stainless Steels

Fig. 1.—An electronically-controlled seam welder.

THE increasing demand for metals for service at high temperatures has called for advances in brazing methods, and a technique has been developed for the copper brazing of stainless steels, and for the brazing of these and other metals using certain proprietary high-temperature brazing alloys.

An electronically-controlled seam welder (Fig. 1) has been developed by G.E.C. for the joining of very thin metal sheets at a speed of 2ft. per minute. It will handle steel sheets 10 mils. thick, Inconel or nickel 6 mils. thick and stainless steel, brass or copper 3 mils. thick. It is already in use at Armstrong Siddeley Motors, Ltd., for joining stainless steel sheets .004in. thick covering the insulation material used to absorb jet engine heat on the new Sapphire jet.

A horizontal batch-type furnace has been introduced for case hardening steels by the carbo-nitriding process. In addition to the heating chamber, this furnace has a purging section, an oil quench tank and a cooling chamber. Thus the whole process is carried out without exposing the charge to air or cooling the heating chamber.

A 275 kW vertical cylindrical furnace for the bright annealing of copper strip in coils is seen in Fig. 2.

The new G.E.C. furnace installation at the Springfields Atomic Factory includes fifty-four 100 kW cylindrical furnaces and two hundred furnace pots, together with associated control equipment, unloading gear and cranes. The equipment is used for the first of two stages in the conversion of pure ammonium diuranate to metallic uranium.

A 56 kW nitriding furnace has recently been installed at the Coventry Works of Jaguar Cars, Ltd., for case hardening crankshafts. Fully automatic temperature control and recording gear are included and the total heating cycle takes some 60 to 70 hours.

In another recent installation, for the scale-free annealing of steel wire, forced-air circulation is used at all stages: in the recuperator pit, inside the controlled-atmosphere-filled containers and in the cooling pit.

Radiant heating has been very successfully applied to the setting of fabrics woven or knitted from nylon or terylene. This setting process involves heating the fabric rapidly to a temperature slightly below its melting point and imparts the qualities of dimensional stability and freedom from edge curling, and yields a material having good "handle" and "drape." The capital cost of the former plant used for setting was as much as seven times that of the new radiant equipment.

Modern plant for radiant heating ovens for paint stoving employs two vertical opposing banks of sheathed wire element reflector units. It is well encased and fitted with unheated entrance and exit vestibules to minimise heat losses. Mounted well above head level it makes no demand on floor space. Paint is stoved in about two minutes and some 400 parts an hour can be handled.

The storage method of space heating, using energy at a low rate at night has proved extremely popular. The original 1.5 kW "Nightstor" heater has now been supplemented by 1 kW and 2.25 kW models which will greatly broaden the scope of heating engineers in planning installations.

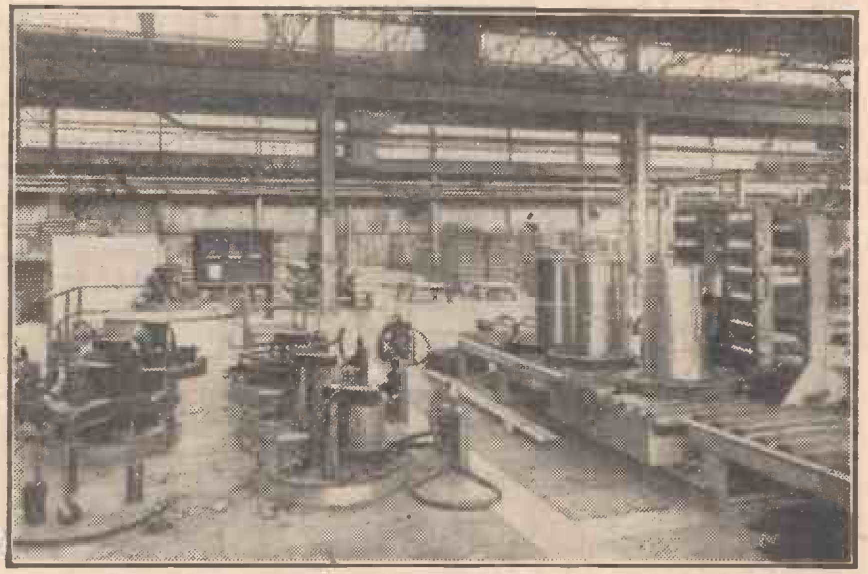
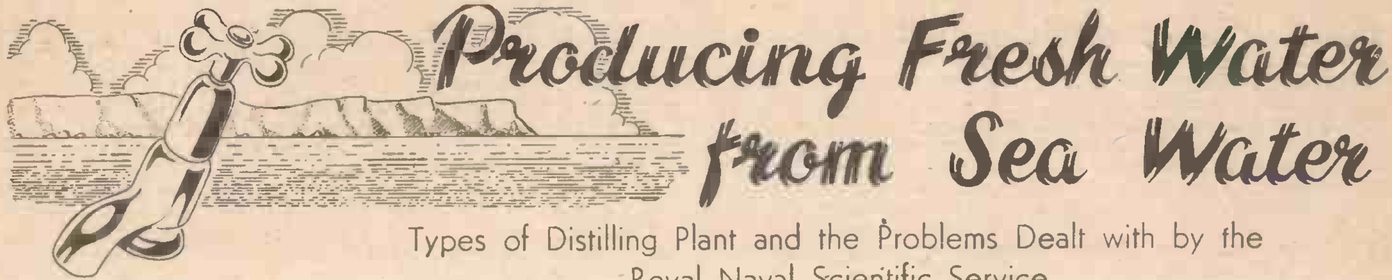


Fig. 2.—Photograph showing a 275 kW vertical cylindrical furnace.



Producing Fresh Water from Sea Water

Types of Distilling Plant and the Problems Dealt with by the Royal Naval Scientific Service

By J. LEICESTER, M.I.Chem.E., A.I.Mar.E.

IT is possible to store on board ship a limited amount of fresh water for domestic use, which can be replenished whenever the ship touches port, and in fact this is done to-day in many merchant liners making regular and short trips between two ports of call. However, the fighting efficiency and cruising radius of naval ships are at a premium, and the stowage of large amounts of fresh water is very wasteful and reduces considerably the fuel oil stowage and hence the endurance or cruising range of the vessel.

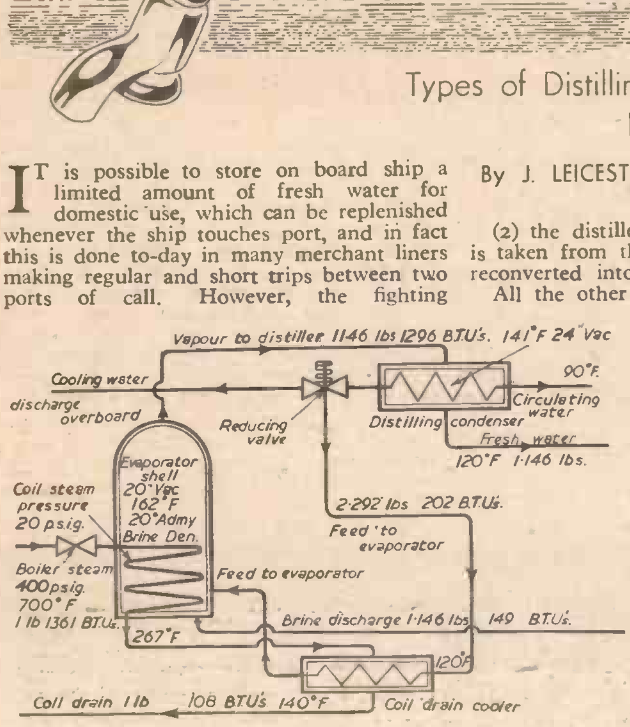


Fig. 1.—Single effect evaporator.

The obvious solution to this problem is to make use of the unlimited sea water available and to convert it into pure water for drinking and other domestic needs. This is no mean task, as may be seen from the fact that a battleship requires some 350 tons per day of fresh water to satisfy the needs of the ship's complement and to make up water losses in the boiler circuits. There is only one way of meeting this requirement. The fresh water must be produced by boiling the sea water in an evaporator plant, and condensing the vapour to form the required distilled water, whilst discharging overboard the concentrated sea water or brine from the shell of the evaporator, to maintain a convenient working density.

Single Effect Distilling Plant

A single effect distilling plant can be said to consist primarily of two heat exchangers, namely:

(1) the evaporator, in which heat is supplied to the sea water and which converts some of this water into steam (or vapour), leaving salt impurities behind in the residual brine.

(2) the distiller condenser, in which heat is taken from the vapour, which is thereby reconverted into distilled water.

All the other parts of the plant such as pumps, valves, feed heaters, etc., are supplementary to these two main components and are fitted either to enable them to perform their correct function or to increase the operating efficiency of the plant.

The term "vapour" is used to signify the steam/air mixture released from the boiling brine and the term "brine" refers to the concentrated sea water in the evaporator shell.

The single effect evaporator possesses one shell only. Heating steam passes through a series of heating coils where it condenses and gives up its latent heat of condensation to the surrounding brine, a proportion of which is converted vapour. The vapour then passes out to the distiller condenser where it condenses to form the product, distilled water. A typical flow diagram for a single effect plant is shown in Fig. 1. The vapour pressure in the shell can be either above, at or below atmospheric, according to the pressure of the heating steam available and the necessity for maintaining a temperature differential of about 70°F. between that of the heating steam and the brine boiling temperature.

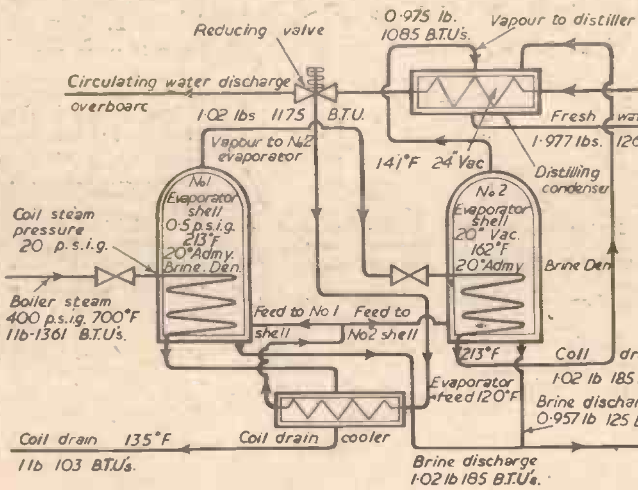


Fig. 2 (Above).—A double effect evaporator.

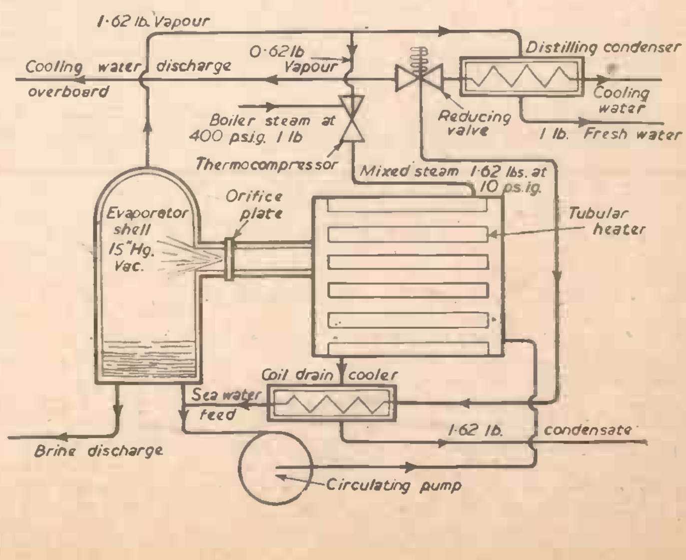
Fig. 3 (Right).—Forced circulation evaporator with thermocompressor.

Multiple Effect Evaporator

The multiple effect evaporator is merely a number of single effect units operated in series, but instead of the vapour from the first effect passing directly to the distiller condenser, it passes to the heating coils of the second effect, and so on throughout the number of effects that may be in use. The vapour from the last effect passes straight out to the conventional distiller condenser. A flow sheet for a double effect plant is shown in Fig. 2. The shell pressure or vacuum decreases in each effect to maintain the desired temperature differential between brine and heating steam. The choice of single or multiple effect evaporation depends upon a number of factors, the main ones being the initial pressure of heating steam available, the average daily output required and the space available for the plant. In general, the cost of water produced by a multiple effect evaporator is less than that from a similar capacity single effect plant, but this is offset by the increased size of the multiple effect evaporator. Thus for marine installations, where size and weight of plant are major considerations, single or double effect evaporators are preferred. In land power station installations, where cost is a more important consideration than space, it is found that quadruple and even sextuple plants are quite common.

Forced Circulation Flash Evaporator

Another design of conventional evaporator, the forced circulation flash evaporator with a steam thermocompressor, is in quite common use in land power stations, but it is not favoured for marine use. A schematic flow sheet illustrating this type of evaporator is



given in Fig. 3. The main advantage claimed is increased thermal efficiency coupled with reduced cost per ton of distilled water. However, to achieve this the plant becomes more complicated, and, what is even more important, the present design of heater with brine inside the tubes is very prone to scale formation from the concentrated brine. Once scaled up this heater is very difficult to clean on board ship.

Combating Scale Formation and Foaming

Scale formation is due to the dissolved salts contained in sea water and the seriousness of this fault may be seen from the fact that with untreated sea water it is quite common during a 500 to 600 hour operating period for a hard adherent scale layer ¼in. thick to form over the entire heating surface. This results in a considerable loss of efficiency.

When the sea water in the evaporator is boiled foam is formed on the surface and if the rate of vapour generation is sufficient the whole becomes a foaming mass. As the vapour is released from the foam surface large masses of brine are thrown upwards, and these break into droplets of varying mass and diameter. The height to which these droplets are projected is directly related to the rate of vapour release from the foam surface. If the evaporator design is such that there is sufficient height between foam surface and the entrance to the baffle no brine particles will reach the baffle by direct splashing. However, once each splash has broken up, the individual droplets then come under the influence of the velocity of the vapour passing up the shell of the evaporator. Particles above a given size will, due to their mass, drop back into the brine; whereas particles of smaller mass will be entrained in the vapour stream and pass upwards into the baffle. A proportion of these small particles may pass through the baffle and into the condenser; this is known as carry-over. It will be obvious that for a given brine density in the evaporator the salinity of the made water (distillate) will be directly proportional to carry-over.

Feed Water Additives

It is not always possible to modify a plant to increase the height between foam surface and the inside of the baffle, but this effect can be achieved by the addition of a feed water additive. An anti-foam compound may be introduced, reducing considerably the head of foam on the boiling brine and thereby increasing the height safety factor between brine level and the inside of the baffle. The result is to increase the heating surface immersed in the boiling brine and thereby increase the output of distilled water whilst maintaining a high standard of purity.

After considerable research the Royal Naval Scientific Service have found chemicals which will combat the formation of scale. With these chemicals in use scale still forms, but no longer adheres to the metal heating surface. Instead it cracks and falls away.

Costs

Feed water treatment has reduced the cost of water produced from 18s. per ton to 12s. per ton and assuming a total production of water throughout the fleet of 2,000,000 tons of distilled water per annum a net saving of some £500,000 per annum is obtained.

The future will probably see the increased use of new methods, particularly the vapour compression distillation method, which can produce fresh water at a cost of 3s. to 4s. per ton. Under active consideration also are two alternative methods based wholly or partly on ion exchange principles.

A Portable Extension Lead

A Useful Flexible Mains Extension Lead for the Home or Workshop

By R. S. H.

WHEN using portable electric tools or appliances about the house it is often found that the flexible cord fitted is too short to reach the nearest power socket. The extension lead described provides a permanent solution to this temporary problem. It may be hung on the workshop wall, or stored in a cupboard without fear of finding a tangled muddle of flex and tools when required for use.

The basis of the lead is a non-returnable cable drum as used by manufacturers for

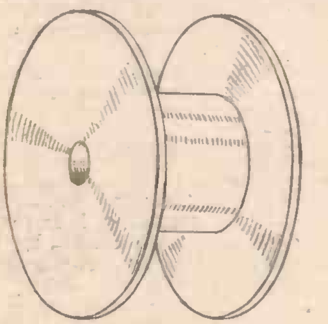


Fig. 1.—Drum before modification.

small radio and electrical cables. The most suitable type is that supplied with co-axial cables of the television aerial variety. Such a drum has sturdy plywood sides, and a central cylinder of stout cardboard supported by metal cross-pieces (Fig. 1), and most dealers will supply one, without charge, upon request.

Drum Modification

As supplied, the drum has a small hole in the centre of each cheek. These are enlarged with a keyhole saw to admit the bodies of two flush-fitting power outlet sockets. The particular type of socket will, of course, be dependent upon the type of plugtop fitted to the appliances in use, but the 13 amp. flat-pin socket, taking a plugtop with internal fuse, is in all respects the most suitable pattern. Such a socket has a spring-loaded cover blocking the holes until

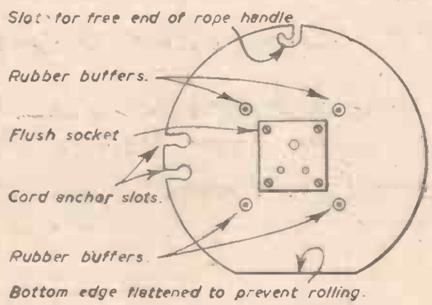


Fig. 2.—Side of drum after modification.

the plug is inserted, and since each plug has an individual fuse, the fuse rating may be selected to suit the loading of the associated appliance.

The flexible cord should be of good quality heavy rubber covered of circular section, often known to the trade as "cab tyre flex." Such a flex does not kink easily, and will stand an enormous amount of wear. The length fitted will depend to some extent upon local requirements, but 10yds. is more than adequate for all normal purposes.

Connections

As shown in Fig. 3, one end of the flex is passed through a hole in the central cardboard cylinder, and terminated, together with three short lengths of insulated wire, to one of the flush sockets. Several layers of electrician's adhesive tape are bound round the flex in a suitable position to prevent strain on the connections, should the lead be pulled back and through the hole when in use. The ends of the short leads are passed through the hole in the opposite cheek, the socket placed in position and screwed to the plywood with woodscrews. A second socket may now be connected and fitted in the same manner on the other side of the drum. When joining the plugtop to the other end of the flex, it is essential to be certain that each pin is connected to its opposite number on each of the sockets. This may be readily checked by the colour coding of the cable.

Four small rubber feet are screwed to the plywood around each of the sockets as shown in Fig. 2. These protect the faceplate from damage when the drum is lying on its side.

The Handle

The handle is simply a short length of sash cord passed through a hole at the top of the cheek and knotted, as shown in Fig. 3. The other end of the cord is also knotted, but

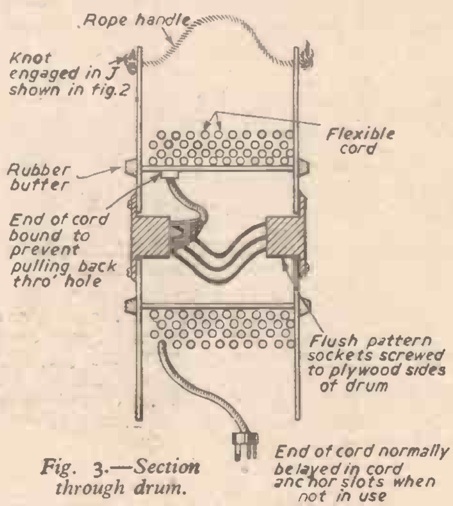


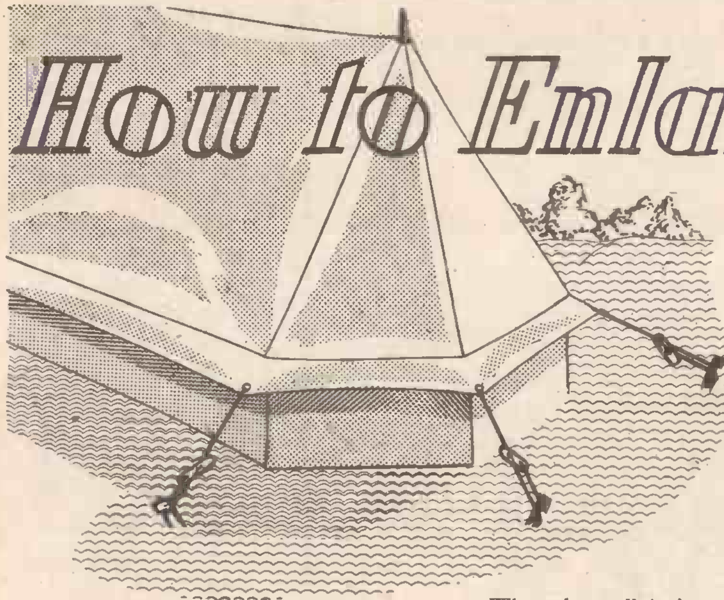
Fig. 3.—Section through drum.

in this case it is slid into the J-shaped slot, shown in Fig. 2, the knot engaging in the short leg of the J. Thus, when winding or unwinding the flex, one end may be released, leaving the winding area clear.

The cord anchor slots shown in Fig. 2 should be just wide enough to admit the flex, and should terminate in slightly larger holes. If the bight of the cord is hitched in and out of the two slots it will be firmly held and will not unwind itself until released.

The bottom edge of the drum is flattened by sawing off a small portion of the plywood sides, as illustrated in Fig. 2.

How to Enlarge a Tent



Two Methods of Obtaining More Space in a Small Tent

By H. A. ROBINSON

TENTS on the whole do not offer spacious accommodation and most campers using small-sized equipment will have wished at times that there was just a little more room.

With small-sized tents and light to medium weight material this "little more" is not difficult to achieve.

Extra headroom and greater value to the space close down by the sides is given by deepening the walls. Indeed, the increased cubic capacity of the tent with even only a small deepening is remarkable, a 6in. added depth producing $14\frac{1}{2}$ cu. ft. extra in a 7ft. x 5ft. tent.

To deepen the walls some material similar in weight to that used by the makers must be obtained and sewn into a strip equal in length to the perimeter of the tent and in width equal to the desired deepening; 6in. being a convenient depth.

Erect the tent, using bricks temporarily to give the necessary greater height to the poles. Remove the peg loops from the bottom of the walls, end and front, and take off any brailing there may be, and proceed to sew on the new strip.

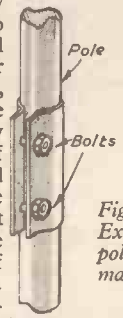
Hang it all round first with big tacking stitches or pins to obtain smoothness, then finish with finer stitching along the seam. Even though only using a strong needle and thread, a "palm" or at least a thick glove will be found useful in preventing a sore hand while sewing.

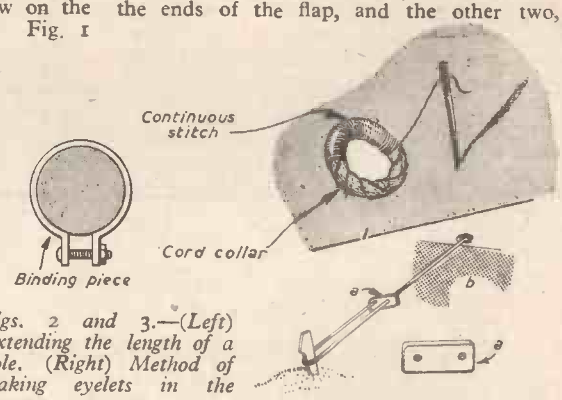
In setting up the tent to the new height, the runners will have to be let right out, but see to it that the angle of the roof is maintained correctly. With the usual length of guy no renewals should be necessary, but if any guy is too short replace it with a new and longer length.

When the wall is in position sew on the peg tapes and the brailing, if any. Fig. 1 makes this clear.

Lengthening the Poles

Should there be any to hand, it is easiest to replace the original poles with a fresh pair 6in. longer. If not, extensions can be made to the existing poles by cutting extra lengths of the same diameter and securing these to the ends of the now short poles with a simple binding piece of stiff tin, as shown in Fig. 2. Experience has demonstrated that when the bolts are taken up tightly very rigid joints result.





Figs. 2 and 3.—(Left) Extending the length of a pole. (Right) Method of making eyelets in the canvas.

At the front of the tent two new door tapes are finally sewn in position.

As well as giving an added height to an already walled tent the 6in. or so addition can be given to a wall-less bivouac. Here the improvement of inside space is very marked, but the task is harder, for the lower edge of the sloping roof must now be given eyelets and guy-lines. Eyelets are made by piercing the canvas and then sewing on a small collar of cord by a continuous stitch, see Fig. 3. Runners are pieces of wood as (a), while the complete guy line is as (b).

A second way to obtain more room in a tent is to make an end bay. When the tent is of the two-door type it can be made as a fixture at one end. With a one-piece end this can be cut and the bay thus introduced. The bay can be put in at the door end, but it is not so convenient here.

To make a bay, erect the tent, and fitting new guys (A) and (B) pull the existing flaps at the end to an angle (Fig. 4). Now cut three triangular pieces of material approximately equal in weight to that of the tent material. The pieces are (b) to fit between the ends of the flap, and the other two, (c) and (d), to bring the bottom of the walls level.

A rectangle (e) is also required to complete the space now left in the wall at the front. If the bay is to be a fixture, which is best of all, these parts are now sewn in position, new peg tapes being put in at (f).

Should it be wished, however, to incorporate the bay with the door, then one side of the triangular piece (b) and the rectangle (e) must be sewn in position only, fastening tapes being located at suitable positions along the other. It is best for the lower rectangle to have a heavy hook and eye at (K) as do most bell-tent doors.

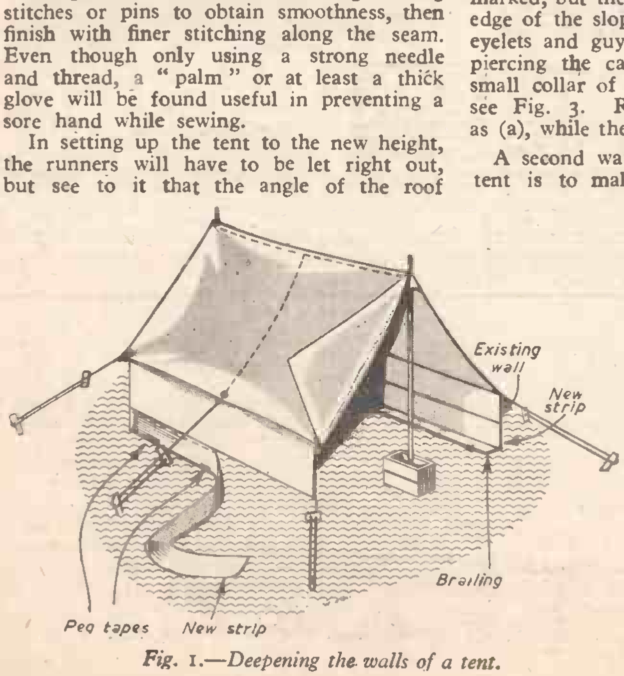


Fig. 1.—Deepening the walls of a tent.

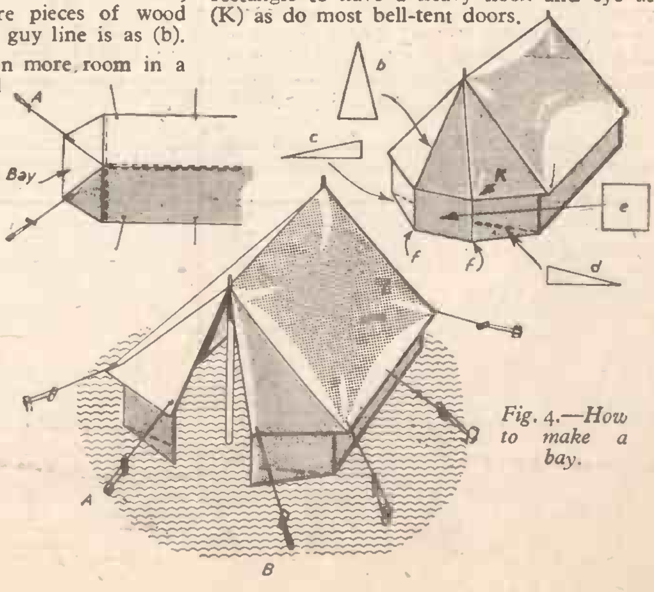


Fig. 4.—How to make a bay.

Voltage Reduction by Resistors and Choke Coils

The Theory and Mathematics Involved in Designing these Components

By J. L. WATTS

THERE are many occasions when it is required to supply a piece of electrical apparatus from a supply which exceeds the rated voltage of the apparatus, for instance, to charge an accumulator or to supply a low-voltage motor or coil. It is, of course, possible to obtain a reduced voltage from a D.C. supply by simply connecting a resistor in series with the apparatus at which the reduced voltage is required, as indicated in Fig. 1. There are, however, two factors which should

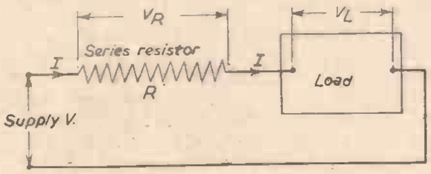


Fig. 1.—Connections of a series resistor.

be taken into consideration: first, there may be considerable losses in the series resistor; secondly, the voltage at the apparatus will vary with the load current.

Volt Drop Across a Series Resistor

In order to supply a piece of apparatus with a current I (amps) at a voltage V_L from a D.C. supply of voltage V the series resistor must be designed to create a volt drop of $V-V_L$. By Ohm's law the volt drop across a resistor having a resistance of R (ohms) which carries a current of I (amps) is equal to $I \times R$ volts. The series resistor should, therefore, have a value of $\frac{V-V_L}{I}$ ohms. The power loss (watts) in the series resistor will be equal to $I^2 \times R$, or equal to the product of the current I and the volt drop $(V-V_L)$ across the resistor; thus there may be considerable losses if a high resistance is required to create a high volt drop, and such losses are dissipated as heat in the resistor. A series resistor is, however, suitable for reducing the voltage at many small devices which require a constant current.

Accumulator Charging from a D.C. Supply

As an example we may consider the case of a series resistor used to charge an accumulator, of nominal voltage 12 volts, from a 230 volt D.C. supply. In order to charge the battery fully about 16.5 volts may be required across the battery, thus the volt drop across the series resistor should be $230-16.5=213.5$ volts. If 2.5 amps charging current is required the ohmic value R of the series resistor $\frac{V-V_L}{I}$ will be equal to $\frac{213.5 \text{ volts}}{2.5 \text{ amps}}$, or 86 ohms. The power supplied to the battery will be equal to $V_L \times I = 16.5 \times 2.5 = 41$ watts. However, the power loss in the resistor, equal to $I^2 \times R$, will be $2.5^2 \times 86 = 530$ watts, which is many times greater than the power supplied to the battery.

In some cases it may be possible to use an existing load circuit to charge the battery without losses. For instance, if a 600-watt 230-volt radiator is normally used for appreciable periods a single-pole two-way switch could be connected in the radiator circuit to enable the battery to be connected in series with the radiator for charging, as shown in Fig. 2. The current taken by a 600-watt radiator element on 230 volts is equal to $\frac{600 \text{ watts}}{230 \text{ volts}} = 2.6$ amps. The resistance of the element, equal to $\frac{\text{volts}}{\text{current}}$, is equal to $\frac{230}{2.6}$ $=89$ ohms, which is practically equal to the series resistor required to charge the 12-volt battery at 2.5 amps. When the battery is connected in series with the radiator element the volt drop across the element will be reduced to practically 213.5 volts, and the current through the element will be slightly reduced in proportion to the volt drop. With the battery in series the current will be equal to $\frac{\text{volts}}{\text{resistance}} = \frac{213.5 \text{ volts}}{89 \text{ ohms}} = 2.43$ amps. The output of the element, equal to $I^2 \times R$ watts, will be reduced to 520 watts, not a very serious reduction since the voltage required at the battery is comparatively low. An accumulator of lower voltage could be charged through the same element at about 2.5 amps with less effect on the output of the radiator. Similarly, a 750-watt mains voltage element could be

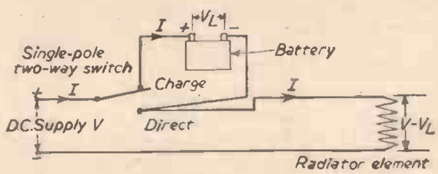


Fig. 2.—Use of existing D.C. load circuit for battery charging.

used to charge a battery at about 3.2 amps whilst a 1,000-watt element could be used to charge a battery at about 4.3 amps. Two elements can be connected in parallel with each other to double the charging current if required, as shown in Fig. 3. By the use of two elements of different rating, with separate switches as shown, three different charging rates can be obtained.

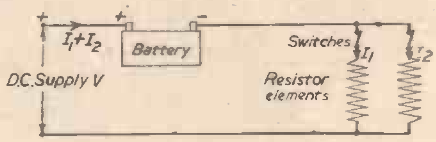


Fig. 3.—Connections for a three-rate battery charger.

Effect of Varying Load Current

The power loss in a series resistor is proportional to the volt drop; thus, if a piece of apparatus is supplied at half voltage D.C. the power loss in the resistor will be equal to the power supplied to the apparatus. In the case of an accumulator the voltage between its terminals does not vary to any serious degree when the load current varies, but this does not apply in the case of an electric motor, which requires special consideration. If a 120-volt D.C. motor having a full-load current of 4 amps is fed through a series resistor of 30 ohms from a 240-volt D.C. supply the volt drop across the series resistor will be 120 volts when the motor is fully loaded, and 120 volts will then be applied to the motor. The power loss in the series resistor will then be 480 watts, which will be the same as the power input to the motor.

However, if the load on the motor is reduced the motor will speed up and its back E.M.F. will rise, causing the current input to fall until this is just sufficient to allow the motor to develop a torque which is equal to the resistance torque of the load to which the motor is coupled. When fed through a series resistor, however, the volt drop across the resistor is proportional to the ohmic value of the resistor and to the current and thus will fall when the load on the motor is reduced.

If the motor load falls to 1 amp. the volt drop $(I \times R)$ across the series resistor will fall to 30 volts, and the voltage applied to the motor will automatically rise to 210 volts. The increased voltage may result in damage to the insulation and is likely to result in burning out of shunt-connected field coils. In any case it would cause the speed of the motor to increase to a much higher value than would otherwise be the case, especially if the motor has series-connected field windings. The rotating parts may then be damaged by the increased centrifugal stresses, which are proportional to speed². With a 1-amp. load the power loss in the series resistor will fall to 30 watts and the power input to the motor will be 210 watts. The voltage applied to the motor could be reduced to 120 volts on a

(Continued on page 361)

S.W.G.	Dia. in Ins.	100 deg. C. Amps	212 deg. F. Ohms Per Foot	200 deg. C. Amps	392 deg. F. Ohms Per Foot	300 deg. C. Amps	572 deg. F. Ohms Per Foot
5	.212	31.4	.0147	48.8	.0148	63.9	.0150
6	.192	27.4	.0180	42.8	.0181	54.6	.0183
7	.176	24.25	.0214	38.1	.0216	47.9	.0218
8	.160	21.5	.0258	33.65	.0260	41.9	.0263
9	.144	18.75	.0318	29.2	.0322	35.9	.0325
10	.128	16.0	.0403	24.5	.0408	30.4	.0412
11	.116	14.1	.0491	21.4	.0496	26.4	.0501
12	.104	12.25	.0612	18.4	.0617	22.7	.0623
13	.092	10.4	.0781	15.6	.0788	19.2	.0797
14	.080	8.7	.103	12.8	.104	15.75	.105
15	.072	7.5	.128	11.3	.129	13.7	.130
16	.064	6.4	.162	9.6	.163	11.75	.165
17	.056	5.3	.211	8.2	.213	10:0	.215
18	.048	4.3	.287	6.8	.290	8.3	.292
19	.040	3.4	.414	5.4	.417	6.6	.421
20	.036	2.9	.510	4.6	.515	5.75	.520
21	.032	2.4	.645	4.0	.652	4.8	.658
22	.028	1.9	.843	3.25	.852	4.1	.859
23	.024	1.5	1.14	2.6	1.16	3.3	1.17
24	.022	1.3	1.37	2.15	1.38	2.78	1.40
25	.020	1.13	1.65	1.9	1.67	2.48	1.68
26	.018	0.99	2.04	1.65	2.06	2.17	2.08
27	.0164	0.9	2.46	1.48	2.49	1.95	2.51
28	.0148	0.8	3.02	1.31	3.05	1.75	3.08
29	.0136	0.75	3.58	1.2	3.61	1.6	3.64
30	.0124	0.68	4.30	1.07	4.34	1.44	4.38
31	.0116	0.64	4.91	1.0	4.96	1.35	5.01
32	.0108	0.6	5.67	0.91	5.73	1.23	5.78
33	.0100	0.56	6.61	0.85	6.68	1.15	6.74
34	.0092	0.52	7.81	0.78	7.88	1.04	7.96
35	.0084	0.48	9.38	0.7	9.46	0.94	9.56
36	.0076	0.43	11.5	0.62	11.6	0.84	11.7

Table 1.—Currents required for given temperatures in straight, horizontal 80/20 per cent. nickel-chrome resistance wire when free to radiate.

1-amp. load by using a series resistor of 120 ohms, but if the load is variable it is seldom practicable to adjust the value of the series resistance each time the motor load changes. A series resistor should, therefore, only be used to supply a motor at reduced voltage if the load on the motor is constant and there is no risk of the motor becoming unloaded, as might occur if a driving belt should break or slip off a pulley.

Use of Potentiometer Resistors

A more steady voltage can be supplied to a load which does not have a constant resistance, or to a motor which operates on a varying load, by supplying it through a potentiometer resistor, as shown in Fig. 4. In this case if a

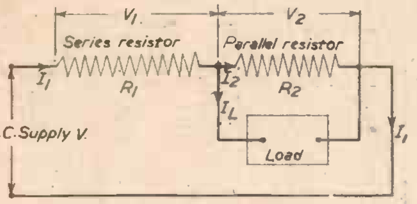


Fig. 4.—Connections for a potentiometer resistor.

load current of I_L amps is required at a voltage V_2 at a piece of apparatus the current I_2 amps passing through the parallel portion of the resistor, of resistance R_2 ohms, will be equal to $\frac{V_2}{R_2}$ amps. The current I_1 amps passing through the series portion of the resistor, of value R_1 ohms, will be equal to I_2+I_L amps. Thus, the ohmic value of R_1 must be equal to $\frac{V-V_2}{I_1}$ ohms, which is equal to $\frac{V_1}{I_1}$ ohms. If the load consists of a simple resistor of ohmic value R_L the current I_L through this load will then be equal to $\frac{V_2}{R_L}$ amps.

As an example we may consider the case of a 120-volt D.C. motor having a full-load current of 4 amps which is fed from a 240-volt D.C. supply by means of a potentiometer resistor. If the current I_2 through the parallel resistor is to be 1 amp when the motor is fully loaded this resistor must have a resistance of $\frac{120 \text{ volts}}{1 \text{ amp}}=120$ ohms. The current I_1 taken from the supply will then be 5 amps so that, for 120 volts drop the series resistor must have a resistance of $\frac{120 \text{ volts}}{5 \text{ amps}}=24$ ohms. The power input to the motor, equal to $V_2\times I_L$, will then be 480 watts. The power loss in the series resistor of 24 ohms is equal to $I_1^2\times R_1$, or 600 watts; whilst the power loss in the parallel resistor of 120 ohms is equal to $I_2^2\times R_2$, or 120 watts. This gives a total loss in the potentiometer resistors of 720 watts as compared with 480 watts for a simple 30-ohm series resistor. However, if the motor load I_L falls to 1 amp the volt drop $(I_1\times R_1)$ across the series resistor plus the volt drop $(I_2\times R_2)$ across the parallel resistor, must still equal the supply voltage. Thus $(I_2+I_L)24+I_2\times 120=240$ volts, from which it will be found that the current I_2 through the parallel resistor has now increased to 1.5 amps. The volt drop V_1 across the series resistor will then be equal to $R_1\ (I_L+I_2)=$ 24 ohms $\times$ 2.5 amps $=$ 60 volts. Thus, if the motor load falls from 4 amps to 1 amp the voltage V_2 across the motor will rise to 180 volts, as compared with 210 volts when supplied through a simple 30-ohm series resistor.

On the other hand, if the resistors are such that when the motor or other apparatus takes 4 amps at 120 volts the parallel resistor also takes 4 amps, the parallel resistor R_2 must have a value of $\frac{120 \text{ volts}}{4 \text{ amps}}=30$ ohms. The mains current I_1 will then be 8 amps so that the series resistor R_1 must have a value of $\frac{120 \text{ volts}}{8 \text{ amps}}=15$ ohms. On full load the power input to the motor will be 480 watts as before, the power loss in the parallel resistor R_2 will be 480 watts, whilst the power loss in the series resistor R_1 will be 960 watts, giving a total loss of 1,440 watts in the resistors. If the motor load current now falls to 1 amp the current I_2 in the parallel resistor will rise to 5 amps, thus I_1 will be 6 amps, resulting in the volt-drop V_1 across the series resistor falling to 90 volts. The voltage V_2 applied to the load will then be equal to 150 volts.

It will thus be seen that by allowing an increased current through the parallel resistor a more steady voltage can be obtained at the load under varying load conditions, with increased losses. If the potentiometer resistors were made of such a value that the load current was only a small proportion of the mains current through the series resistor, a more constant voltage could be obtained on varying load, but only at the expense of greatly increased losses. Fig. 5 shows the connections

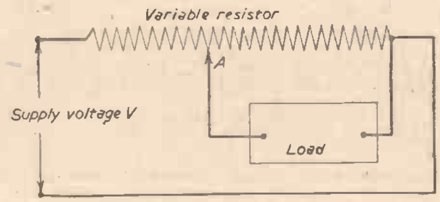


Fig. 5.—Connections of a variable potentiometer.

of an adjustable potentiometer by means of which a variable voltage can be obtained at the load if required. The adjustable contact A could be arranged to slide along the resistor, or to pass over contact studs connected to various points on the resistor.

Design of Resistors

When designing a resistor care must be taken that the wire used is sufficiently large to carry the required current without excessive temperature rise. Nickel-chrome wire of high specific resistance is suitable. It should be understood that a given resistor may be constructed of fairly thick wire having a comparatively low temperature; or thinner wire operating at a higher temperature, with the same heat dissipation concentrated in a smaller volume. Table 1 gives the resistance per foot of 80/20 per cent. nickel-chrome wire at various temperatures and the current at which the wire will reach various temperatures when the wire is straight, horizontal and free to radiate heat. When coiled in a small volume a higher temperature will be reached by a given

Rating (watts)	Current (amps)	Resistance (ohms)
1,000	4.35	53
750	3.26	70.5
600	2.61	88.5
500	2.17	106
250	1.09	211
100	0.43	530
75	0.33	705
60	0.26	885
40	0.17	1,360
25	0.11	2,110
15	0.06	3,850

Table 2.—Normal current and resistance of 230 volt elements.

current in a given wire, because the wire cannot dissipate its heat so freely. For instance, a given size of wire may reach a temperature of 500 deg. C. with a given current when straight, horizontal and free to radiate, but may reach 900 deg. C. with the same current when coiled into a radiator element. Radiator elements and filament lamps can often be utilised as compact resistors, and Table 2 gives the permissible current loading and resistance of 230-volt elements and filament lamps when operating at the working current. They can, of course, be used on lower current values, but their resistance will then be reduced somewhat because the resistance of the wire falls on reduced temperature.

Use of Series Resistors on A.C.

Series resistors can also be used to supply

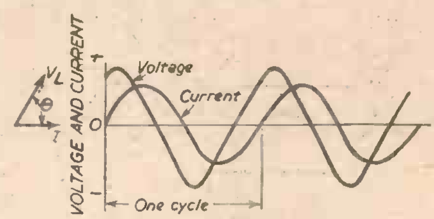


Fig. 6.—Voltage and current relationships in inductive circuit.

plant at reduced voltage from an A.C. supply, with the same disadvantages of considerable losses in the resistor and a varying voltage at the apparatus on a varying load. Both these difficulties are overcome by using a step-down transformer to supply the apparatus, which is always advisable where an economic supply is required and/or it is required that the voltage at the load shall be substantially independent of the load current. A series resistor is a practical solution, however, if the load current is constant; in this case the same method of calculation as for D.C. can be employed if the load is non-inductive as in the case of a resistance element.

In the case of an inductive load, which in general applies in all cases in which the load current produces an electromagnetic field, however, special calculations are required. In such a load circuit induction causes the load current I to lag by a certain angle θ behind the voltage V_L applied to the load, as shown in Fig. 6. The cosine of the angle θ is equal to the power factor of the load. In a single-phase circuit the power factor is also equal to $\frac{\text{watts}}{\text{volt-amps}}$. For instance, if a given load takes 250 watts with a current of 5 amps on a 100-volt supply, the volt-amps will be $100\times 5=$ 500 volt-amps. The power factor of the load will then be $\frac{250}{500}=0.5$, which is equal to the cosine of the angle 60 deg., as may be seen from Table 3. Thus the 5 amp load current will lag by 60 deg. behind the voltage applied to the load as shown in Fig. 6. In the case of a powerful electromagnet having a laminated iron core with a very small air gap the power factor may be almost zero, in which case the current will lag behind the voltage by almost 90 deg., or a quarter of a cycle.

Series Resistor Calculations for A.C. Circuits

Fig. 7 relates to a load circuit having a power factor of 0.707, with 45 deg. angle of lag, and shows the method which may be employed in calculating the value of series resistor required to reduce the voltage at the load. The first step is to draw a horizontal line O—I to represent the current I amp required. This line need not be to any scale. A line O—V_L is then drawn at the angle θ to O—I, such that cosine θ is equal to the power factor of the load. It may be mentioned that the power factor of a motor will depend on its design and its loading; a fully loaded ½ h.p. motor may have a power factor in the region of 0.75. The line O—V_L represents the voltage which is to be applied to the load and should be drawn to a suitable scale. The next step is to describe the arc with radius O—V to the same scale as the vector O—V_L, the length of this radius being proportional to the supply voltage V. Thus, if the load is to receive half the supply voltage, the radius of the arc should be made twice as long as the vector O—V_L.

The next step is to draw the horizontal line from V_L parallel with O—I. The length V_L—V then represents the volt-drop required on the series resistor, which can be scaled off to find

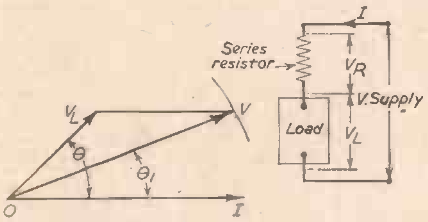


Fig. 7.—Vector diagram relating to a resistor in series with an inductive circuit.

the volt drop V_R required across the resistor. The ohmic value R of the resistor required will then be equal to $\frac{V_R}{I}$, where I is the load current (amps). When this resistor is connected in series with the load the angle of lag of the current behind the supply voltage V will be reduced to θ_1, the power factor of the circuit being increased to cosine θ_1. The losses in the series resistor when carrying the load current I will be equal to $I^2 \times R$ watts. When this series resistor is used a variation of the load current, or a variation of the power factor of the load as may occur due to alteration of the air gap of an electromagnet, will alter the voltage across the load and will alter the angle of lag of the current. It may be noted that, with a power factor of less than unity, a greater volt drop is required across the series resistor to provide a given voltage at the load. A purely resistive load circuit has a power factor of unity, the current being in phase with the voltage applied to the load.

Choke Coil Calculations

A reduced voltage supply to apparatus can more economically be obtained by using a series choke coil, or reactance, instead of a series resistor, on an A.C. supply. If the choke coil has negligible resistance and negligible core losses the losses in the choke will be negligible. The volt drop across such a coil when carrying a current I amps on a 50 cycle supply is equal to 314.2 × L × I volts, where L is the self-inductance of the choke coil in henries. If the supply has some other frequency f cycles per second the volt drop across the choke will be equal to 6.284 × f × L × I volts. The volt drop across the choke coil will, however, lead the current by almost a quarter of a cycle or 90 degrees. A choke coil is only effective on A.C.

An Example

As an example we may consider the case of a piece of apparatus which requires a current of 50 amps at 40 volts, which is to be fed from an 80 volt supply A.C. at 50 cycles. We will assume that the power factor of the load is 0.95 lagging, in which case the power input (watts) to the load will be equal to $V_L \times I \times$ cosine θ, where V_L is the voltage applied to the load, I is the load current (amps), and cosine θ the power factor of the load. In this case the power input to the load will thus be equal to 40 × 50 × 0.95 = 1,900 watts or 1.9 kilowatts (kW). At a power factor of 0.95 the load current I will lag behind the load voltage V_L by the angle θ having a cosine of 0.95, i.e. 18.2 degrees. Thus, having drawn the current vector O—I as in Fig. 8, the vector V_L to represent 40 volts to a suitable scale can next be drawn at the angle 18.2 degrees to O—I. An arc with radius O—V proportional to the supply voltage V can next be drawn. The line A—V can then be drawn perpendicular to O—I and passing through V_L to cut the arc at V. Then the line V_L—V represents to scale the volt drop required across the series choke coil. This volt drop is equal to O—B and, assuming negligible losses in the choke coil, will lead the current vector O—I by 90 degrees.

The required value of O—B can also be found as follows:

Wattless component of the load voltage V_L = O—E = $V_L \times$ sine 18°.2 = 40 × 0.312 = 12.48 volts = B—D.

Wattless component of supply voltage V is equal to O—D and is equal to the volt drop O—B across the choke coil plus B—D = 12.48 volts + B—D.

Watt component of load voltage V_L = O—A = 40 × cosine 18°.2 = 40 × 0.95 = 38 volts. Then $OD^2 = V^2 - OA^2 = 80^2 - 38^2 = 4{,}956$, thus OD = 70.4 volts.

Thus the volt drop O—B across the choke coil will be equal to OD—BD = 70.4 − 12.58 = 57.8 volts.

Angle (deg.)	Cosine	Sine	Angle (deg.)	Cosine	Sine	Angle (deg.)	Cosine	Sine
0	1.0000	0.0000	31	0.8572	0.5150	62	0.4695	0.8829
1	0.9998	0.0175	32	0.8480	0.5299	63	0.4540	0.8910
2	0.9994	0.0349	33	0.8387	0.5446	64	0.4384	0.8988
3	0.9986	0.0523	34	0.8290	0.5592	65	0.4226	0.9063
4	0.9976	0.0698	35	0.8192	0.5736	66	0.4067	0.9135
5	0.9962	0.0872	36	0.8090	0.5878	67	0.3907	0.9205
6	0.9945	0.1045	37	0.7986	0.6018	68	0.3746	0.9272
7	0.9925	0.1219	38	0.7880	0.6157	69	0.3584	0.9336
8	0.9903	0.1392	39	0.7771	0.6293	70	0.3420	0.9397
9	0.9877	0.1564	40	0.7660	0.6428	71	0.3256	0.9455
10	0.9848	0.1736	41	0.7547	0.6561	72	0.3090	0.9511
11	0.9816	0.1908	42	0.7431	0.6691	73	0.2924	0.9563
12	0.9781	0.2079	43	0.7314	0.6280	74	0.2756	0.9613
13	0.9744	0.2250	44	0.7193	0.6947	75	0.2588	0.9659
14	0.9703	0.2419	45	0.7071	0.7071	76	0.2419	0.9703
15	0.9659	0.2588	46	0.6947	0.7193	77	0.2250	0.9744
16	0.9613	0.2576	47	0.6280	0.7314	78	0.2079	0.9781
17	0.9563	0.2924	48	0.6691	0.7431	79	0.1908	0.9816
18	0.9511	0.3090	49	0.6561	0.7547	80	0.1736	0.9848
19	0.9455	0.3256	50	0.6428	0.7660	81	0.1564	0.9877
20	0.9397	0.3420	51	0.6293	0.7771	82	0.1392	0.9903
21	0.9336	0.3584	52	0.6157	0.7880	83	0.1219	0.9925
22	0.9272	0.3746	53	0.6018	0.7986	84	0.1045	0.9945
23	0.9205	0.3907	54	0.5878	0.8090	85	0.0872	0.9962
24	0.9135	0.4067	55	0.5376	0.8192	86	0.0698	0.9976
25	0.9063	0.4226	56	0.5592	0.8290	87	0.0523	0.9986
26	0.8988	0.4384	57	0.5446	0.8387	88	0.0349	0.9994
27	0.8910	0.4540	58	0.5299	0.8480	89	0.0175	0.9998
28	0.8829	0.4695	59	0.5150	0.8572	90	0.0000	1.0000
29	0.8746	0.4848	60	0.5000	0.8660			
30	0.8660	0.5000	61	0.4848	0.8746			

Table 3.—Sines and cosines of various angles.

The power factor (cosine θ_1) of the input from the supply will be equal to:

$$\frac{\text{Watt component OA}}{\text{Supply voltage V}} = \frac{38}{80} = 0.475.$$

The power input from the supply will be practically the same as the power used at the load and will be equal to V × I × cosine θ_1 = 80 × 50 × 0.475 = 1,900 watts. In order to obtain the volt drop O—B of 57.8 volts across the choke coil the self-inductance L of the choke coil must be equal to

$$\frac{\text{Volt drop}}{6.284 \times f \times I} = \frac{57.8}{6.284 \times 50 \times 50} = 0.0037$$

henry or 3.7 millihenries.

Choke Coil Applications

The choke coil will reduce the power factor of the current taken from the supply by

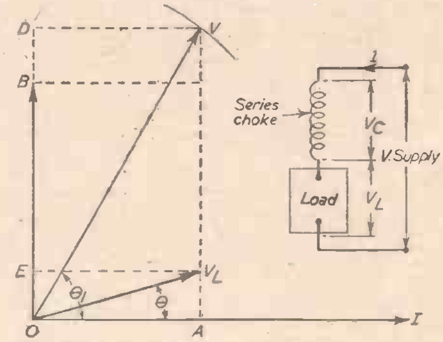


Fig. 8.—Vector diagram relating to a choke coil in series with an inductive circuit.

increasing the angle of lag from θ to θ_1, the power factor will vary on a varying load current as will also the voltage applied to the load. However, the method is very suitable for supplying a reduced voltage to a constant load. A choke coil is also a very useful device for use on A.C. where it is required that the voltage at the load shall automatically fall on increased load, as in the case of an arc welding plant where a higher voltage is required to strike the arc than to maintain it. The choke coil prevents short circuiting of the supply when the electrode is brought into contact with the work.

Uses of a Series Choke Coil

If required a variable voltage can be obtained at a load of constant impedance, or a constant voltage can be applied to a load of varying impedance, by using a series choke coil having a varying self-inductance L. This can be arranged by using an iron-cored choke coil with a variable air gap in the magnetic circuit, or a tapped choke coil. Maximum value of L, and maximum volt drop across the choke coil, with a given current through the coil, occurs with minimum air gap or with all the turns in circuit. The choke coil should be wound with conductors which are large enough to carry the load current without overheating; in some cases heavy-current choke coils are oil immersed.

Flux Density of the Core

The value of the self-inductance of an iron-cored choke coil depends on the flux density in the core. If the core is used with a high magnetic flux density the self-inductance will tend to fall somewhat on high currents due to saturation effects. Thus if it is required that the volt drop across the choke coil shall be proportional to the current the flux density in the core should not be excessive. Alternatively an air-cored choke coil, which has no saturation effects, may be used, such a coil being particularly suitable for a high-frequency supply. In order to minimise iron losses the core of a choke coil should be constructed of lightly insulated laminations of Stalloy or Lohys iron, and the magnetic flux density in the core should be limited.

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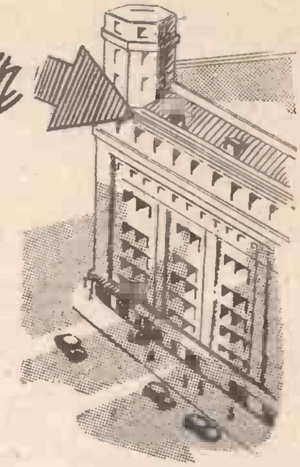
Letters to the Editor



The Editor Does not Necessarily Agree with the Views of his Correspondents

The Passing of the Steam Locomotive

SIR,—I have been a reader of PRACTICAL MECHANICS since issue No. 1 and even with the many publications one has to read, I find most pleasure in reading the P.M.

I like your editorials under the heading of "Fair Comment," and now refer to the one in the March issue. I consider the comment far from fair.

You refer to carriages being uncomfortable; if this comment refers to the new B.R. standard carriage then please qualify your statement as the censensus of opinion does not agree with yours. If, however, you mean some of the old stock still operating, then make due allowance for the war years and the steel crisis, both of which retarded the replacement programme.

Regarding long distance arrivals at London termini, as one that frequently uses these trains I think the late arrivals are the exception rather than the rule, but your statement implies that it is a red-letter day when a train arrives on time.

Reference is made to air travel; how much did our aircraft industry benefit by the war years? This also applies to the motor industry, but the railways had to apply their productive efforts and technical skill in other directions than their own fields of activities—this was essential, but give them credit for it!

Mention is made of industry being impatient, with a productivity ratio of 2.3 as compared with the U.S.A. at 5.5, surely they can content themselves with correction of their own inefficiencies whilst the railways are making good their own.

Atomic power is the next issue. Admittedly the U.S.A. have a submarine, but the general feeling is that the first applications will be by introducing power stations, and these will not be operating for a number of years yet. I cannot agree that atomic power offers any immediate threat to the railways plan.

Helicopters are mentioned for inter-city transport, but will this poor brother of the aircraft industry produce suitable designs during the next 10 to 15 years? A considerable amount of energy and technical skill is required to resolve all the problems in connection with the design of rotors and to determine whether stub wings are necessary.

Now a word about roads; the road plan is excellent, but at least 20 to 30 years will be required for it to become effective. Surely with the huge toll of human life, and the maiming of countless thousands, the effective way of getting immediate results in lowering the road casualties, is to get on to the rail some of the heavy goods traffic at present being moved by road.

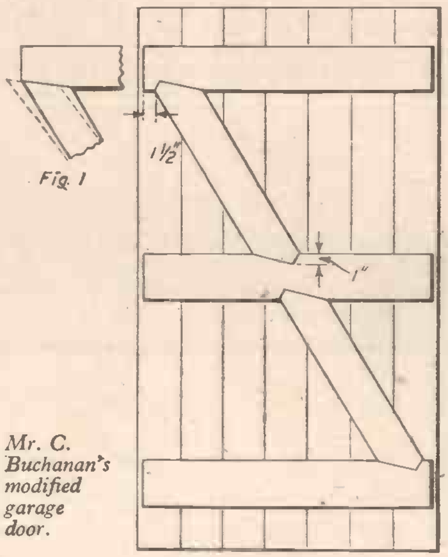
In conclusion you state that it is possible that by 1970 the railways will have ceased to function as passenger carriers; possible may be, but highly improbable!—G. T. S. (Nr. Derby).

Door for Concrete Block Garage

SIR,—Having read the article in your March edition referred to above, I suggest readers would be well advised, when making the doors, to adopt the construction shown in the sketch below.

Experience shows that nails alone cannot hold the braces in position, and they soon assume the position shown by the dotted line.

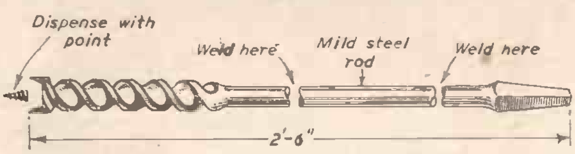
As the primary purpose of the brace is to support the swinging edge of the door it is necessary to provide a positive seating for the ends.—C. BUCHANAN (S.E.25).



Mr. C. Buchanan's modified garage door.

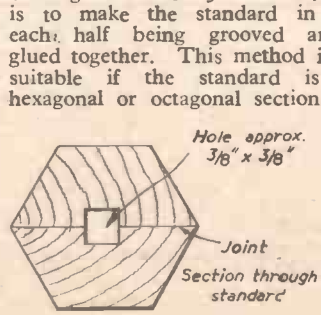
Drilling Lamp Standards

SIR,—Re Mr. J. F. Margerison's query in PRACTICAL MECHANICS, March issue, on drilling standard lamps. There is an easy way of drilling with a converted wood drill and an ordinary hand brace. The sketch shows a suitable conversion.—G. H. JAMES (Hereford).



Mr. G. H. James's converted wood drill.

SIR,—With reference to the enquiry regarding the drilling of standard lamps, one method, which is much simpler than drilling a hole 5 or 6ft. in length, is to make the standard in two halves, each half being grooved and the two glued together. This method is particularly suitable if the standard is to be of hexagonal or octagonal section as the joint will not show.—W. G. GALLING (Leeds).



Mr. Galling's lamp standard made in two halves.

SIR,—"The old craftsman's way" referred to is the old custom of boring wood with a hot bar of iron. I have tried this method myself on a lampstand.

By making the iron bar red hot and applying it to the piece of wood concerned, a hole is burnt out until the bar has cooled, when the latter has to be re-heated and the process continued.

If this method is applied at both ends, the hole would be bored straight through the centre of the piece of wood.—JOSEPH BUTTIGIEG (Malta).

Lathe Stand Wiring

SIR,—In Mr. W. E. Rickard's article, "Making a Lathe Stand," in your March issue, details were given of an electric wiring system which is most dangerous. It was proposed that the electricity supply to the lathe should be fed in by connecting a plug to a socket. It follows that the plug could easily be alive and exposed, and accidental contact with the plug in this condition could prove lethal.

It is quite clearly stated in the regulations published by the Institution of Electrical Engineers that the attachment of a flexible cable to an appliance shall, if the connection be made by contact tubes and pins, be so arranged that separation of the pins from the contact tubes disconnects the pins from the supply.

Correct practice would be to make permanent connections to a double pole isolating switch with a fuse in the live main, and feed the motor from this switch via an on line starter with stop and start buttons, mounted on the left-hand side of the lathe stand. The stand should be permanently earthed.—C. T. LAMPING (Cardiff).

Author's Comments

SIR,—I see that under certain conditions the loose connection could be dangerous. I must confess that this aspect had not occurred to me otherwise it would not have been used.

I have been using this system, in ignorance it seems, for many years without inconvenience, but as I have always been taught to be cautious where electricity is concerned I have been most careful to ensure that the fading switch was in the "off" position before moving the plug. I shall now modify my own wiring.

I would also emphasise the fact that in the article I make it quite clear that if there is any doubt regarding the wiring that no risks should be taken, but a fully qualified person should be consulted.—W. E. RICKARDS (Birkenhead).

INDEXES FOR VOLUME 21—
1/1 by post from The Publishing Dept., Geo. Newnes Ltd., Tower House, Strand, W.C.2

Trade Notes

Rotary Tube Pump

FROM Patay Bros., 17, Chapmanslade, Westbury, Wilts, comes news of an entirely new type of hand-operated pump, the rotary tube pump. It is substantially a centrifugal one having the advantages of continuous flow of liquid combined with the highest possible efficiency and discharge.

The pump is suitable for the requirements of builders, contractors and farmers. It is especially suitable for lifting dirty water from trenches, foundations and deep holes; for pumping drinking water from wells; for milk, beer, oil, petrol or any liquid. Large quantities of water can be pumped within a few minutes.

The pump can be fitted with a tripod supplied on request for outside use and because of its light weight only one man is needed to carry the pump and its accessories.

The price is £26 for the pump and £1 10s. for the tripod. Details are available from the above address.

The Rotary Tube Pump.

Multicore Solders, Ltd.

THIS firm announces that an improved version (the Mark 2) of their Bib Recording Tape Splicer is now available. It incorporates two tape retaining clamps which, in addition to having extensions on them, providing an even easier releasing arrangement, are also fitted so that the clamp openings both operate identically towards the tape recorder. It is claimed that this makes tape splicing a quicker and simpler job without losing any of the advantages of the orignal Bib product. If an earlier model has already been bought and the user requires this latest modification, the work will be undertaken on receipt of the Splicer by Multicore, properly labelled with the owner's name and address, and a postal order for 2s.

A leaflet entitled "A New Non-corrosive Flux" is now available from this firm. This is reprinted from a paper by Dr. W. Rubin, read at the conference on Reliability of Electric Connections held in Chicago.

After further research, additional products are available for printed circuit soldering. The complete range at present offered is dealt with in detail in Multicore publication P.C.101, available free of charge from Multicore Solders Ltd., Multicore Works, Maylands Avenue, Hemel Hempstead, Herts.

"Wolf Cub Book of Profitable Pleasure"

THIS book will undoubtedly be of interest to the owner of the Wolf Cub drill and its associated range of equipment. The first chapter of the volume deals with the various attachments and how to use them and the following sections cover joints and jointing, household jobs, making fitments, furniture, toys and games, gifts and models. It is illustrated throughout with line drawings and photographs. The book is being sold by Wolf stockists, at 5s. 6d. and is available from Wolf Electric Tools, Ltd., Hanger Lane, London, W.5, for 5s. 9d., post free.

The 1904 Darracq model.

Model Vintage Cars

THE first of a series of kits for model cars has been produced by the Exakta Casting Co. and this is a model of the famous 1904 Darracq. This series of models is aimed to appeal to the motoring enthusiast and each is to be an accurate replica of an actual car. The kit of the Darracq comprises a set of small scale metal castings which are easily assembled by the amateur. Messrs. Graphic Designers, 4, Holly Park, Finchley, London, N.3, have been appointed distributors and the first kit is available from them price 21/-, plus 1s. postage, or a completely assembled and hand-painted model on a wooden plinth for 65s., plus 1s. postage. All enquiries should be sent to the above address.

Aluminium Construction Kits

DURING the past few years the trend has been towards home construction of useful household articles as a hobby and now we have received details of a new range of construction kits, using aluminium as the basic material. Complete kits, including materials, pattern and construction data sheets, for a considerable number of household articles are being marketed by J. and S. Newman, Ltd., 86, Hampstead Road, London, N.W.1. Kits are available for a flower pot stand, record rack, table lamp book shelf, coffee tables and for the newspaper and magazine stand shown in the photograph. Further designs are in course of preparation and details are available from the above address. Prices range from 9s. 9d. for the record rack kit to 26s. 6d. for the stand illustrated.

The completed aluminium newspaper and magazine stand.

Advertisement Price Error

WE have been informed that Messrs. J. and H. Smith Ltd., 16, Harrison Street, Leeds 1, made an error in their advertisement which appeared on page 281 of the April issue of PRACTICAL MECHANICS. They gave the price of their Senior Slik-Saw as £46 10s. 0d., whereas it should have been £44 10s. 0d.

J. Bull and Sons

IN connection with the review of the "Easiplate" Home Electroplating kit which appeared in last month's Trade Notes, we omitted to mention that J. Bull and Sons, 246, High Street, Harlesden, London, N.W.10 are in a position to supply this to readers. The price is 12s. 6d. or 13s. 6d. by post.

Circular Saw Attachment

SAWING wood by hand is always a tedious and tiring job, but it is now possible to simplify this operation by means of a circular saw attachment obtainable from Aero Spares Co., 16, High Holborn, W.C.1.

It consists of a 4in. saw fitted with a special guard having a comfortable hand-grip at one end and a guide mark at the other for guiding the saw blade. The spindle for the saw projects through a suitable boss in the guard and this will accommodate the chuck of a $\frac{1}{4}$in. electric drill. Thus the attachment is converted into a fast-cutting portable electric saw. The price is 33s. or 1s. 6d. extra by post.

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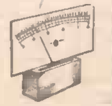

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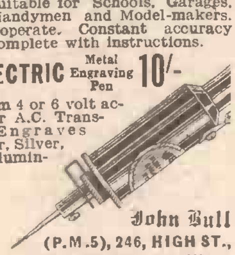

John Bull
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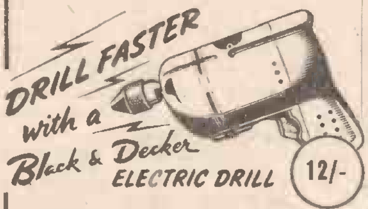

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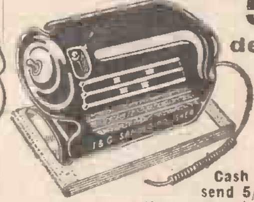

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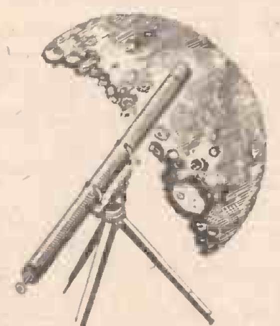

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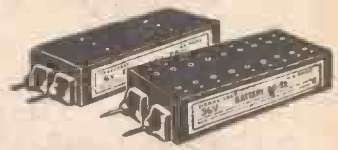

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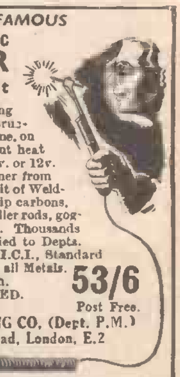

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Your Queries Answered

RULES

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

Chemical Removal of Tree Stumps

I HAVE a large tree root quite close to a building, which I wish to remove but cannot use mechanical means or an explosive.

I have read of a chemical method; can you furnish me with details of the process ?—Charles Dale (Staffs).

WE have been in touch with the Timber Development Association, who suggest that you first fell the tree and drill a large hole into the base of the tree. Fill this with sodium phosphate or sodium chloride and seal with some clay or rag. The chemical will then act on the root and burn it away in time. We would like to warn you that sodium chloride is toxic and would, therefore, be dangerous to animals or children.

Lime-sulphur Fungicide

CAN you please tell me how to prepare lime-sulphur fungicide ?—George G. Milne (Aberdeen).

A VERY effective type of lime-sulphur fungicide can be prepared by placing equal measures of lime and sulphur in a pan, covering the mixture with water, and then gently simmering the contents for half an hour. The contents are then strained or filtered, thus producing a yellowish liquid consisting of calcium polysulphides together with a little colloidal and semi-colloidal sulphur. This solution can be diluted to any extent by water. This solution is not stable in air; it slowly oxidises and deposits sulphur.

Fireproofing Scenery

CAN you inform me of a method of fireproofing scenery for an amateur dramatic society ? The materials used in the construction of the scenery are wood and sisal kraft paper (i.e., a waterproof covering consisting of two sheets of paper bonded together with pitch or some similar substance).—Keith Elliott (Edinburgh).

IT is quite impossible adequately to fireproof a kraft union paper of any type, since such papers contain an inner layer of pitch, bitumen or other combustible material which is not affected by any fireproof medium.

Ordinary paper, fabrics and textiles of most varieties can be fireproofed by simple immersion in a variety of solutions. Here are some of them:

Ammonium sulphate	14	parts by weight
Borax	2	" " "
Boric acid	$\frac{1}{2}$	" " "
Water	100	" " "

The fabric is immersed in the above solution for about an hour, after which it is dried slowly. This solution will probably shrink the fabric. In the case of paper and card scenery and of fine canvasses which have already been painted, it is probably better not to adopt the above method of immersion, but to spray the fireproofing liquid on to the material.

Another fireproofing solution can be made as follows:

Calcium chloride Anhydrous ...	40	parts by weight
Zinc chloride ...	10	" " "
Formaldehyde ...	5	" " "

Mix the above with:

Calcium chloride. Anhydrous ...	30	parts by weight
Boric acid	10	" " "
Ammonium chloride (sal ammoniac) ...	5	" " "

of this mixture dissolve 10-15 parts (by weight) in every 100 parts (by weight) of water, and use it for impregnating textiles.

As above mentioned, it is quite possible to spray these solutions on to paper and fabrics, but they are seldom brushed thereon. At the same time there is no reason why the brushing method should not be adopted. The whole object of the process is to coat and to saturate the material with chemical solution which, after the water has evaporated, leaves on, and in, the material a chemical salt which is fire-resisting and which, therefore, inhibits the active combustion of the treated material. Note, however, that these processes only fireproof the material against relatively small conflagrations. They do not protect against charring, but they do definitely set up against the fire an initial barrier to its rapid spread.

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The above blue-prints are obtainable, post free, from Messrs. George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

*An * denotes constructional details are available free with the blue-prints.*

Paint for Photographic Dishes

I WISH to make up some large photographic dishes from tin plate and make them impervious to photographic chemicals. Can you suggest a paint formula ?—W. T. Dimmock (Clapton).

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.

THERE is, in our opinion, no paint which will successfully resist the solutions used in photographic processes. The best, perhaps, is a bakelite varnish which can be made by dissolving bakelite resin in a suitable solvent.

Metallic dishes are most unsuitable for photographic solution usages, unless they are of stainless steel or of monel metal or pure nickel. Tin, zinc, brass, copper and iron dishes are unsuitable and they will contaminate the solutions. That is why so many of the larger photographic dishes are surface enamelled with a hard "vitreous" or baked-on enamel. There is, however, quite definitely no paint which you could apply with success to your dishes for photographic use.

Varnish Coatings to Prevent the Warping of Wood

I HAVE been advised to treat thin wood with shellac to prevent it from warping when modelling. Is this satisfactory ?—A. E. West (Northwood).

TO a certain extent a coating of shellac on the surface of thin wood will prevent warping of the wood. The effect is not in any way due to the shellac itself, and, indeed, the shellac does not actually prevent the warping action. It merely slows it down. The anti-warping effect is due to the fact that the shellac layer inhibits the passage of moisture to and from the material. Thus it prevents the thermal movements of the wood cells, and so inhibits their contraction and/or expansion. For this reason any type of moisture-inhibiting varnish would be successful.

The best of all coatings for this purpose would be a thin layer of polythene resin. This is made by I.C.I., Ltd., but is not obtainable in small quantities. The resin is melted at 110 deg. C. and applied in the hot, molten condition. It is clear and transparent, and forms an absolute barrier to the passage of moisture through it. Other resin or varnish coatings prevent or inhibit wood warping in proportion to their inhibiting the passage of moisture.

Petrifying Liquid

COULD you give me any information on a substance known as petrifying liquid, which is brushed on to walls, brick, plaster, etc., to create a non-absorbent undercoat before paint is applied?—J. L. Cass (Chatham).

"PETRIFYING liquid" is a meaningless term which is now used by the decorating trades. It is misleading as all these so-called "petrifying liquids" have no petrifying properties at all. They are merely emulsions of linseed oil which are readily made. Their function is that of a "sealing fluid," that is, they are absorbed by porous surfaces and, partially filling the pores thereof, they prevent the absorption of paint oils and other liquids. In this respect they are very efficient, but it is a moot point whether they are really able to prevent dampness in a wall or a wall surface.

A petrifying liquid can be prepared readily at home. Dissolve 8 parts (by weight) of good glue or gelatine in 92 parts of hot water. Stir into the solution a few drops of carbolic acid to act as a preservative. If the solution sets to a jelly on cooling add more water. Then heat the solution again. Stir it rapidly (perferably with a mechanical stirrer) and add to it a little raw linseed oil (say about 4-8 parts by weight). This will render the solution turbid. Allow it to cool, and then it is ready for use.

An entirely different type of sealing liquid for use prior to painting on an absorbent surface is:

Pale boiled linseed oil: 33 parts (by volume).
White spirit: 17 parts
Lithophone, or barytes, or white lead or zinc oxide: 50 parts.

This is, in effect, a very thin ground paint, but it is very good for the purpose named. It should for preference contain a small quantity of a paint drier.

Hand-painting Ties

I HAVE tried with little success to hand-paint silk ties. Cellulose and oil paint tends to crack. Water paint wears off and dyes run during the execution. Could you please recommend a really fast colour medium?—L. F. Ewington (Romford).

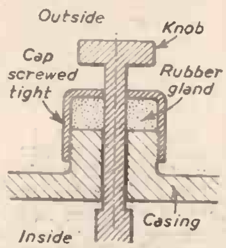
YOU will be able to obtain fabric paints, such as you need, from Dryad, Ltd., St. Nicholas Street, Leicester. If, however, you wish to make your own we suggest a flexible paint based on a synthetic resin, polyvinyl acetate. A resin of this type is sold under the name of "Gelva," by Shawnigan, Ltd., Marlow House, Lloyd's Avenue, London, E.C.3. We think that the smallest quantity of this which you will be able to get is about 1lb. costing, say, 5s. There are several grades of these resins. We suggest "Gelva No. 7."

Dissolve 20 parts (by weight) of this in 80 parts warm methylated spirit. To the solution add about 1 part of castor oil to render the paint film more flexible. This clear solution will form your "paint base." It will keep indefinitely in a corked bottle, and it can be used as a clear varnish as well. To make the fabric paints take a small portion of finely ground *dry* colour and grind it up on a slab with about an equal amount of the paint base. The consistency of the paint will of course be readily adjusted by the amount of pigment or paint base which you incorporate.

If you consult our advertisers of plastic materials you may possibly be able to purchase small amounts of polyvinyl acetate (Gelva) resin.

Under-water Camera

I INTEND to make an under-water camera case for my 35 mm. camera. There will be two aluminium alloy castings which will be made locally and I would like to know how to give this alloy a sea-water resistant surface, without, if possible, the use of paints, etc. (e.g., anodising). There will be three external controls — the film wind-on, shutter release and focusing knob. I intend to use rubber glands (greased) of the type illustrated in sketch below.



Will this arrangement be satisfactory to withstand a pressure of about one atmosphere? Also, what type of rubber should I use, natural rubber, foam rubber or vulcanised? Do you recommend the use of grease in the gland?—J. R. Warn (Paignton).

TO set up an anodising bath for this single purpose would be expensive and we would advise you to send your castings to: Technical Platings, Ltd., Craig Works, Luther Road, Teddington, Middlesex. The type of gland you propose using seems to us to be quite satisfactory and we would suggest natural rubber in preference to foam rubber or vulcanised. They should easily withstand a pressure of one atmosphere. We think grease would be unnecessary.

Grouting Joints in a Wood Block Floor

I HAVE just laid an oak block floor in my dining-room with a special mastic which never sets "dead hard" to allow for expansion and contraction. I understand that it is advisable to "grout" in the joints to ensure that no blocks work loose, and I would like to know the best material to use for this purpose. I would also like to know the best type of stain and polish to use, as they will not be covered by carpets.—A. Smith (Staffs.).

THE grouting compound commonly used for wood blocks is a bituminous mixture which is applied in the hot, plastic state, and which, when cold, sets to a hard, black mass. These jointing compounds are of various compositions and they are usually obtainable from any firm dealing in asphaltic compositions. You could, for example, make a grouting compound for yourself by melting together a medium soft bitumen and a hard bitumen, utilising sufficient of the hard bitumen to render the mixture sufficiently hard for your purpose on setting. On an average, the proportions are two-thirds medium soft bitumen and one-third hard bitumen, but these proportions are capable of much variation. For use, the molten compound is applied to the contacting surfaces, which are then pressed together. Any stray splashes or other markings on the wood surface can be dissolved or wiped away with ordinary paraffin oil or solvent naptha

Information Sought

Readers are invited to supply the required information to answer the following queries.

Mr. J. B. Wale writes to ask: "Can you give me any details which would assist me in making a soldering gun of the 'Burgoyne' or 'Primax' transformer type?"

Mr. H. E. Bray, of Hereford, writes: "Having in my possession a quantity of pure beeswax, I should like to try to make some candles, such as are used in religious services in churches. Have you any information (especially concerning the wick) which you are able to supply?"

J. Johnson (Harrogate) asks us: "Would it be possible to give an article in PRACTICAL MECHANICS on building a knitting machine?"

From Sports Utilities, Ltd., Oldham, comes the following: "We shall be pleased if you can give us details, circuits, component values, etc., of Electrostatic Flock Depositing Machines."

From A. J. Jarvis, of Wellington, comes the following: "My problem is producing the following effects for a stage production: (a) clouds of steam—the more the better; (b) a loud explosion—the louder the better; (c) a loud hissing noise, as of escaping steam. The whole effect required is similar to that of a boiler explosion. Can (a) be produced chemically, for instance, by tablets dropped in water? I should be grateful for any suggestions, names of firms, etc."

C. J. Forsyth writes: "I am being trained for watch and clock repairs. We have no timing machine, and due to there being a number of men on different stages of the course, I have trouble in hearing the beats of movements. Could you give me a plan of a small amplifier or acoustic box, non-electrical, with a clip to hold the movement? I have tried several small boxes, but these are not suitable."

H. Punford (St. Albans) asks: "Can you give me information on converting an ex-Government G.45 camera gun for normal use as 16 mm. cine camera?"

The following was sent by A. Whittaker (Cheshire): "I wish to construct an oil-burning convection heater suitable for use in a small modern house. Could you please supply me with the best arrangement of baffle plates for this purpose, and also advise me as to the best type of lamp to use?"

R. Laxton writes: "Can you help me regarding the circuit, etc., for a faradic-type surging machine, using valves to control the surge and duration of the stimuli supplied? I would like to make and use such a machine in my chiropody practice."

From Mr. A. E. Harris comes the following: "I am trying to sand, buff and polish a pair of crankcases of my motor cycle; they are made of magnesium alloy. This, I am told, is useless because they will not stay polished long before they return to their old dull grey. Is it possible to keep these crankcases polished? Can you suggest a way of keeping magnesium dust out of the drill?"

R. J. Shailer writes: "I would like to construct the gymnastic apparatus shown in sketch. I believe the top bar swivels. I wish to make it full size, not a model. Could you let me have any information?"

From Belfast, W. White writes: "I intend building a small workshop welding plant to work off 220-230 volts A.C. mains. I would need to be able to weld $\frac{1}{4}$in. angle iron framing, i.e., $\frac{1}{4}$in. thick × 2in. × 2in. Could you give me some instructions on how I should build this? Galpins Electrical Stores have for sale a heavy-duty spot welding transformer. Would that suit? Would it have to be kept cool in an oil tank? Would I have to use welding rods or carbon and where is the best place to obtain same?"

THE Cyclist

Editor : F. J. CAMM

VOL. XXIII MAY, 1955 No. 396

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

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

COMMENTS OF THE MONTH By F. J. C.

The New Highway Code

THE new Highway Code, which rivals the Bible as a best seller, has been available since March. Unlike previous issues there has been no free distribution except to learner drivers when they apply for their first provisional licence. Free copies are also to be distributed later to other drivers when they renew their licences, to older children at school and to the armed forces. The new Code includes a number of new rules. For example, pedestrians before stepping on a zebra crossing are advised to "wait for a suitable gap in the traffic so that drivers have time to give way." If a police officer is in charge of the crossing, they are told, "watch for his signals and do not cross until he holds up the traffic." Drivers giving way to pedestrians on zebra crossings are reminded to signal to other drivers their intention to slow down or stop. The Code emphasises that this signal is not an invitation to overtake. When pulling up at the kerb, drivers are asked to give the signal meaning, "I am ready to be overtaken" where this is appropriate. This will leave the slowing down signal to be used in all circumstances where the rider is *not* ready to be overtaken, as, for example, at zebra crossings.

When the Code was first presented to Parliament it contained a suggestion that the turn-right signal might also be used by riders stopping at a zebra crossing to warn traffic behind not to overtake. This suggestion has been dropped because it might lead drivers of following vehicles to attempt to pass on the near side.

Motor cyclists are told: "If riding a motor cycle, even one fitted with a mirror, glance behind before you signal or move off, or change course or overtake or turn."

The Code, of course, has not the force of law, but it can be quoted in a Court of Law, as tending to establish or disprove liability.

Other major changes are: drivers are informed to give way to pedestrians, who have right of way, on uncontrolled zebra crossings; drivers are told never to cross a continuous white line along the middle of the road unless they can see the road well ahead and know that it is clear; drivers are told not to rely on sidelights in built-up areas after dark unless the street lighting is good; when parking or stopping on the carriageway, drivers are advised to get out on the nearside whenever possible.

Footnotes have been added showing the major factors contributing to accidents. Accident statistics are related in this way to the rules of the Code.

Bury
Sussex.

A charming little village lying in the Arun valley two miles from Amberley. The church with its shingle spire has many interesting features

The drawings of drivers' signals have been improved and the signals to be given by motor cyclists have been added. These drawings leave no doubt as to the proper hand signals to give.

Many more traffic signs are illustrated and the features of mandatory, prohibitive and warning signs are explained. The significance of the chequer symbol on direction signs are explained. Notes on first aid have also been added.

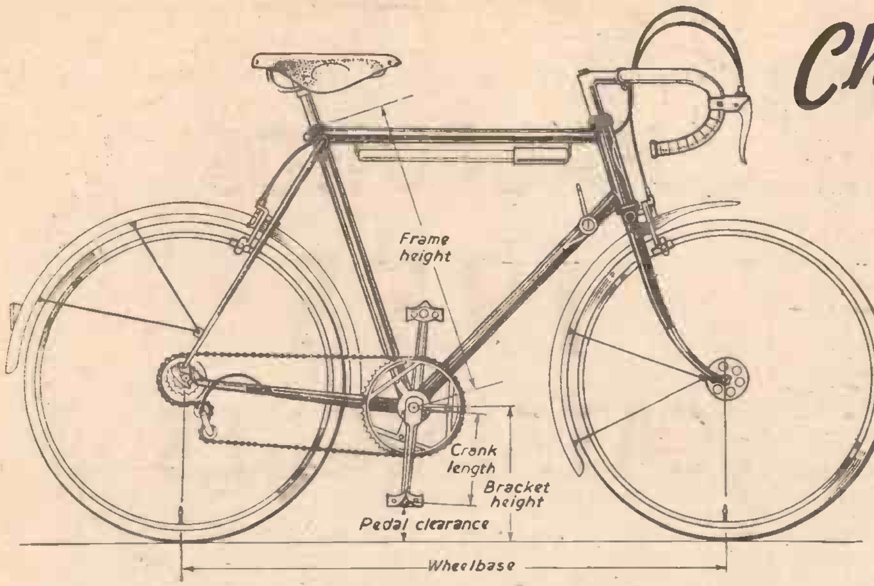
The Code, of course, is designed to make the roads safer for all, but it must be remembered that all accidents are not due to negligence or carelessness. For example, police reports show that bad weather conditions in January of this year were the main cause of nearly 2,000 accidents, mostly due to ice, frost or snow.

The Century Road Club

ELSEWHERE in this section a contributor replies to correspondence he has received from three members of the Century Road Club. Our contributor last month stated that this club owed its existence to a newspaper competition, and the secretary of the Century states that the Club never has and never did owe its existence to a newspaper. He then goes on to destroy his own denial by stating that the club was formed out of a small group of 100-milers who entered this particular newspaper competition. It is surely beyond all doubt that had this competition not been held neither the Century Road Club, nor even its name, would have been in existence. Apart from that the first president, who has carried his bat through to date, was the editor of the paper concerned, and the club badge is a facsimile of the initial letter of the title of the newspaper. Can the Century still maintain, perhaps with an eye on the R.T.T.C. rule, that it does not owe its existence to a newspaper? The R.T.T.C rule specifically bans recognition of any club associated with any firm, newspaper or periodical, in furtherance of the R.T.T.C. policy to avoid shamateurism and publicity. We have always felt that the Century Road Club in this respect, by its very badge, has transgressed this rule and it may be that the objection to our contributor's remarks was based on this. The secretary objected to our contributor's reference to this club as a comparatively unimportant one. The importance of a club is decided by its present as well as its past achievements. The Century has a past of which it can be proud. It has not a present worthy of its past. It may have imposing names, as our contributor points out, on its membership rolls. Are they, however, only members of the knife and fork brigade who turn up only at the Annual Dinner to receive the plaudits in speeches made by the younger generation? How many of them take an active inerest in the club's affairs? Too many of these old clubs live on and in the past. They have no riders of the ability and achievement of their past membership, and their meetings in many cases are merely occasions for nostalgic narrations of the past deeds of daring-do of old members or members who have passed to that bourne from which no traveller returns. It would be true to say that the Century in common with the North Road and Bath Road *were* great clubs. They are not great clubs to-day. If these and similar clubs wish to regain the positions they once held they should train and put into the ranks of racing cyclists riders of the quality which made them great and the oldsters should resign.—F.J.C.

Choosing Your BICYCLE

If You Cannot Choose a Cycle Exactly to Your Liking, Then Have a Machine Built for You



The dimensions of the bicycle.

SO many cyclists these days choose their machines more or less haphazardly, believing that as long as their choice is a well-known or much-advertised make, it is sufficient, but this is a sad mistake. Sometimes would-be cyclists (more especially, perhaps, members of the fair sex) become so disappointed with cycling, because they have chosen the "wrong" mount, that they dispose of their machines very early after purchase, complaining that cycling was full of aches and pains and soreness, and that they were unable to keep the pace of their associates.

When you enter a cycle dealer's showroom, you should already know exactly what you want, for it is only natural that a salesman will attempt (and generally succeed) to sell either the bicycle he reaps most profit from or one that he is particularly desirous of removing from his stock. Many cycle salesmen know little or nothing of practical cycling. My first point of advice is: if you want a special machine, make your purchase at a store where the staff are cyclists themselves, for they alone realise the importance of care in selection.

A "Ready Made"

If you cannot possibly secure a "ready made" exactly to your liking, then have one built for you. It will not cost a great deal extra.

Will you use the machine solely for business purposes? If so, will you make just short journeys or be in the saddle for lengthy periods? Are you seeking a cycle to provide pleasurable week-end trips? Are you going to join a cycling club? Have you any ideas of racing? Are you a tourist, a potterer, a clubman, or a racing man? Are you short, tall, light, heavy, slim or stout, strong or not so strong? These are the kind of questions that a would-be purchaser must ask himself or herself, for the purpose to which the machine will be put decides the style of bicycle.

Do not let fashion worry you unduly. All machines sold to-day are modern and up to date. Do not buy a so-called "racing" bicycle just for its "sporty" appearance, and do not be influenced by flash finishes. A sports model is usually fitted with dropped pattern handlebars, narrow and hard saddle, narrow rims and light tyres, and is hardly the mount for long tours or business riding, being designed more for speed than comfort. If the saddle will be your seat for hours on end, and high speeds are a factor not to be reckoned with, choose a saddle of the soft mattress-top type, but not too wide. It is debatable whether a rider obtains any degree of actual comfort from dropped handlebars but it is, of course, a matter of personal choice. Do not select a bend simply because it is popular or because it is the one used by a particular racing "crack." Endeavour to obtain a comfortable position by trying several shapes until you find that which suits you best. For utility work an ordinary flat is usually suitable, or, if a more forward position is favoured, a North Road drop. As for handlebar width, times have seen ridiculously narrow ones, and very wide ones. Of the two extremes I favour the wider, but a good guide is to have somewhere about the width across your shoulders. Probably this will be about 16in.

Saddle Position

The correct position for the saddle and handlebars can only be determined by the rider, and although this can be indicated approximately here, the final placing can only be arrived at by individual experiment. The peak of the saddle should be about 2in. behind the bottom-bracket axle and low enough to allow the rider to reach the underneath of the pedal with his toe when the crank is in a downward position. The ends of your handlebars, from centre of saddle, should be about 5in. less than the measurements from centre of saddle to bracket axle.

Your arms must not be stretched forward in a straight line; a slight bend at the elbow affords a little absorption of road shock. An "upright" position is to be avoided quite as much as a "crouching" attitude, as the rider's weight must be evenly distributed over the machine. Whether handle-grips of the shock-absorbing type are used or not depends upon the handlebars and on personal preference.

A very heavy cyclist might need heavier and wider tyres than his lighter companions, but the $1\frac{1}{4}$in. rims and tyres which are in common use to-day are quite suitable for most people. The wider $1\frac{3}{8}$in. might be selected by a man or woman well above the average weight. A good substantial tyre with a non-skid tread would suit the utilitarian or business rider, while a reasonably light and lively type is the clubman's choice. Always keep your tyres pumped hard.

A Variable Gear

If your machine is to have variable gear or hub brakes, see that heavier gauge spokes are used—13 or 14-gauge for speed gears and 12 or 13 for hub brakes, according, again, to weight of the user. The lighter gauge spokes are suitable for lightweight machines. A good plan is to have them tied and soldered at the crossings, thus making a more rigid and generally stronger wheel. The question of brakes is a matter of taste.

Variable gears are in everyday use and whether they be of the hub or derailleur type, their assets greatly exceed the slight disadvantage of additional weight. They are well worth the extra initial outlay. A moderate-sized gear must be obtained as "normal," one that is comfortable for lengthy pedalling spells. A man should find his "normal" between 65 and 70, a woman a little lower.

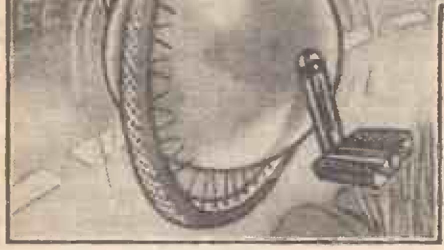
Do not buy the tallest machine you can reach; in fact, it is better to err on the small side, for adjustments can always be made with saddle and handlebars. Your machine must be rigid to sideways springiness or "whip," otherwise the give or bend in the frame will absorb part of the thrust you intend to propel the machine. A frame built with first-quality steel tubes, or preferably in the well-known "531" tubing, and with straight (not cranked at mudguard bridges) seat and chain stays is the best to purchase.

Up-and-down resilience is essential to comfort, and without comfort there is little enjoyment in cycling for with it the speedman can ride faster and the tourist farther and longer. Vertical resilience is provided mainly by the front forks, so see that they have a rake of $2\frac{1}{2}$in. or 3in. if your mount be in the roadster class. If your choice is a lightweight sports model with more upright head angles, 2in. to $2\frac{1}{2}$in. will be more suitable. Light and easy steering is an attribute and the longer the steering head the better. Frame angle, measured inside the top and seat tube, should be about 69 deg., or about 71 deg. to 73 deg. for racing cycles.

Frame Height

To arrive at the size frame you require deduct 12in. from your full inside leg measurement (women 11in.). Frame height is taken as the distance from the top of seat lug to the centre of the bracket axle. The bracket axle should be $10\frac{1}{2}$in. from the ground if the cycle is fitted with $6\frac{1}{2}$in. cranks and 11in. if 7in. cranks. The distance from the centre of front hub to rear hub (wheelbase) may be anything from 40in. to 44in., while the measurement from centre of bracket axle 24in. if the cycle is fitted with 26in. wheels, $6\frac{1}{2}$in. cranks and mudguards.

The weight of a bicycle depends entirely on the components fitted, but if a machine for business riding weighs 32lb., or a sports model turns the scale at 25lb., you should not have cause to complain.



By ICARUS

Biographies and Biographers

I HAVE received a letter from Walter L. Howe, Hon. Secretary of the Century Road Club, regarding my biographical notes on the late B. W. Best, who was a member of the Century. Mr. Howe thinks that my notes were scurrilous and he tells me that the Century Road Club does not owe its existence to any newspaper. I have never subscribed to that stupid doctrine of *De mortuis nil nisi bonum*. If a biography, however brief, is to be written at all it should state the good and the bad, so that those who did not know the person concerned can get an accurate picture of him. Otherwise, every man becomes a saint when he dies! A man is protected by the law of libel from the truth being told about him whilst he is alive. It is only right that a man should have all the facts stated and all the facets of his character. It is natural, of course, for the Century Road Club to wish to defend one of its members. I do not know whether Best was a first claim member. I should doubt it, as he was a member of so many clubs, including the spurious Hornchurch Wheelers, which he founded in order to obtain a delegacy to the R.T.T.C. at a time when no other club would appoint him.

So many clubs to-day like to have some imposing names on their membership roll. Large numbers of clubs to-day have members who never turn up at any meetings, except the annual dinner, when they can bask in a little glory, never support the club's functions, and indeed are members in name only. Mr. Howe overlooks the fact that I knew Best for many years, and far better than he did. As I have stated, he was on the staff of this journal for a short time only. It was obvious that Best as a timekeeper could not keep time at the office. He was an unemployable person, as many had found out, although he was useful as a contributor. Even then one had to sub-edit his copy very carefully indeed to ensure that he was not by oblique and veiled means waging one of his numerous vendettas. I challenge anyone who knew Best well to deny the accuracy of my comments, and nothing has nauseated me quite so much as some of the obituary notices written in a sickly sycophantic and fawning adulatory style by those who ran Best down to the lowest whilst he was alive. It cannot be denied that Best was a trouble-maker, that he was untruthful and underhand. Although he frequently libelled and slandered others he objected when reprisals were taken. In a later letter Mr. Howe admits that he did not know Best well, and therefore fortifies the policy of the good and the bad being stated. I am referring to this matter not because of any intention to degrade Best, of whose good points I am aware, and to which I referred. I write merely in the interest of historical accuracy. I received another letter from one Draisey, a non-reader. Draisey is also a member of the Century Road Club!

Regarding the quibble about the foundation of the Century Club, what I said was "it owed its existence to a newspaper." I do not withdraw that statement, in spite of the denial by Mr. Howe that the Century Road Club does not and never has owed its existence to any newspaper. He admits that it was formed in 1912 by some of the riders in the Century Competition organised by a cycling journal. But for that competition the club and its title would not have come into existence.

I referred to the Century as an unimportant club, aware when I wrote it of its past glories, and the famous rides and records of some of its members, but can it be said that the Century to-day has the same sheen to its escutcheon that it formerly had? Has it not, like all other old clubs, had its rise and its fall? Is it not now living on its past glories, like the Bath Road Club Ltd. and the North Road Club Ltd.? The Bath Road Club seldom finds a rider to enter into opens which it promotes. Mr. Howe in his letter to me tells me that the Best All Rounder Competition of 1935 was won by Stan Miles of the Century. But the year 1935 was 20 years ago! It was in the thirties that Hubert Opperman broke R.R.A. records and it was also many years ago when Frank Lipscombe and Jack Rossiter were in their glory. What is the Century doing to-day, and where are its riders of that calibre? Imposing names as presidents and members do not make a club great, and age proves nothing but antiquity. There are many new clubs which have outshone the two limited liability clubs I have mentioned, the Century and others, in spite of these imposing names, which to the modern generation mean very little indeed. It is not until some younger blood is infused into the veins of these old clubs that they may once again produce first-class riders instead of becoming largely meeting places for those suffering with nostalgia, and who cannot forget the deeds of the past, believing that they are adequate to cover the defects of the present. I have nothing, therefore, to withdraw from what I have written about Best and the Century, in spite of the letters from Mr. W. L. Howe and one Draisey.

NCU Officials Panel

THE National Cyclists' Union intends to set up a panel of persons willing to serve in the capacities of team managers, mechanics, masseurs, etc. Any person who would be prepared to undertake these duties when British teams travel abroad should submit application, in writing, to N.C.U. headquarters, 35, Doughty Street, London, W.C.1.

World's Championship Selection Races

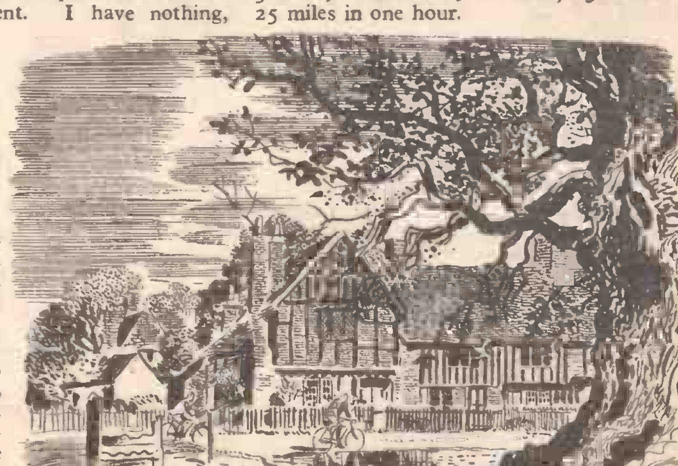
THE N.C.U. Racing Committee invites applications from race promoters to use their races as possible selection events for the World's Championship Team. The events should be approximately 110 miles in distance, a climb in the region of 700ft. should be included approximately every 12 miles, and laps should be not more than 20 miles in distance. The races may take place throughout June and up to and including July 3rd. Application should be sent to N.C.U. headquarters.

"Two on a Tandem"

READERS will know from past references in this feature that I collect old cycling literature. For some years I have been endeavouring to obtain a copy of "Two on a Tandem," published in 1896 by Chapman and Hall. Through the good offices of my friend R. L. Jefferson, himself a keen collector, and the son of *the* Jefferson, I have now obtained a copy. This neat little book was the first of a cyclist library inaugurated by the publishers. It is the story of two gentlemen who sally forth on a tandem on a cycling tour through Kent, and it describes the various accidents which befell them. They are arrested as burglars in a Kentish village, for example. This book could not have had a very large edition and was never reprinted. It breathes enthusiasm for wheeling in the early days of the cycling boom, but I doubt very much whether such a book would sell to-day. An amateur author before the war wrote a cycling novel, but it was not successful and I believe that a large part of the edition was janked off. From what I remember it was printed on foul-smelling paper!

Track Tandem Records

THE N.C.U. Racing Committee has set up standards for unpaced tandem records (to be established) as follows: 5 miles, 10 minutes; 10 miles, 21 minutes; 25 miles, 52 minutes. Women's records in the same classification bear standards as follows: 5 miles, 11 minutes; 10 miles, 23 minutes; 25 miles in one hour.



ALBURY, Hertfordshire, with its old timber houses and ancient village stocks.

Wayside Thoughts

By F. J. URRY, M.B.E.

ALFRISTON SUSSEX.
With its old inns and cottages set against beautiful downland.

Long Ago

HOW things revert. The other day Mr. James B. Bayliss, late of the Perry Company rang me up and, with an air of humorous truculence, asked if I had ever considered myself a cycle tourist.

Having suggested that I did imagine that I knew a little about the game, he informed me he had just come across a postcard hailing from Russia and sent in 1896 to say that the Perry chain had stood the long journey well and had only been adjusted once, in Moscow. The signature was R. L. Jefferson. "Ever heard of him?" James Bayliss asked. I replied that I had and had known him as one of my early wheeling heroes. "Ever heard," I countered, "of a book entitled *My Ride to Khiva?*" Of course he had not. "Well, that man wrote it," I told him, "and was probably one of the first long-distance cycling adventurers to be sponsored by the trade, in this case by the Rover Company, and at that date one of the great cycle-makers turning out a bicycle famous the world over for quality."

Somewhere at home I have a copy of that book, signed by the author, presented as a tribute to an admiring youth for my "Guv'nor" knew R. L. J. well and spent many hours in his company. I well remember thinking at the time how gracious it must feel to be able to afford to roam a country considered barbarous, and what a fare adventure to sleep on the prairies, carry a revolver and really rough it. I had no idea of sponsoring then and thought every rider, except the known professionals, was a real amateur in the strict sense of the term.

The discovery of that postcard opened a door on my earlier years through which the shades of Harry Smith, the then Rover boss, and J. K. Starley, Junr., flitted past and for me wore the mantle of kings. James B. Bayliss told me that this date was prior to any Bayliss family connection with Perrys. How time flies.

The Quiet Process

DURING the next decade, the Rover bicycle was a favourite mount of many racing cyclists and the silver shield of its head was always in the competitions. The Rover Club, still preserving cycle racing interests, was formed by the late Walter B. Goodwin, the Rover representative in Birmingham, and he gathered round him many of the finest riders of that day. Vic Johnson, Billy Baxter, Arthur Taylor, Leon Meredith, Dennis Hodgetts, Ernie Payne, to mention but a few, and I have little doubt now that quite a lot of mild sponsoring came from the parent company. However, we did not speak of these matters then in a general way, though I expect they were discussed by the parties concerned in private conclave. The N.C.U. were strict on the amateur status then and not even rail fares or hotel expenses were allowed.

Yet Walter Goodwin was prominent in N.C.U. circles and I suppose his ever-buoyant approach to such matters gave him that dual mind on sport and business, the like of which we now see in so many people, but without the necessity for the mild intrigue of surreptitious finance. A great character was Goodwin, a great servant to the Rover Company and almost as great a one to the cycle racing world. Like other men of those times, he went over to the motoring interests along with his firm and was the first Rover car agent in Birmingham. He died too early, from tuberculosis, in the fullness of his manhood.

More Individuality

IN those times bicycles had a more distinct pedigree and presentation; the cyclist could tell make from make by a glance without looking at the transfer. The only feature left to-day, of the glance recognition, is the tubular fork crown of the Raleigh. That has outlasted all of them and functions as well as it looks. The old Rover was a very neat machine, with clean lines and box-fork crown and—that which I always considered the secret of its sweet running—big balls in wheel bearings and bracket. You could hear the balls drop when turning a perfectly adjusted bearing slowly and to me the spin of the wheel seemed to outlast the running qualities of other wheels fitted with smaller bearings.

I have often mentioned this fact to modern makers, but to my knowledge none of them has been interested or even sought to prove if such impressions were correct. It was not until the Osmond came on the market that any great advance in cycle design occurred and it was, in its way, a mild revolution. The old ordinary and safety champion, F. J. Osmond, certainly pushed the industry into a new conception of cycle design. The one great thing that he handed down was the half-inch pitch roller chain, the type of drive that will never now be superseded. The Rudge Whitworth, always a lone member of the industry outside the range of standardisation, with its inverted V-fork crown—still in service—fitted a $\frac{5}{8}$in. pitch roller chain, the cotterless bracket, and nuts and spindles of non-standard thread.

But standardisation was bound to win in the end, for it meant simplicity in repair and replacement.

An Old Query

SOMETIMES when I speak to friends on the subject of quality machines in the early days as compared with the best class bicycles of to-day, they ask me if there has been little or any improvement in performance.

It is not easy to answer, for it is not only the machines that have changed but the men who ride them, then and now, roads, tyres, bearings—particularly bearings—and the attitude of the cycling public. If you possessed a class bicycle, towards the end of the last century, you were somebody in the travel world, for I suppose the number of riders was then well short of a million. Now, that number is nearer 12 millions, and though discrimination in choice is as keen as ever, it automatically follows that the widening of that choice by manufacturers has given a greater incentive to the public looking for cheap, easy, active transport, either for utility, pleasure or sporting purposes.

Huckworthy Bridge
The ancient bridge over the River Walkham near Horrabridge Station South Devon

I think the answer to the question of whether the modern best is as good as the old best, is a decided yes, accounted for in the main by the enormous improvement in tyres and bearings. Tyres are an important feature in the easy running of a bicycle and the best of them, not necessarily of the racing type, are very good indeed. Bearings to-day are no worry to the rider and, apart from an occasional oiling, he can forget about them. Their perfection is, of course, due to the improvement in quality steels and modern manipulation. When one speaks of weight, it should be remembered that the 19th century machine had no variable gears, no free wheel, and as often as not neither brakes nor guards. One cannot compare them and it is unfair to try; I once heard Freddy Osmond say he could build a faster bicycle weighing 23-24lb. than one of 18-19lb.

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