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SEPTEMBER

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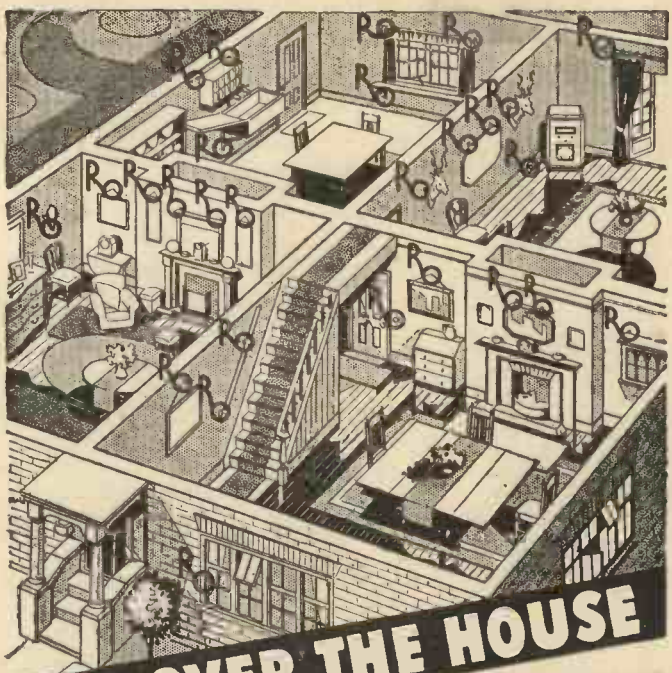

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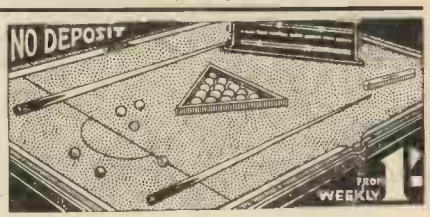

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PRACTICAL MECHANICS

VOL. IV. SEPTEMBER, 1937 No. 48.

Fair Comment

By The Editor

Scientific Fads and Fallacies

I AM really amazed at the credulity of even educated people where scientific matters enter their daily lives. The other day I was astonished to hear an otherwise educated person state in all seriousness that a person weighed *less* after a meal than before it. When I jocularly remonstrated with him for attaching credence to this fantastic notion (quite an old belief), he assured me that it was so! Apparently, therefore, if you stand on a pair of scales holding your lunch, your own weight being ten stone, and the lunch 2 lb., so that the scales register 10 stone 2 lb.; you only have to eat the lunch whilst standing on the scales for your weight to be registered as less than 10 stone! Carrying this idea further, you merely have to stand on a pair of scales and eat a sufficient number of luncheons to vanish into thin air.

I am sure that ladies who are nowadays so interested in slimming will be interested to try this new remedy for excessive adiposity! I must say that it is amusing to imagine that you can reduce weight by increasing it, and I have not heard before that by over-eating you could reduce your weight. Of course, a pair of scales and a packet of sandwiches soon convinced my friend and dispelled from his mind a notion he had held since childhood.

This friendly demonstration caused me to reflect upon many similar silly notions and fads which still find acceptance in the minds of many people. There is a good deal which we have to unlearn as we grow up, not the least of which is that bogymen do not exist, and that circus posters do not always speak the truth. It is a pity that we do not also forget some of the silly tales which we may believe when young, and which are handed down by some peculiar process of folk memory.

Many people believe that if the sun shines on the fire it puts it out, apparently because the brilliance of the sun shining on it causes it to appear to glow less The sun has no effect upon the fire other than to cause it to glow an infinitesimal amount hotter! There are many similar instances which will occur to you, and really they should be the object of contumely.

I always regard with a certain amount of pity those people who blindly accept these statements without stopping to think about them. Intelligent people will refuse to be the third to have their cigarette lit by the same match, whilst others will refuse to walk under a ladder. It is still popularly believed that it is unlucky to open an umbrella in a house. In this enlightened age we should find no room for these ignorant beliefs which have been handed down from the ignorant dark ages—the days of necromancy, legerdemain, and prestidigitation. Now examine yourself and see to how many foolish beliefs you subscribe!

End of Volume Four

I REMIND readers that this issue concludes volume four and the annual index will be ready shortly, price 7*d*. by post. A bound volume of PRACTICAL MECHANICS is a treasury of knowledge on all scientific and practical subjects, and I would urge readers to have their issues bound; even if they do not wish to do so they should certainly purchase a copy of the index which will guide them rapidly to the contents of the twelve issues comprising a volume.

If you have the indexes to the previous volumes these should be kept together in a folder so that you can rapidly consult the contents of the 48 issues without having to handle a large number of loose copies. Many issues of PRACTICAL MECHANICS are out of print, but we can supply back issues where such are available at 7½*d*. each, excluding the Christmas Number for 1935, which costs 1*s*. 1½*d*. A bound volume also makes a most acceptable Christmas or birthday present.

The Model Engineer Exhibition

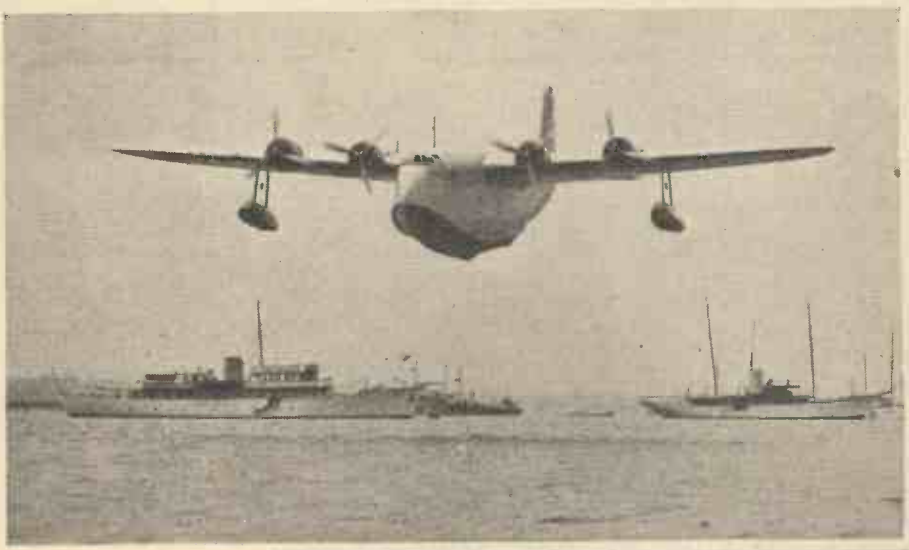
READERS interested in model aeroplanes, model railways, model boats, model engineering, and small-power engineering should make a point of visiting the Model Engineer Exhibition which takes place at the Horticultural Hall, Westminster, London, S.W.1, from the September 16th to 25th inclusive. My friend, Mr. Percival Marshall, the organiser of this Exhibition, has again managed to stage a most successful show, judging from the number of entries and exhibits he has received. I hope my readers who are able to do so will pay the Exhibition a visit. I always find this Exhibition one of the high spots of the Exhibition season, and I shall be pleased to meet any of my readers there.

The Cycle Show

WHILST I am dealing with Exhibitions it is appropriate to state that the Cycle and Motor Cycle Show takes place at Earl's Court from Wednesday, September 22nd, to Wednesday, September 29th, inclusive. Our companion weekly, *The Cyclist*, and its associated organisation, The Cyclist Road Club, will be represented there, and visitors may consult our various other technical periodicals and technical books. Readers who wish to consult me on any matter may do so by leaving a card at our Stand No. 2, facing the main entrance. Our other companion journal will be represented at the Motor Show which takes place at Earl's Court on October 14th to 23rd. Readers should note that these two Exhibitions are held in the New Exhibition building at Earl's Court and not at Olympia as hitherto.

ACROSS THE ATLANTIC IN TWELVE HOURS

The Dream of Centuries Comes True! The Start of an Atlantic Two-way Air Mail and Passenger Service.



The Imperial Airways long-range flying-boat Caledonia is here seen taking off and in the air. It weighs, fully loaded, 45,000 lb., and is powered with four Bristol "Pegasus" engines each developing 900 h.p. and has a maximum speed of 200 m.p.h.

ON July 6th, 1937, two flights were completed across the Atlantic by two giant flying boats, who thus started a two-way regular mail and passenger service.

The machines concerned were the Caledonia, an Imperial Airways air liner which landed at Botwood, Newfoundland, 15 hours 3 minutes after leaving Foynes, Ireland, and Clipper III, of Pan-American Air Lines, which crossed from west to east in 12 hours 40 minutes. Three facts account for the difference in times. First, the British machine had to face a head wind, secondly, her course of 1,933 miles, was 30 miles longer than the more southerly route of the Americans, and lastly, the Caledonia was delayed 40 minutes by mist over Newfoundland.

A Small Hop

Capt. G. E. Gray, commander of the Clipper, said it was an uneventful journey, and, in fact, it was rather a small hop compared with the Pacific runs of 2,400 miles which he had been doing for two years. He also said that they were flying at times at 10,000 ft., with clouds beneath them, but the sun was shining brightly nearly all the way after daybreak.

The two commanders were in constant wireless communication whilst flying over the ocean, exchanging weather information. When they passed each other they were about 67 miles apart.

On the first part of the journey Caledonia had to contend with rain and cloud, but after clearing the depression she speeded up, exceeding 160 m.p.h., which is given as her cruisi g speed. The Clipper, aided by the wind, and less hampered by rain and cloud, flew most of the way at about 172 m.p.h.

A Triumph for Weather Experts

It was a great triumph for the meteorologists. Almost every condition they predicted came true. The pilots found wind and rain where they expected it and passed

The American flying-boat, Clipper III, takes up her anchorage after landing at Foynes, Ireland.

their patches of fog as forecast. It is said that this was one of the most successful weather charts prepared for any great flying adventure.

The two planes undertook the return journey on July 16th, and it proved to be a personal triumph for Caledonia. She reached Foynes, Limerick, at 10.32 a.m., after flying 1,996 miles from Newfoundland in 12 hours 7 minutes—an average of 162 m.p.h. The Pan-American Clipper arrived at Botwood, Newfoundland, from Foynes at 1.49 a.m. Her time—against the wind—was 16 hours 24 minutes. Thus the English machine beat the Clipper's time for the West-to-East ocean crossing by 27 minutes, and the East-to-West by 75 minutes.

Favourable Weather

Weather conditions were mainly favourable and Caledonia had a following wind to help her. The two machines passed each other at 4.41 a.m., in the darkness high above the ocean, 1,000 miles from the Irish coast.

At 4.14 a.m. the Pan-American Clipper wirelessed that she had reached the halfway mark across the Atlantic. The course followed by the machines was a direct line between Botwood and Foynes.

On August 9th the record for the Atlantic crossing was again lowered, this time by the Cambria, a sister ship of the Caledonia. The Cambria's time was 12 hours 2 minutes, although the actual time in the air was 11 hours 57 minutes, 5 minutes being allowed for taking off and landing.

A Point to Consider

Although these two air-liners have put up a remarkable performance, it will be some years before an Atlantic air service can be run on satisfactory lines. The chief thing to consider is the carrying capacity of the planes. The Caledonia is allowed to load to 45,000 lb., but it can only carry 1,000 lb. of payload over the Atlantic. The reason for this is that the empty weight of this boat is under 25,000 lb. and the great fuel load, with the oil, weighs about 19,000 lb., making a total of 44,000 lb. before allowing for the weight of the crew and food. The Caledonia could, it is believed, take up another 5,000 lb. of load in the form of airmail and passengers across the Atlantic, in fact they could safely load to over 40 lb. per square foot of wing area.

But heavier wing-loading will probably be left to the bigger flying-boats yet to be constructed, as the Caledonia was not designed to achieve this.

We must consider, however, that before higher wing loadings and, therefore, increased payloads can be carried, some means must be found to assist the aircraft in the take-off. It would prove too costly for flying-boats over the 40,000 lb. class to be over-engined merely to assist them to get into the air, so we must look in another direction. It would help considerably if it were possible for the plane to refuel during the journey, and the idea shown in the illustration on this page would prove a suitable solution to the problem. It has been designed by an American inventor as a basis of a modernised plan to bridge the Atlantic with a string of artificial islands. Planes using these islands in stepping-stone fashion could transport heavy loads at high speed, since their loads of fuel would be light.

Catapulting Aircraft into the Air

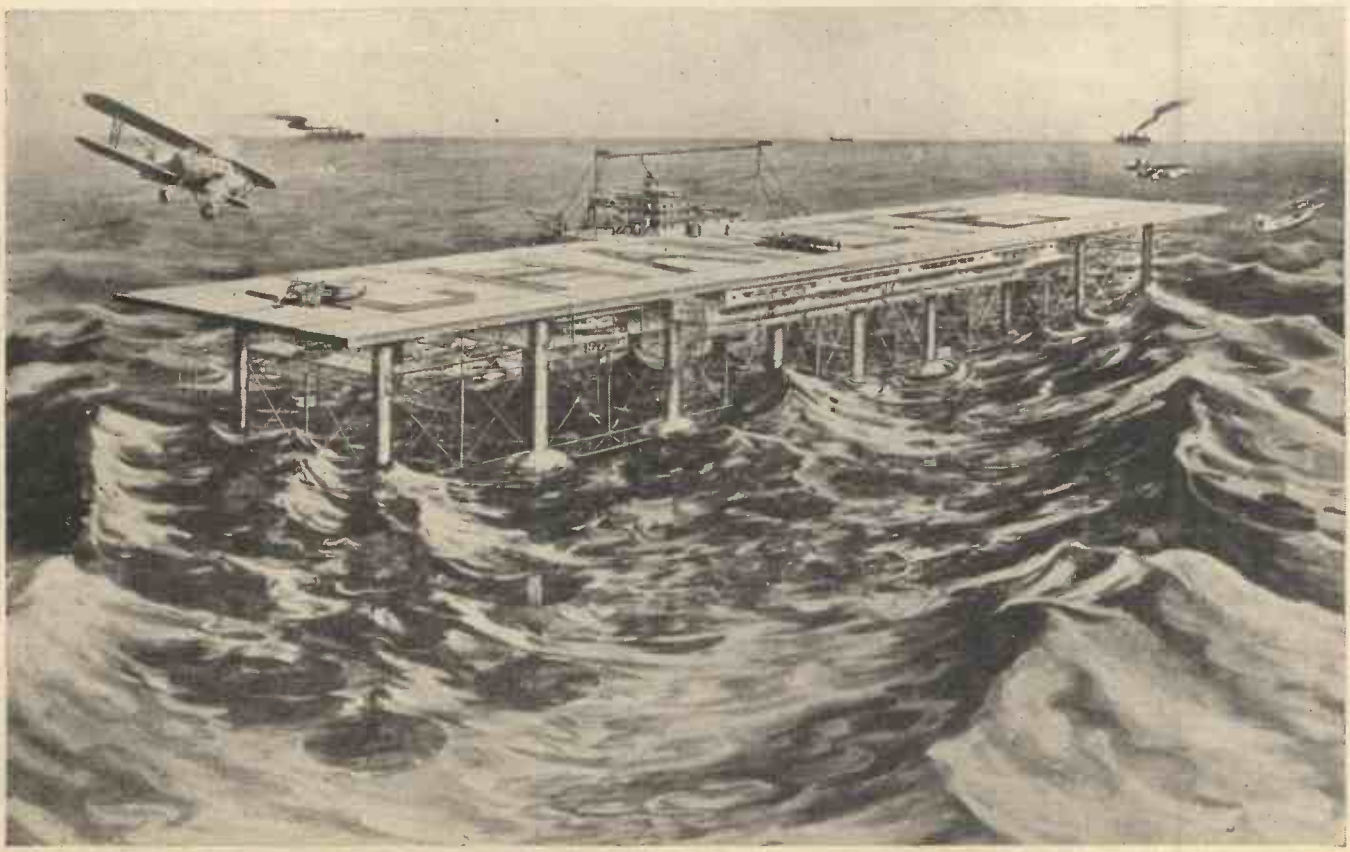
Another method being investigated at present is the catapulting of aircraft into the air. Germany has already made a number of successful experiments with seaplanes up to loads of 37,000 lb., or almost the weight fully laden of our Empire flying-boats. Auxiliary launching of aircraft into the air is, however, not new, as in 1903 the Wright Brothers used a launching device at Kittyhawk, Carolina, for their first heavier-than-air flights. The Wright biplane slid down a single rail under the impetus of a falling weight, with the engine revolving when it left the rail and became air-borne.

Successful catapult gear has been built at the Royal Aircraft Establishment at Farnborough, Hants, that can launch aircraft of up to 18,000 lb. An aircraft of this weight gets into the air after a run of only 120 ft., and starts flying at 60 m.p.h.

The station equipment of Langstone Harbour, Portsmouth, will, in time, include catapult apparatus, and the ideal type will be one which can act on a turntable to launch large aircraft into the wind or over the sea. Thus, if launching large aircraft into the air by means of a catapult proves successful, they can be given a bigger payload than that with which it can take off, and operating costs generally would be cheaper.

The Mayo Composite Seaplane

Yet another idea for facilitating Atlantic flights was the ingenious pick-a-back aircraft designed by Imperial Airways, and fully described in the February 1936 issue of PRACTICAL MECHANICS. The main feature of this novel craft was that it comprised two aeroplanes in one. A long-range high-speed seaplane was mounted on top of a powerful multi-engined flying-boat. When the large flying-boat attained a height of 10,000 ft. the smaller plane was launched into the air. The advantage of this mid-air launching is that the seaplane thus launched at its operating height is able to carry a heavier load for a longer distance at a higher speed, and with a lower expenditure of power, than would be the case with any machine which has to ascend from the surface of land or sea.



A Possibility of Transatlantic Flight of the Future. Bridging the Atlantic by means of artificial islands to enable aircraft to refuel during the flight. This would give greater load- and passenger-carrying capacity, since fuel load would be reduced.

STARGAZING FOR AMATEURS

A NEW SERIES

By N. de Nully

A GUIDE FOR SEPTEMBER

THE Sun enters the zodiacal sign Libra (the Scales) at noon (B.S.T.) on the 23rd. This will mark the autumnal equinox, when the days and nights will be of equal length all over the world. The full Moon on the 20th will be the Harvest Moon for this year. In early days the evening rising of the Moon at about the same time for several nights in succession at this season was thought to have been specially ordained to facilitate the gathering of the crops—a kind of natural daylight-saving scheme. The real cause of the phenomenon is the small angle that our satellite's path makes with the horizon at this period. Though attractive to the naked eye, the full Moon offers little of interest to the amateur stargazer. In the intense glare of lunar noon the rugged formations both previously and subsequently thrown into bold relief along the "terminator" become mere splashes of light with all details obliterated.

The Tycho Rays

Nevertheless, this phase manifests a mysterious effect in the appearance of a remarkable ray system, which diverges like luminous meridians, in every direction from the saucer-shaped "crater" Tycho. The photograph on this page was taken when the Moon was 16½ days old and shows the most conspicuous of the strange streaks one of which stretches right across the disc; observe also the striking prominence of Tycho itself as compared with other almost effaced features. The nature of these extraordinary apparitions is unknown. They cast no shadows and consequently cannot be due to either ridges or depressions. Moreover, they pass in straight lines over every irregularity in their track. Similar systems of lesser extent are associated with the ring mountains Copernicus, Aristarchus and others. No satisfactory explanation of them has been forthcoming. In the illustration, sunlight is drawing off the western edge of the Moon, showing up many of the walled-plains on the curving surface adjacent to the rim.

The Planets

Mercury will pass between the Earth and the Sun on the 14th and is therefore already invisible. Venus continues a "morning star" inconveniently placed. Jupiter and Mars will be found low in the south and south-west respectively, during mid-evening. Mars sets at 10.30 p.m. and Jupiter at 1 a.m. On the 14th and 17th, at 9.30 p.m., a small astronomical telescope will show one of Jupiter's moons in transit across the disc. On the earlier of these dates another of the moons will at the same time be hidden in eclipse; leaving but two visible, one on either side of the planet. In addition to these happenings while in course of progress, the following phenomena may (weather permitting) be witnessed at the moments of their occurrences. On the 2nd at 10.55 p.m. Sat. I will emerge from previous eclipse. On the 9th at 9.25 p.m., the same satellite will be occulted by Jupiter and reappear from out of its shadow at fifty minutes after midnight. On that evening, too, Sat. II will similarly reappear at 10.44 p.m.; while on the 18th at 9.13 p.m. and on the 25th at 11.8 p.m., there will again be emergences from eclipse by Sat. I. Saturn will be in opposition on the 25th and at its least distance from the Earth—791,125,000 miles. The planet rises at 8 p.m. and may be observed a couple of hours later as a dull yellow "star," well above the south-eastern horizon. Its rings remain virtually closed.

Photograph of the nearly-full moon showing some of the Tycho rays.

The multiple star in the constellation Lyra.

Stellar Marvels

The stellar panorama once more begins to attract attention on moonless nights. In the southern aspect three prominent stars form an inverted triangle, the apex pointing downwards and marked by Altair; Deneb and Vega, almost overhead, represent the base. Altair, the chief member of the little group Aquila (the Eagle), is a magnificent sun half as large again and much hotter than ours. It is also a million times farther off: and though one of the nearest of the brighter stars, its light takes sixteen years to reach us. Its composition is mainly glowing hydrogen gas and it is situated in a region rich in "star clouds." Deneb, in Cygnus (the Swan)—sometimes called the Northern Cross—is the top star in the cruciform arrangement and is known to astronomers as α (Alpha) Cygni. It is a solar giant 10,000 times more radiant than the Sun, and placed at a remoteness that can be comprehensively expressed only as 800 "light years." β (Beta) Cygni, the middle star of the Cross, is a beautiful blue and yellow double, easily seen through a small telescope. The constellation Cygnus lies directly in the track of the Milky Way and Beta is in the midst of a gorgeous assemblage of thousands of stellar diamonds, many of them coloured. A faint idea of the splendour of this glittering region may be obtained through even a binocular on a dark clear night. The photograph reproduced shows how closely the stars are crowded together.

Star-crowded region around (Beta) Cygni.

The Wonders of Lyra

Vega in Lyra (the Harp) is bigger than either Altair or Deneb and at a higher temperature. It is the most brilliant star in the northern heavens; for Sirius, though visible from here, is south of the celestial equator. Among the several wonders of this relatively diminutive group is the remarkable eclipsing variable star β (Beta) Lyræ. This object really consists of two suns which, owing to their mutual close revolution round each other, bring about a cycle of regular light changes spread over nearly 12½ days. Slightly to the east of Vega is another marvel, the famous multiple star ϵ (Epsilon) Lyræ, perceptible to normal vision as a single point of light. To keen sight or through an opera glass, it becomes double; while an astronomical telescope of but moderate power will further reveal that each of the pair is likewise double! They constitute a quadruple system embracing five still smaller stars discernable only in large instruments. Yet one more wonder in Lyra is the unique Ring Nebula, described and illustrated in PRACTICAL MECHANICS last January.

Astronomical Notes

A seasonal variation in the brightness of the Zodiacal Light is attributed to the probable presence of an extensive veil of meteoric particles passing between the Earth and the Sun during the late winter months.

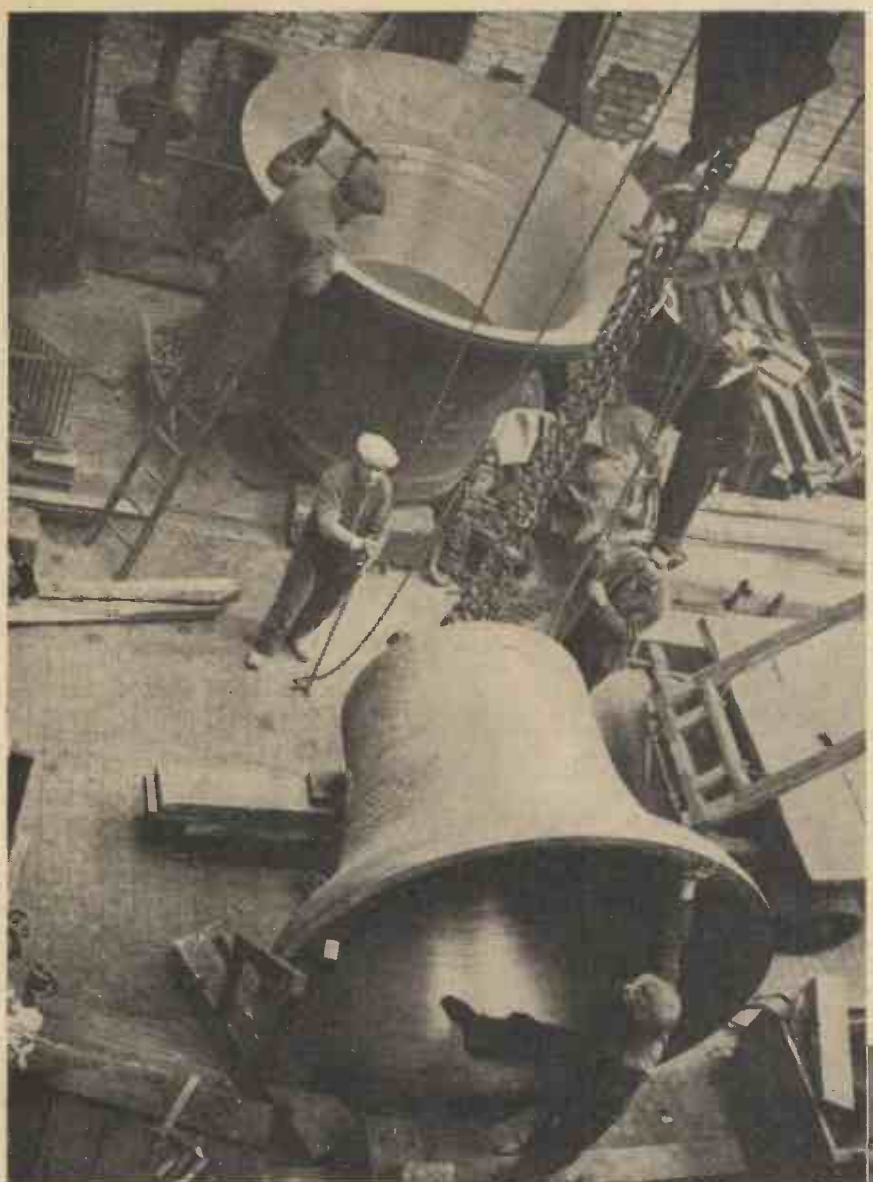
* * * * *

The transit of Mercury last May was well observed in favoured parts of the world. There was, however, no sign of the slender shadowy aureole that on previous occasions has been seen encircling the silhouetted body of the planet. Such appearances have hitherto been regarded as corroborative evidence of a suspected atmosphere.

(*Continued on page* 698)

A CARILLON IN THE MAKING

It is only in Recent Times that the Casting of Huge Bells has Been Brought to Perfection



The bell in the foreground is the 7½ ton Bourdon for Buckfast Abbey, named "Hosanna." The other bell is the 11 ton tenor of a carillon of 53 bells for Michigan University, U.S.A.

THE making of bells has occupied the close attention of engineers, scientists, and musicians of every nation of the world for centuries, but not until recent years has bell-founding reached a satisfactory standard, although thousands of years before the Christian era, huge bells weighing many tons were successfully cast in China and exist to this day.

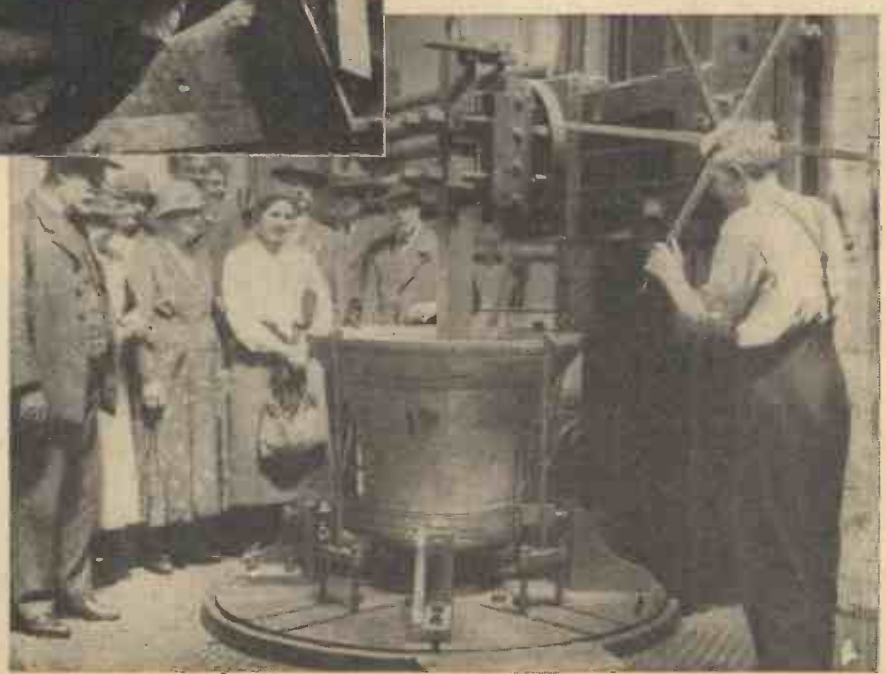
It has always been necessary to construct bells with great care—a faulty bell may cause thousands of pounds worth of damage if hung in some lofty building—but not until modern times has the casting of huge bells been based on such satisfactory lines.

In order to avoid breakage from the blows of the bells' clapper and also to ensure musical tone, a special metal must be used in the casting of bells. This is an alloy of tin and copper, according to the size and tone required—usually thirteen parts of copper are used to four parts of tin.

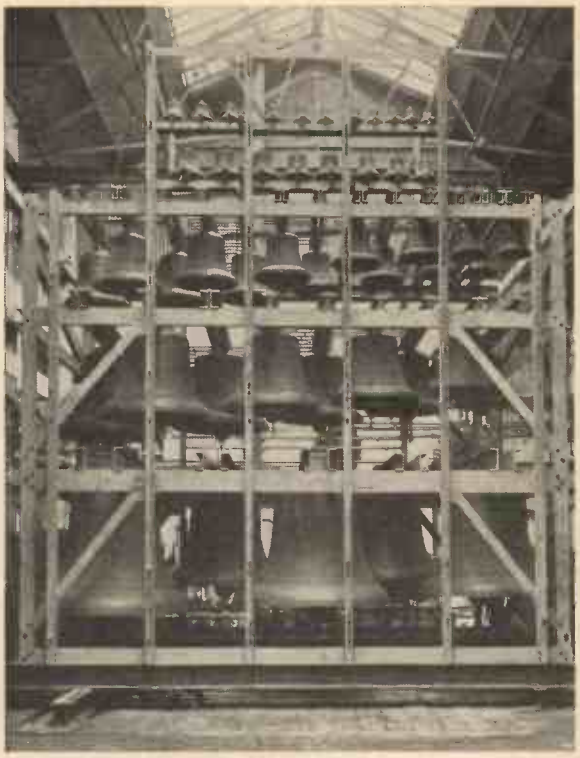
Shape of the Bell

The shape of the bells is of the utmost importance as they have to be tuned in harmonic sequence. In the old days church bells were hung in wooden frames on plain bearings and in crude fittings, but to-day they are fixed in iron and steel frames or cages, swung on ball-bearings, so that the task of the ringers is greatly lightened; also the stress on the towers, caused by the vibration of bells swung in complete revolutions, is lessened. In carillons, however, the bells are hung "dead," i.e. they do not swing, but the clappers are swung to the sound bow of the bells by a series of wires and levers.

When a bell is about to be cast, an outer iron case or cope is inverted and the inside coated with soft loam, which is "swept" into shape by a strickle board revolving on a pivot. This then represents the *outside* of



Tuning a bell.



(Left) The Wellington carillon (49 bells), New Zealand.

(Right) The 10 ton Bourdon of a carillon of 52 bells with an inscription in English on one side and in French on the other.

the future bell, and on this is placed the designs and the inscription the bell shall bear. Next, a "core" or *inner* shape of the bell is made, again of soft loam, and moulded into required shape by a smaller strickle or template, which revolves and shaves off the soft surface to the exact size required. This core is built up on an iron baseplate, and after both cope and core are thoroughly dried, the former is placed over the latter and both securely clamped together. The space between them represents the exact shape the bell will be.

In the meantime molten metal has been prepared. This is poured in through a hole in the top of the outer case. When very large castings are made, pits are used, and when the casting is completed, these are filled in with sand and the castings left to cool off for several days.

Trimming the Bell

When ready, the outer case is taken off and the inner core broken away, and the bell is revealed! This is then trimmed up, sand-blasted and drilled. It is then taken to the tuning machine, which is a kind of vertical lathe, and by removal of a small quantity of metal, the principal note and its harmonics are adjusted. A "true" bell after tuning gives its principal or "strike" note and the following harmonics: (*a*) an octave above the strike note called *nominal*, (*b*) the *hum* note, (*c*) the *tierce* or third, (*d*) the *quint* or fifth.

In early days the tuning process was of a very crude character indeed. The method was to chip away certain portions of the bell with a sharp-pointed hammer.

Thus to flatten the note, the chipping was performed inside the sound-bow where the clapper strikes, and to sharpen it, it was chipped on the outside of the rim.

The bells having been cast and tuned are now ready to be fixed in their frames. These are specially designed to fit the campanile (or bell tower) to which the carillon is destined to dwell, and made so that the sounds of the bells are equally distributed. The small bells are usually placed at the top and the heavier bells below, sometimes in several tiers, according to the number and weight of the carillon.

A carillon is a set of bells tuned to the notes of the chromatic scale, upon which music in two or more parts might be played; that is, airs with accompaniment, sonatas, fugues, fantasias and similar music. The bells are played either by a carillonneur (bell player) or automatically. The smallest number of bells which may be correctly termed "carillon" is two chromatic octaves consisting of 25 bells. Any less number would be called a "chime," and upon so limited a scale only music in one part is possible; that is, tunes without accompaniment. The number of bells in a carillon can be extended to fifty or even sixty or more, and the larger the number the greater the scope for the carillonneur to give expression of his art.

The carillonneur plays the bells by means of a clavier which is constructed somewhat similar to that of the manuals and pedals of an organ. The keys of the manual are made of wood, round in shape and about three-quarters of an inch in diameter. There are two rows, the upper representing the "black notes" of the organ, the lower representing the "white notes." The keys of the pedal are also of wood, flat in shape and so placed as to be actuated easily by the feet of the carillonneur, closely resembling the arrangement of the pedals of the organ.

Besides the usual clavier, in some instances the carillon can be played from an ivory keyboard. The lightest touch upon this instrument will cause the hammers to strike the bells, for the power is derived from an electro-pneumatic installation, which is also used in connection with an automatic player. In principle it is an adaption of the pianola, but with this difference, it has to overcome a resistance of many hundreds of pounds weight in bringing the hammer into contact with the bells, some hammers weighing anything up to four hundredweights each.

The carillon of Louvain University Library. There are 48 bells, the largest weighing 7 tons.

MAKING A SPOT WELDER

By "Home Mechanic"

Constructional Details of a Small Machine for Model Work and Light Shop Use

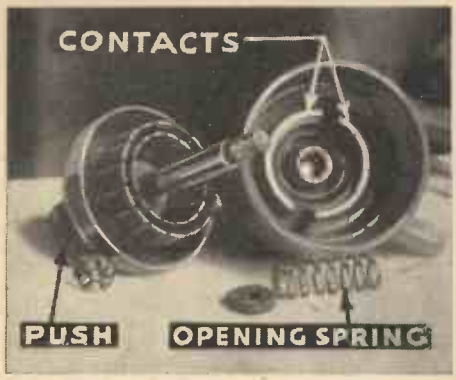


Fig. 1.—Details of the contact switch.

MOST readers can soft solder and some can braze and weld, because these processes require little apparatus. Spot welding is entirely electrical, the two metals to be joined being brought to fusing temperature over a very small area, hence the term "spot." Briefly, the work is placed between two pointed electrodes which are brought together with as much pressure as possible, and the current is then switched on for a fraction of a second. On examination, the metal is just joined over a pin spot. At the point of contact, the resistance is so high and the current so strong that the heat produced, C^2R, is enough to melt the metal. In practice, several spots can be placed side by side, but never one spot over another. Currents vary from 100 amp. upwards, and the voltages from 1·25 to 7·5 or slightly more. It must be understood that if these large currents are to flow at the low voltages mentioned, the resistance of the circuit must be very low. Hence all leads are as short and as fat as possible, and the only material to use is copper of the best quality.

For Model Work

In this article we only deal with a small machine for model work and light shop use. A spot welder can be used in almost any job that requires the quick, clean and sure joining of metals. Of course, a spot welder cannot make a water-tight seam, and for this a special machine is required with revolving electrodes, etc. Since the advent of stainless steel, the welder has been very prominent in dentistry and other professions where fine wires require joining.

We cannot enumerate all the uses of the welder, but after one has been made and installed in the shop, it will be found as useful as the machine vice.

The two types of welder described are actually identical in detail, but the power supplies are different. The first is battery-operated and the second draws its power from the mains through a transformer. Details for making a transformer are given later. To supply the necessary current a six-volt high-capacity battery will be required. A car battery of the lead-acid type is quite good, especially if it can be trickle charged from the mains. It must be a multi-plate cell of very low resistance and fitted with suitable and large terminal posts. The voltage to the electrodes is varied by changing the tappings on the battery. A suitable battery is one of the nickel-iron type. The big advantage of these cells is that they can be left for long periods without deteriorating in any way.

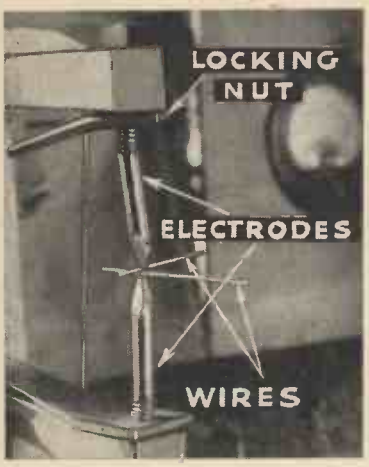


Fig. 2.—Electrodes welding two wires at right-angles.

First obtain a good supply of copper rod ½ in. square: about 18 in. will be required. The first welder is battery operated and is actually mounted on one terminal post of the battery so as to do away with one lead. The lower limb of the welder is 8 in. long and is bolted to one terminal of the contact maker or switch. The pillar is 5 in. long and is fixed to the limb by a ¼-in. copper bolt tapped into it. The two surfaces must be filed dead flat and the pillar must be at right angles to the limb. Screw up as tightly as possible, but remember copper is soft and will strip easily. When tight, soft solder must be flushed all round the pillar to make a good join, and, if possible, get it to run between the metals. The top arm is movable and hinged over the pillar. In order to make this arm free to move and yet obviate side play, *i.e.* so that the electrodes will meet when they are closed, the suspension bracket is made as wide as possible; in this case about 4 in. The top arm is a little

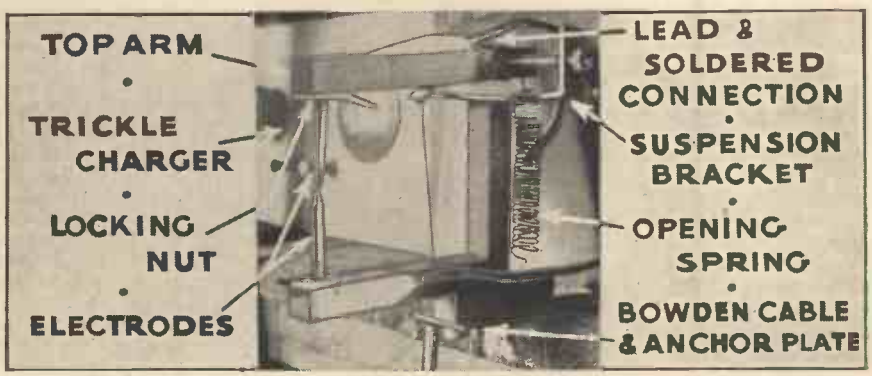


Fig. 3.—The complete welder.

Simple Construction

The actual construction of the welder is very simple and can be followed from the various sketches and photographs (Fig. 3).

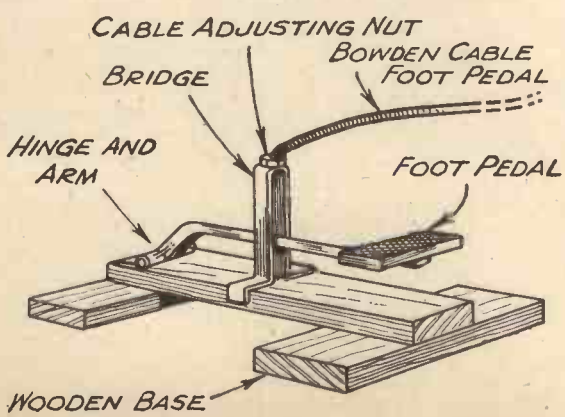


Fig. 4.—The foot control.

larger than the bottom and is drilled with a $\frac{5}{16}$-in. hole 2 in. from one end. Through this hole a rod has to pass and is secured so that it does not make electrical contact with the arm. Reamer out the hole to a little over $\frac{5}{16}$ in. The supporting rod is of brass and ¼-in. diameter threaded any suitable number per inch. Study the various sketches to get a good idea of the general layout of the machine. Slip a length of thin-walled rubber tubing on to the rod and then push this into the arm. It should be a tight fit. Now on either side of the arm place a large washer of fibre or ebonite, and then screw a nut up on either side. Screw up the nut tightly, so that the arm is rigid (Fig. 5). Test on six volts and then on 230 volts just to make certain. The bracket is of brass strip ½ in. × ½ in., bent to

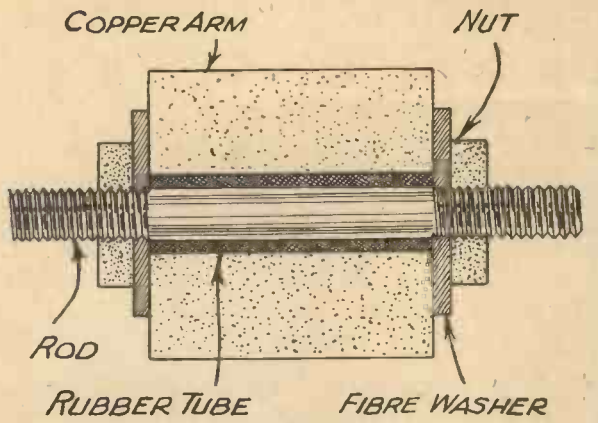


Fig. 5.—Insulating the top arm from the supporting rod.

shape and fixed to the pillar with one screw and soft solder. It will be observed that the arm is insulated from the remainder of the machine. The upper arm is centred over the lower and held in place by two nuts on either end of the threaded rod.

Electrodes

These are made from $\frac{3}{16}$-in. or $\frac{1}{4}$-in. diameter hard copper rod to any shape desired. It is essential that the welding current, in order to get a spot, be concentrated to or over a small area, and therefore the electrodes are pointed. Not to a pin point, but to a flat point of approximately $\frac{1}{32}$-in. diameter, depending, of course, on the material to be welded and the capacity of the machine. For thin steel plate of tinplate guage, a diameter less than $\frac{1}{16}$ in. should be used; the point to be quite flat and kept in this condition by an occasional touch with a fine file. The pointing of the electrodes can be easily accomplished with a file. Make the points fairly blunt, but do not have a long taper to them like a needle. The heat of the weld will soon soften the end, causing mushrooming, and faulty welding will result. The upper and the lower electrodes are both the same for simple plate welding and should be about 2 in. in length. Each one is screwed into its respective arm and adjusted so that the points meet.

A Useful Tip

A good plan is to make some electrodes larger than others so that the gap is not in the centre, but can be made higher or lower according to the electrodes used. This is an advantage when awkward slopes are being welded. The electrodes are threaded any convenient size and then fixed in holes in the arms. In order to lock them in the arms, make small adjusting bolts from strips of copper and tap them to fit the electrodes. A pair should be made for each pair of electrodes and must be fitted to them; this will save a lot of time when the pairs have to be changed. We will deal with the types of electrode required before going on to discuss the method of using them for welding. In some cases it is necessary to weld on the outside of a cylinder, like the handle attachments on a tin can or "billy can." A straight lower electrode cannot be used and a special swan-necked one is required. Make this from similar material as before, and turn up the end to just touch the upper one. The depth of the neck will depend on the distance along the tube that it is required to weld, but if this is greater than 1 in. or so, make the electrode from stouter material. A swan-neck is required for all work where the article is said to be under cut, such as rings and tubes of no great length, etc. (Fig. 6). Wires have frequently to be welded together at right angles and at a simple tap joint. But welding cannot be done with this machine. In these cases, straight electrodes must be used with grooves in them to accommodate the wire. The depth of the groove must be just under half the diameter of the wire, as its function is to firmly hold the wire and get as big a current density as possible. For right-angle welding, the grooves are at right angles and in the same line for top joints (Figs. 2 and 7). Of course, they can be in any other intermediate position.

The Contact Switch

In the original machine this was very successful and was a starting switch from a motor-car. We advise readers to obtain a switch rather than make one. The cost from a "breaker's yard" is anything from 6*d*., depending on the "breaker" and not the switch. Dismantle the switch and clean it, trim the contacts and make them true, and remove the powerful spring that normally works the switch and fit a light one. If your switch is foot-operated, this is essential because it is hand operated on the welder. It should be possible to make contact with one finger and yet the switch must open quickly (Fig. 1). Oil the sliding mechanical parts but not the electrical ones. The switch is bolted directly to the bottom arm of the welder by the contact screw on it. It is a good plan to make this contact to the frame of the switch so that both are firm mechanically and a good electrical join results. The other switch contact is connected to one pillar of the battery. To keep all leads as short as possible, it is necessary to have this contact welded to a battery terminal clamp; the usual battery clamp is ideal but the weld must be a good heavy job. If the battery is filled with screwed terminal posts as in traction batteries and crane batteries of the nickel-iron type, the switch is fixed directly on to the pillar by the terminal nut. This gives a good electrical contact.

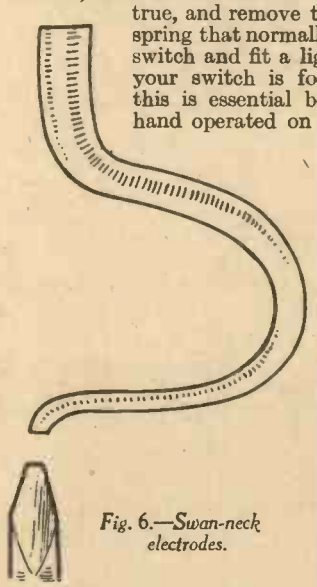


Fig. 6.—Swan-neck electrodes.

Bringing the Electrodes Together

Some device must be fitted to the machine for bringing the electrodes together, and the simplest is a coil spring between the arms. This must, of course, be insulated from the top arm, and if a spring is fitted a means for opening the contacts is required. The best way of doing this is to fit a spring to keep the arms open and close them to suit your own needs. This is done by using a Bowden cable and foot pedal. A length of Bowden cable such as used on cycles is ideal. The method of connecting up is very simple. First make a small arm about 1 in. long and fix this on the upper electrode arm supporting-rod, using lock nuts, etc. The arm is made from sheet brass and is soldered or brazed to a nut to screw on the rod. The arm must not turn on the rod, it has to be well made and quite strong as considerable pressure can be brought on it by the foot pedal. A small catch is fixed on the lower arm or pillar to which is anchored the outer cable.

The Foot Pedal

The foot pedal is very simple to make, and can be just a board hinged to a fairly heavy base, the cable being anchored in the usual manner. The simple foot control shown is more robust, and is very simple to make and easy to handle (Fig. 4). It consists of a mild steel strip $\frac{1}{2}$ in. × $\frac{1}{4}$ in., with a treadle $1\frac{1}{2}$ in. × 2 in. welded on one end. The other end is welded to a simple wood hinge which is screwed to the baseboard. A bridge piece from $\frac{1}{2}$ in. × $\frac{1}{8}$ in. strip is bent over the arm and screwed into the base. A fine hole is drilled through the bridge to take the wire which passes through a hole in the pedal. At one end, the wire should be easily adjustable so that when necessary any slack can be taken up. Grease the wire well so that the arm opens quickly when the foot is removed from the pedal. A connection made from a short length of cable as flexible as possible must be fitted to the top arm. For this make up your own sample, having first determined the minimum quantity required by trial with a length of stiff wire. Take about $\frac{1}{2}$ lb. of No. 20 wire, anneal it dead soft and clean and straighten it out. Cut into lengths as required and twist them all together to give a firm yet flexible cable. Solder one end to the top arm, and to the other end fix a large spade terminal to make good contact to the battery.

Connect everything up. Place the battery and welder on a bench of suitable height, and connect the flexible lead to the lowest voltage, say, 2 or 1·25. Place two thin bits of steel plate between the electrodes and bring them together with moderate pressure. Close the circuit for $\frac{1}{5}$ second (this may sound impossible but it only requires a touch on the switch). The metal between the electrodes should not glow, because if it does so the weld has been too long. A little practice will soon produce good results.

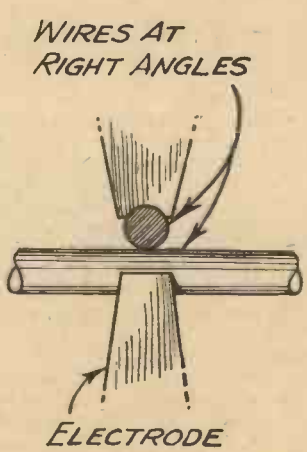


Fig. 7.—Position of electrodes for wire welding.

Room-to-Room Communication

Details of an Efficient Inter-room Communication System

The master unit is housed in an attractive walnut cabinet and costs 12 guineas complete with one speaker.

A RADIO firm has produced in its laboratories a well-tested and proven article which is closely allied with radio by the introduction of a British-made inexpensive but efficient inter-room communicating system, the Philcophone.

Philcophone has also swept the United States as the cheapest high-quality communication system ever placed on the market. It was announced last May that this product would be imported by British Philco and marketed here, but a preliminary survey of the field showed such a tremendous interest in the unit that it was decided to manufacture it here completely.

Necessary machinery and raw materials were obtained for the Perivale factory and production and tests have been under way for some time, so that now Philco can assure its dealer organisation that unlimited stocks can be delivered on and after August 20th. The price has been cut considerably from that first announced. A Philcophone master unit and one speaker can now be purchased for 12 guineas. Additional speakers can be had for 2 guineas each.

Philcophone provides an instantaneous and dependable communication system with unusual clarity and volume for private houses, business houses, restaurants, doctor's and dentist's offices, hospitals, amusement places, stores, hotels, factories, garages, or similar places.

The units are built entirely of standard Philco high-quality components and give the same high performance as Philco wireless sets. They can be used on either A.C. or D.C. mains and can be installed in little time and at low cost.

The master unit is housed in a compact attractive walnut cabinet. Connection can be made instantaneously with one or four stations simultaneously. A volume knob on the master unit sends or receives the voice as loud or as low as is desired. A red signal light shows when the system is in operation.

The remote unit provides two-way communication with the master unit. The speaker need not interrupt his work either to speak into or listen to the Philcophone. It transmits the lowest tones and can be amplified so the voice reaches the most remote corners of a large room.

Philcophone is sturdily built, consumes only 45 watts, requires no servicing, and is of use to anyone wishing to save time in the conduct of his daily affairs.

The remote unit, shown here, occupies practically no space at all, and can be heard while regular activities are carried out.

A New Welding Process

The Barimar "Gas Flux" Method

THE recent rapid rise in the prices of metals has drawn attention to the fact that cast iron and steel are not by any means the only metals used in the manufacture of machinery of all kinds. Copper, aluminium, bronze, and other non-ferrous metals also have important uses.

Skilled welding for the purposes of manufacture and repair is one of the factors that has had a great influence in reducing the cost of manufacturing and maintaining modern machinery. These processes are applied with signal success to the ferrous metals, that is to say, iron and steel, but the welding of non-ferrous metals has presented greater difficulty. This is especially true of copper, which has a high co-efficient of expansion, rapid heat conductivity, and oxidises very quickly. The welding of copper is made even more difficult because very slight variations in the quality and composition of copper have, hitherto, had a considerable bearing upon the methods that had to be applied in welding. It has been felt for a long time that the ideal method was electric welding, but until comparatively recently it has not proved very satisfactory as it had a tendency to make the copper harder and brittle.

It is interesting to relate that the solution has been found along lines that have been highly satisfactory in certain forms of steel welding.

A new process is now being operated by Barimar Ltd., of 14/18 Lamb's Conduit Street, London, W.C.1, for the welding of copper and alloys containing copper, and the main feature is the employment of what can be termed a "gas" flux.

With most forms of welding, a flux in the form of paste, powder, or liquid is used to protect the hot or molten metal from the air, or more correctly speaking, from oxygen in the air, because it is generally admitted that nitrogen does not cause much trouble.

It is, however, an innovation to employ a gas as a flux in connection with the welding of non-ferrous metals. Ordinary fluxes, of course, become liquid during the process of welding, but with the new Barimar method, the flux takes on a gaseous form, and this gas is sufficiently dense to afford adequate protection to the metal without running the risk of any of the flux becoming incorporated in the weld, as is the case with some of the ordinary kinds of flux.

The process, for the present, is only being applied to copper and certain alloys containing copper, but it is hoped that further developments will make it possible also to use it in connection with the welding of other non-ferrous metals.

THE MONTH IN SCIENCE AND

The telephoto camera with giant 56-in. Taylor-Hobson lens used for Coronation close-ups.

Coronation Close-ups

WHEN an astronomer wishes to view distant stars he uses a telescope with a very big object glass in order to catch sufficient light from the faint and distant star to make it visible. A telephoto camera uses the same principle. The camera has a very big lens to receive a large amount of light and focuses on a small section of film. A brilliant picture of distant objects is thereby obtained. But to get cinema shots under the artificial lighting conditions of Westminster Abbey at distant range, a gigantic lens had to be used. It was a Mount Wilson telescope compared with sizes which have hitherto been used. The lens was a 56-inch lens focusing on ordinary size cinema film. Excellent results were obtained. The lens was of English manufacture too, being made by the firm of Taylor-Hobson, of Leicester.

Speed Gun Cameras

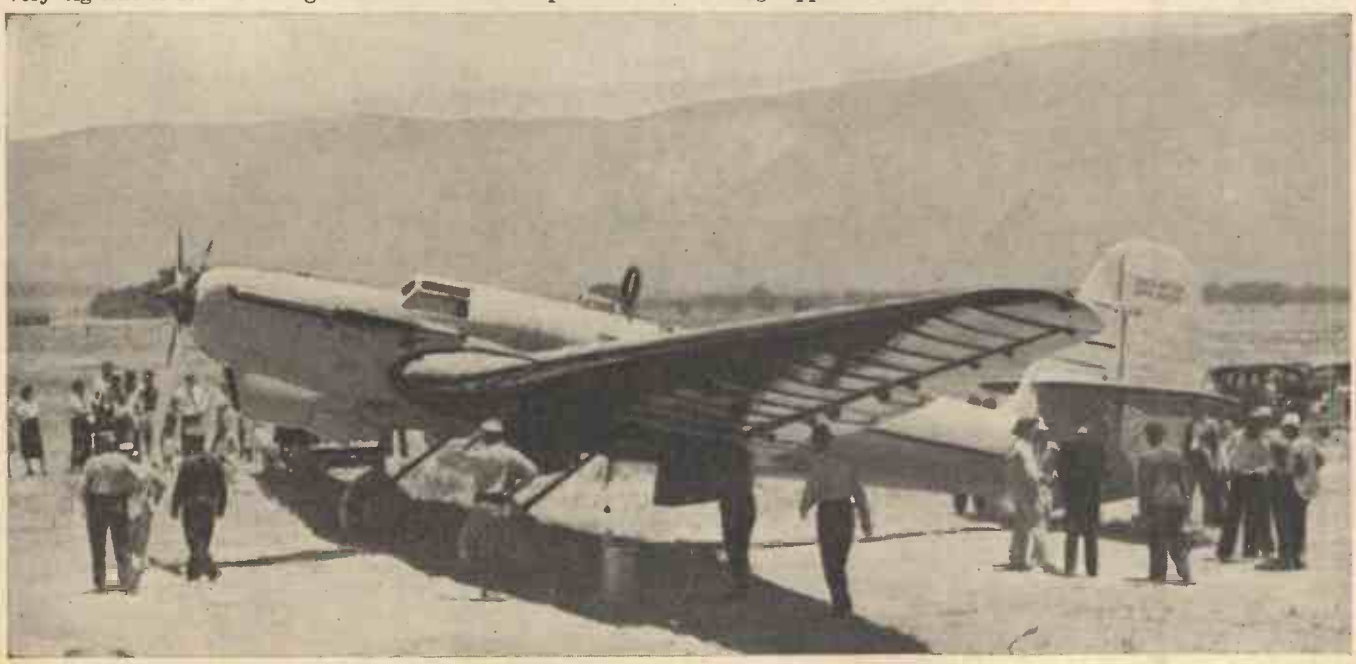
ANOTHER recent development of telephotography is the speed gun camera. It is used for taking press photographs of athletes in action. It consists of a camera mounted on a gun stock fitted with sights and a trigger. The pressman sights the camera from the shoulder and releases the shutter by pressing the trigger. To get instantaneous photographs very short exposures are used. But the camera lens is two inches in diameter and focuses intensely on a tiny film. The concentration of light is so intense that shots can be made at hundredth-second exposures even in dull or sometimes artificial lighting. Your ordinary snapshot camera, of course, needs bright light and about 1/25th sec. exposure. But there you have only a ½ inch diameter lens focusing on a film several square inches in area.

Monastral Blue

EVER since man first mixed pigments with oil to make paint, unfading brilliant colours have been sought. The old Italian painters served long apprenticeships in the art of colour making. Thus red is made by mixing red oxide of lead with oil. White comes from the carbonate of lead. Green from the oxide of chromium and so on. Some of these mineral pigments stand up to light others fade. A notorious fading colour has been blue made either from prussian blue or ultramarine which is clay burnt with sulphur and iron. Brilliant as are the gamut of dyestuffs known to science none of these gives a good paint. But at last, for the first time in the history of paints, a new pigment has been made. It is that long sort goal, a permanant blue. It is brilliant, fadeless, and lasting. It is given the name of monastral blue, and it is not a mineral pigment. It is quite probably the forerunner of a series of new and beautiful colours which will be a remarkable example of science in the service of art.

Synthetic Rubber

THE production of synthetic rubber has been another cherished ambition of the chemist. Chemistry has now quite definitely realised the ambition. A substance possessing the toughness and elasticity which give rubber its unique uses has been produced. The starting points are acetylene and chlorine gas. The product is called Neoprene. It is not quite the same as rubber because in some ways it is superior to rubber. Rubber, as we know, does not resist oil. Oil makes rubber swell and rot. But Neoprene is quite unaffected by oil. Immediately uses for it will be found in flexible oil lines and pumps for handling oil, petrol, and benzole. It may perhaps be worth while using it for motor-car tyres. At present it costs more than natural rubber. But science more than once has



The big-winged 'plane flown by Soviet airmen for a new world's record of 6,668 miles non-stop from Moscow. The 'plane after landing near Jacinto, California, 62 hours 5 minutes after the start.

THE WORLD OF INVENTION

eventually succeeded in making substitute substances more cheaply than nature can. This development may quite likely take place with rubber production.

Coronation Scot

CORONATION SCOT, Britain's latest streamlined train which, as briefly announced in a previous issue, has set up a new world's record for steam train speeds of 114 m.p.h. with a nonstop trial run from Crew to Euston at an average of 81 m.p.h. The new flyer is drawn by a giant loco of the 4-6-2 type, 74 ft. between buffers and weighing 164 tons with coal and water up. Its power is developed by four simple cylinders. A new and interesting device which helps the fireman in his arduous task of keeping up the head of steam is a coal pusher which feeds forward the coal to the front of the tender. The train sets up new standards in comfort and design. The nine carriages follow the streamline of the engine. They are ventilated through air ducts and the ventilation air can be warmed if necessary. The third-class carriages are provided with arm rests and panelling and upholstery which would have been luxurious in first-class compartments a few years back. The outside of the train is brilliantly finished in blue and to accentuate the steam-line a quadruple line of silver breaks from the prow of the engine and runs the whole length of engine and train. Britain thus has a steam train which outdoes the Diesel engine flyers of foreign railways.

Electricity in Aircraft

THE modern aeroplane amongst other things is an electrician's paradise. Electric wiring starts with navigation lights, goes on to cockpit and cabin lighting and has to provide powerful landing lights. Next comes wireless. A big air liner will certainly have directional wireless navigation, perhaps a set for altitude finding and direct telephonic reception and transmission as well. On a multi-engined machine each engine must record in the cockpit its temperature and its engine revs. These readings will be transmitted from engine to cockpit electrically. The gyro pilot when in action flies the machine by electrical relay. Big passenger aircraft may have some sort of electric cooking plate and many incidental lights, bells and warning signals. It has been estimated that all the various circuits mount up in a big air liner to no less than 5,000 feet of wiring. While in a bombing 'plane where simplicity and vulnerability must be more closely studied the amount runs out at over 1,000 feet.

Thames Barrage

THE project of damming the Thames at Woolwich is again being closely considered by the Port of London Authority. The suggested dam would be 15,000 feet long and about forty feet high. It would cost £4,000,000. Six locks would give passage of ships through the dam. Road and rail facilities would be provided along the crest of the dam connecting the big manufacturing areas North and South of the river in Essex and Kent. The dam would be of inestimable benefit to the Port of London because the whole riverside above would become one vast dock unaffected by tides. Lighter traffic up and down the river would no longer have to run according to the tides. From a point of view of public health it would be beneficial for London's biggest sewage outfall is just below Woolwich on the northern shore at Barking. The dam would prevent this being carried by the tide up into the heart of the city as at present occurs. Though a great undertaking, the building of the dam would be within the scope of the achievements of modern engineering. There is every reason to believe that perhaps in the next ten years the project will be undertaken.

Before airmen attempt altitude records, such as the recent one of 53,937 ft. by Flight-Lieut. M. J. Adam, they have to undergo strict tests in a decompression chamber wearing the special rubber suit and helmet which is subsequently used for the flight.

Moscow Canal

SOVIET Russia provides the latest example of giant continental canal building. A new ship canal has recently been completed to connect Moscow with the Volga river. By means of it Moscow is turned into an inland port which ships from both the Baltic and the far northern White Sea may reach. Further projected canals aim to bring the River Don into the scheme and give access to the Black Sea. The present canal is nearly 100 miles long, 150 feet wide, and rises up 100 feet by means of six ship locks each with a lift of 24 feet.

A New Calculator

A NEW aid to speedy calculation has been evolved in the form of a handy calculator which combines a slide rule with a small adding machine, so that it can be used for addition, subtraction, multiplication or, division. This combination instrument was first shown at the Leipzig Fair, and will be exhibited again in the Office Requisites Section of the Autumn Fair which opened on August 29th. The front of the calculator consists of an ordinary slide rule of perfect finish, whilst a small, panel-type calculating machine on the sliding column principle is fitted to the back. The whole combination is no larger than an ordinary slide rule.

New Electrical Device for Tuning Musical Instruments

THE Electro-Acoustics Department of the Institute of Research of the Soviet Musical Industry has constructed a new type of apparatus for tuning musical instruments (harmoniums and accordions) visually. It is intended for use by persons who have no ear for music. Hitherto existing apparatus of this kind have had certain imperfections which have prevented the introduction of them into factories manufacturing musical instruments. The present device, designed by O. N. Kasatkin, is of simple construction. It works without noise on alternating current.

Fordson Tractor Exports to Australia

THE largest order ever received at one time for Fordson tractors to be exported to Australia is now being loaded at the private jetty of Ford Motor Company Limited. A total of 286 agricultural and industrial tractors is being placed aboard lighters at the jetty for transport and reloading into trans-oceanic steamers at the King George V Dock in London for shipment to the Dominion.

According to reports of business con-

ditions in the Dominion of Australia, agriculture is experiencing a tremendous boom. This is said to account for the fact that the large part of the order for tractors is for those designed especially for farm work.

Boring for Water

AN attempt has been made at Croydon to obtain water from the green sand which lies far below the chalk basin from which London's artesian well supplies are drawn. An experimental borehole, which descends 1,100 ft. into the earth, may reveal a vast potential water supply not only for Croydon, but for many other outlying districts where the green-sand basin may be located sufficiently near the surface to make the sinking of wells an economic proposition.

Hot-air Balloons

A WORLD altitude record for hot-air balloons was recently established by two Austrian balloonists, Herr Marek and Herr Emmer, who rose to a height of 24,700 ft.

The New Waterloo Bridge

IT is estimated that the cost of the construction of the new Waterloo Bridge will be £670,000. The new bridge will have two carriage-ways, each 27 ft. wide, separated by central refuges, and two footways, each 11 ft. in width.

Danger of Ice Formation

IMPERIAL AIRWAYS have recently been carrying out experiments to find a new method of overcoming ice formation on the wings of their air liners. One of their four-engined air liners, fitted with a new type of ant-icing equipment has been flying over the routes to Budapest, Basle and Zürich. Ice forming conditions are found here at altitudes of over 10,000 ft. even in mid-summer, and the equipment has received its final tests in readiness for the winter. Through rubber tubes fitted along the wings and struts of the air-liner, a solution is forced out through vents placed at frequent intervals.

British-owned Airships

WE are to have British-owned airships once again after a lapse of seven years. Captain J. A. Sinclair, war-time British naval airship flier, is the moving spirit behind the plan. Lord Ventry, practical ballooning enthusiast who has had R.A.F. experience stated: "We hope to have two or three of the £15,000 American non-rigid airships, blimps, here sometime next year."

Locomotive Driven by Coal-dust

THE first streamlined locomotive, driven by coal-dust, has just been put into service on the German State Railway. It is scheduled for a speed of 110 m.p.h. Owing to the automatic coal-dust feed, the fireman's work has been greatly reduced and the driver's cabin is situated in front so that he has an uninterrupted view of the track.

An Aero-cycle

FROM America comes the news that a designer has produced a streamlined aero-cycle, which, with the aid of a 27-in. propeller fitted in front, is capable of a speed of 45 m.p.h.

A £1,250,000 Bridge

EUROPE'S longest bridge, the Storstroemsbroen, in Denmark is nearing completion. It is being built by a British firm, Messrs. Dorman Long, and it will cost the Danish Government about £1,250,000. On the main route between Copenhagen and Germany, it crosses the Storstroem between the Zealand Island and Falster, and will replace the present ferry. The bridge is 2¼ miles long and will be opened on September 26th.

New B.B.C. Transmitter

THE new B.B.C. 50-k.w. transmitter to serve the North-east is nearing completion at Stagshawbank, Northumberland, and will be opened late this month.

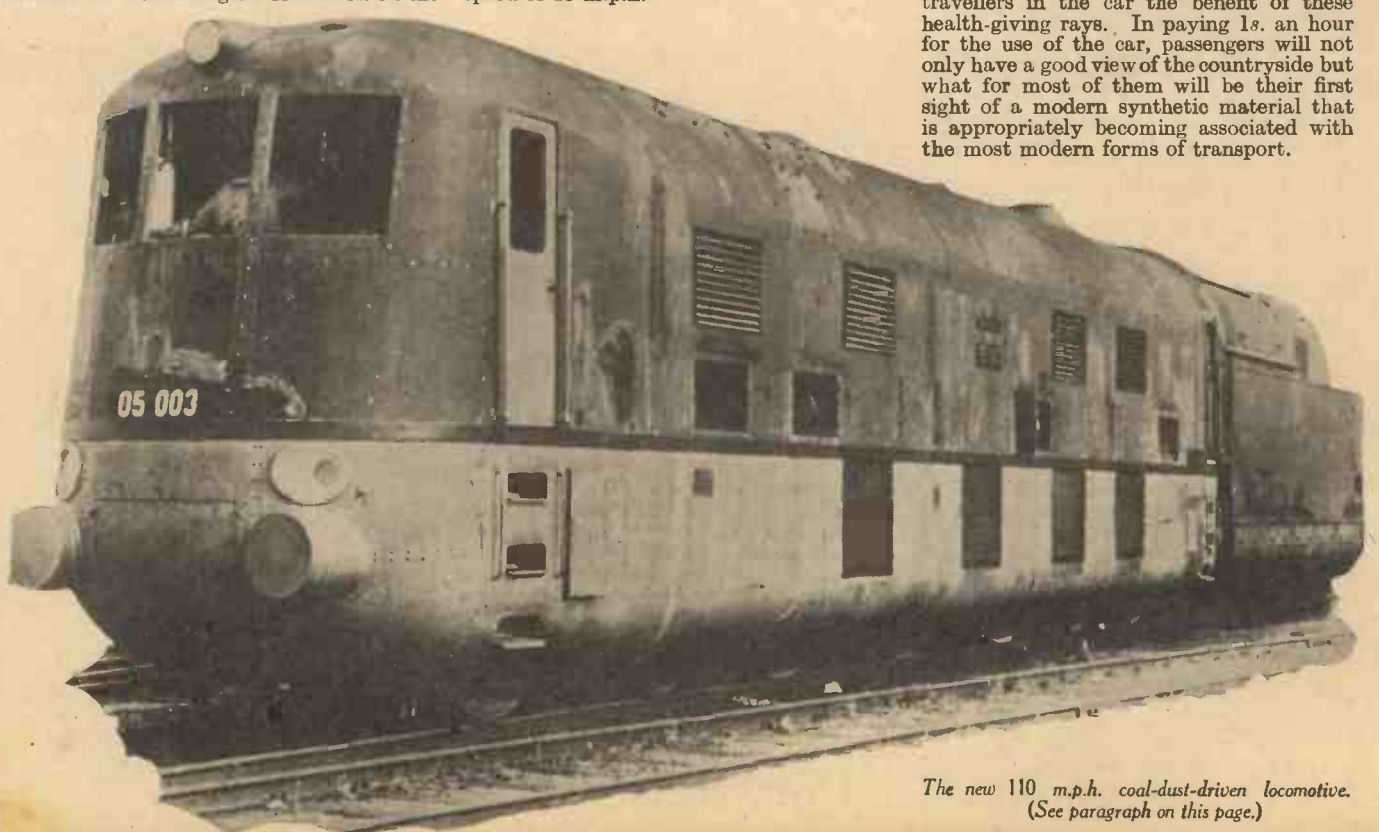
Plastic Windows

THE embodiment of a streamlined observation car in the design of the L.N.E.R. Coronation Express has been made possible by the use of the transparent plastic "Perspex." This material has among other advantages the property of being mouldable to shape, and has enabled the L.N.E.R. to use the "beaver tail" as a contribution to the streamlining of the fastest train in the Empire.

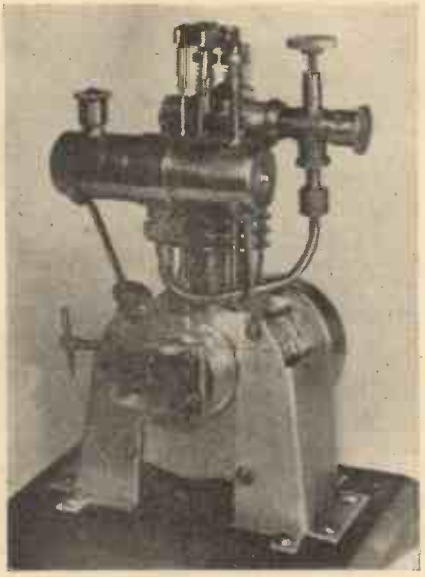
The panels were specially moulded to shape by Triplex Safety Glass Co. Ltd., who have had considerable experience in the manipulation of this I.C.I. product for the aircraft industry. Over fifty new types of aircraft, both Service and Civil, use "Perspex" in some way.

"Sun Parlour"

ANOTHER property of "Perspex" adds to its success in this new use—its very high transmission of ultra violet light gives travellers in the car the benefit of these health-giving rays. In paying 1s. an hour for the use of the car, passengers will not only have a good view of the countryside but what for most of them will be their first sight of a modern synthetic material that is appropriately becoming associated with the most modern forms of transport.



The new 110 m.p.h. coal-dust-driven locomotive. *(See paragraph on this page.)*

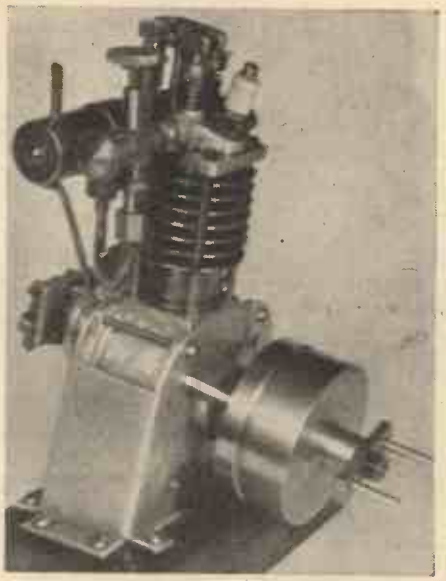


View of the Bantam 6-c.c. o.h.v. engine.

MODEL AERO TOPICS

CURRENT NEWS FROM THE WORLD OF MODEL AVIATION

BY F. J. C.



Another view of the Bantam 6-c.c. o.h.v engine.

The Wakefield International Cup Result

THE annual competition for the International Wakefield Gold Challenge Cup which is held in the country of the holder each year, took place at Fairey's Gt. West Aerodrome, on Sunday, August 1st. Surprisingly enough it resulted in a win for France, Monsieur E. Fillon of that country putting up a duration of 253·23 seconds. Mr. R. Bullock, of Great Britain, was second with 194·53 seconds and R. T. Howse, of Great Britain, third with 193·46 seconds. The times of the first twelve are given below:

Wakefield Cup Results

1. E. Fillon (France), 253·23 seconds.
2. R. Bullock (Great Britain), 194·53 seconds.
3. R. T. Howse (Great Britain), 193·46 seconds.
4. Chabot (France), 157·6 seconds.
5. R. Coasens (Belgium), 156·83 seconds.
6. B. Andersen (Sweden), 155·73 seconds.
7. M. McKinney (Belgium), 155·05 seconds.
8. G. Stark (Germany), 151·83 seconds.
9. K. Schmidtberg (Germany), 147·65 seconds.
10. A. Dague (America), 145·1 seconds.
11. D. Bodle (America), 136·16 seconds.
12. B. Lindn (Sweden), 132·73 seconds.

The Bantam Engine

MR. A. J. EVERY, of 27, Elder Place, Brighton 1, Sussex, recently sent me one of the Bantam engines for test. I found this an easy starter and thoroughly reliable, with a fair range of speed control. Two illustrations are given of it. The bore is $\frac{3}{4}$ in. and the stroke $\frac{7}{8}$ in. and the model is interesting in that it is of only 6-c.c., yet is a 4-stroke with overhead valves. The engine weighs only $12\frac{1}{2}$ ozs., including the $\frac{3}{8}$ in. plug and the carburetter. I found that it would swing a 15 in. laminated propeller at over 5,000 revs. per minute. Mr. Bamford is the designer and he has sent me a photograph of a complete Puss Moth aeroplane of 6 ft. 3 in. span, and he tells me that with a 15 in. propeller the static thrust exerted was just 16 ozs. The engine is available in the form of castings or finished parts, whilst the finished engine with carburetter, coil, condenser, and 15 in. propeller, costs £6. The blue-print, with full machining details, costs 3*s*. 1*d*., post free. Price lists are available from the address given.

Further details of the Puss Moth are that it is fitted with $4\frac{3}{4}$ in. diameter pneumatic tyres weighing $3\frac{1}{4}$ ozs. a pair, and that the model is provided with a sprung chassis, and double surfaced wing. I hope to be able to publish these photographs next month.

Launching a model from the roof of a car.

Launching

IT is often difficult to find a smooth patch upon which to launch an R.O.G. model. As many motorists have now taken up the hobby of model aeroplaning and amuse themselves during an alfresco meal, a reader reminds me that the top of the car makes a useful launching ground. He has sent the photograph which I reproduce herewith. Personally, on such expeditions I take a canvas which is attached to two rollers which I can stake into the ground; by means of a winding handle and ratchet I am able to tension the canvas. Even heavy petrol models have been launched from it. Although I have been building and flying models for many years, I still am fascinated by watching the flight of a model, and enjoy retrieving them from the tops of trees and from the bottom of rivers. Just a reminder that I am always anxious to publish and to pay for any model aircraft photos of interest.

Speed Models

IT may surprise many to know that the speed record is held by Mr. R. L. Rogers, who this year flew a model which under official observation flew at a speed of no less than 46·48 m.p.h., in a perfectly straight flight only 2 ft. above the ground. It was a low-wing monoplane, having twin fuselages and twin screws revolving in opposite directions to counteract

Mr. A. Fieldgate with his model.

the terrific propeller torque. Each fuselage contained five strands of ¼ in. strip rubber which developed, it is claimed, 1 h.p. at 4,000 revs. per minute. The total weight of the model was 75 ozs., and the area of the main plane was ⅙ of a square foot, the loading being 64 ozs. to the square foot. The elastic alone weighed 15 ozs. Last year's winner was Mr. H. E. White, whose model Hornet attained a speed of 42·61 m.p.h., which meant that it took 3 secs. to cover the course of 150 ft. The speed contest is held annually under the auspices of the Society of Model Aeronautical Engineers; for the keen model aeroplane enthusiast this society holds many annual competitions for all types of models, and valuable trophies and prizes may be won.

The "Petrel" Competition

BECAUSE this issue closes for press beforehand, we are unable to include the results of the postponed Petrel Competition for our £50 cash prize.

The "Frog" Range

FOR those who find as much interest in building their machine as in flying it, there is a large range of FROG scale model construction kits which give a good performance when completed. At prices as low as half a crown, they are within the reach of everybody.

These are a new departure, because every important part is blanked out or shaped, and as no tools whatsoever are required, the construction of these models presents no difficulties to the builder.

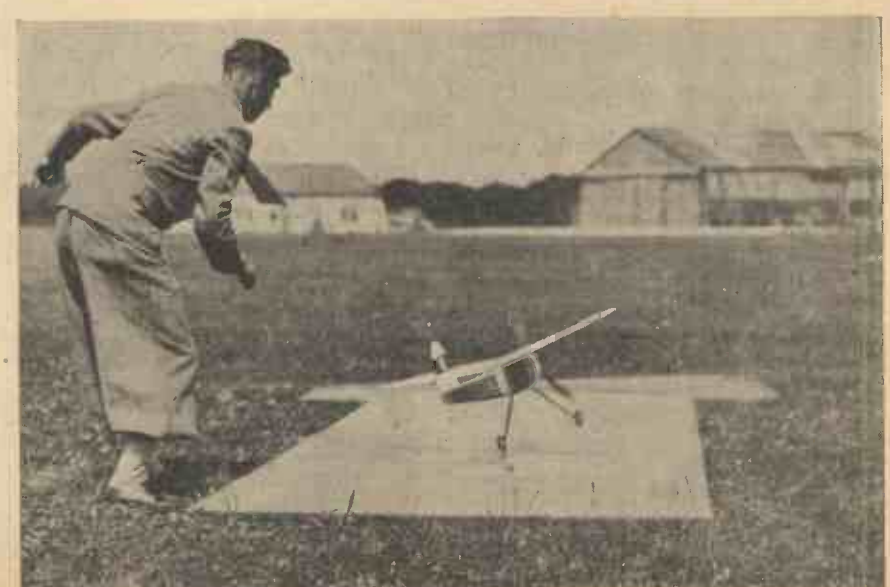
Model aeroplane flying as a hobby leads to mention of local flying clubs. In nearly every district there is a model flying club, which holds competitions under S.M.A.E. regulations. To win these competitions, a really fine model is necessary. The FROG Competition model, which is available either complete or as a construction kit, is sure to put up a high performance in these contests.

Talking of high performances, the machine which last year won for England the Wakefield Trophy and proved itself better than representative machines of other nations, is now being made as a construction kit. This enables enthusiastic model aeroplane builders to create a model of outstanding efficiency at a cost of only one guinea.

The New Penguin series of non-flying scale models, which can be obtained either in parts or completely assembled and coloured, supplies the demand for the decorative model. The construction of these models is extremely simple, as every part is correctly shaped, but yet gives several hours of interesting study.

A New Book

For the benefit of wireless enthusiasts I have just produced a new book entitled "Wireless Coils, Chokes, and Transformers, and How to Make Them." It costs 2*s.* 6*d.*, or by post 2*s.* 10*d.*, and contains nearly 190 pages and over 130 illustrations. It deals with the construction of every type of coil, coil troubles, coil types, selectivity, aerial and earth systems, break-through, H.F. chokes, L.F. chokes, L.F. and mains transformers, coil data, and formulæ, coil winding tables, wire and sheet metal gauges, copper-wire data, making coil winders, all-wave tuners, etc., etc. The wireless experimenter will find this a useful handbook. Orders may be placed through your newsagent or sent direct to: The Publisher, George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

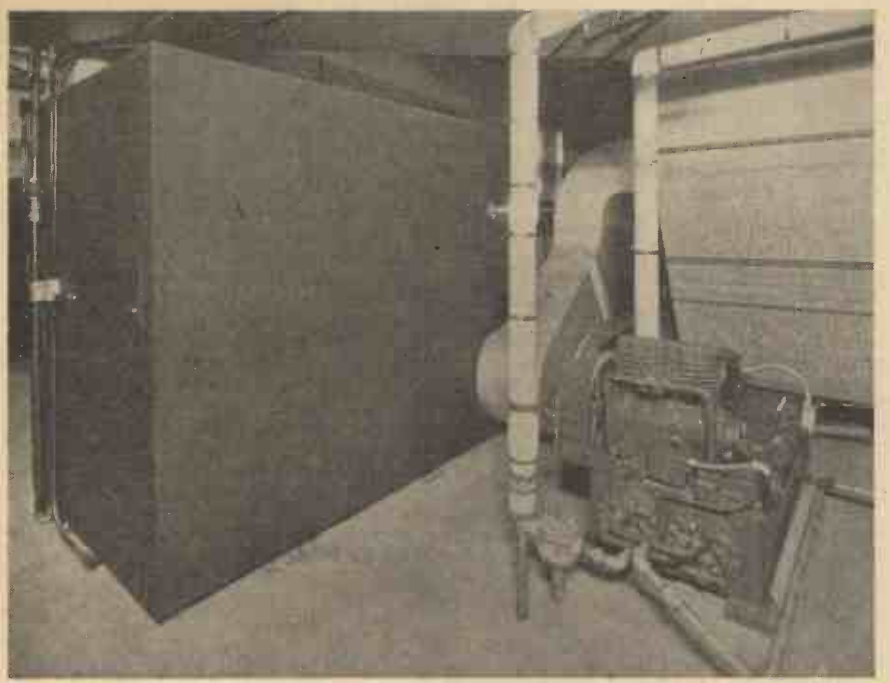


Herr Klose (Germany) in the Wakefield Cup Contest.

MODEL BOAT BUILDING
By F. J. CAMM
96 Pages
1/- or 1/2 by post from Geo. Newnes Ltd., Tower House, Southampton Street, W.C.2

AIR CONDITIONING

Human Beings Require Three Conditions of the Air for Comfort. The Air must be Gentle in Movement, the Right Temperature for the Time of the Year and Contain the Correct Amount of Moisture



A gas-operated air conditioning plant in the basement of an American hotel.

AIR Conditioning provides a way of keeping cool in summer, and warm in winter. In the near future it will become the recognised way of keeping rooms and buildings at the proper state of human comfort level, as already it is generally used in restaurants, hotels, cinemas, theatres and large office buildings.

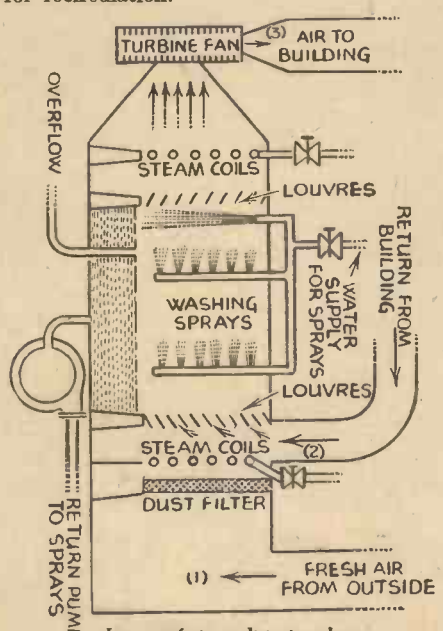
To most people air conditioning is just forced ventilation. But it is something more than that. In addition to circulating air into rooms and removing the used up air, warming, cooling and humidifying plant is incorporated into the scheme to give the best conditions for human comfort according to the season of the year.

Human Comfort

Human beings require three conditions of the air for comfort. The first is that it shall be gentle in movement so that the air around them is always being replaced by fresh air. The second is that it shall be at the right temperature for the time of year. In winter 65° F. is about right. But in summer when the body is used to warmer outside conditions and the clothes worn are lighter, 70° F. is more suitable. These hold for sedentary and office workers. Men in a workshop in movement will need temperatures 5° F. lower than this. The third condition is that the air shall contain the correct amount of moisture for comfort. The human system dislikes too much water vapour in the air. The reason is that by perspiration from the skin, and by water vapour expelled in the breath he is always giving up water vapour to the air. If the air is too close and muggy he cannot do this at the proper rate to be comfortable.

Air Movement

Experience has taught ventilating engineers that the air in a room must be changed at the rate of between ten and thirty times per hour. A large restaurant may have a room space of 200,000 cubic feet. Thirty changes of this in an hour is 6,000,000 cubic feet of air. You will find the basement of a large modern hotel largely devoted to man-high air ducts, and ten foot diameter fans needed to handle such large quantities of air. Not only are there the inlet air ducts delivering the air to the room, but as well there are the withdrawal ducts taking off used air from the top of the room and bringing it back to the conditioning plant for recirculation.



Layout of air conditioning plant. Fresh air enters by shaft (1) and is filtered free from dust by the viscous oil filter. It then joins air returned from the rooms down shaft (2) and the two streams together pass through the conditioning processes to the turbine fan which feeds the freshly conditioned air back to the room.

Fresh Air

Air movement is not enough. Air continuously circulated round a room becomes vitiated, stale and odorous. It is considered that for every human being in a room, a minimum of 1,000 cubic feet of fresh air per hour must be supplied. This air is taken in through a duct up on the roof of the building. Naturally an equal amount of used air has to be vented from the circuit to make room for it.

Air Condition

A room loses heat on a winter's day by conduction of heat through its walls to the cold outside conditions. That means that the air in circulation loses heat every time it passes through the room. To make good this heat loss the circulating air has to be warmed and for this purpose a bank of steam heated tubes are incorporated in the plant on the inlet to the fan. The cold air drawn from ouside is also warmed up to comfort level by the same means.

Human Furnaces

In some cases however, it is unnecessary to warm the fresh or circulated air. The human body in repose gives up to the air no less than 400 heat units per hour. Take the case of a cinema with 3,000 people seated inside. Such a crowd will evolve 1,200,000 million heat units in an hour. That is as much heat as a dozen blazing coals fire would give. It is quite easy to understand that with such a crowd that the heater on the conditioning plant may be cut right out of circuit on all but the coldest of winter days.

Humidity

Evaporation of water vapour always produces cooling. The human skin when in a healthy state is always in a state of perspiration. Moisture is continously exhaled with the breath. Of the 400 heat units lost by the body, half of them are lost through this evolution of water vapour. It is in fact nature's compensator. If we burn energy by working or playing hard, perspiration increases and pushes up our evaporation rate to keep us from getting overheated. In summer it again comes in to play the part of natures radiator, and it is common knowledge that though we like dry hot weather we detest warm close weather. On the other hand the most penetrating cold is that which comes with a dry east wind which makes us lose heat by moisture loss as well as by direct cooling.

The amount of water vapour which the air takes up depends on its temperature. The higher the temperature the higher the saturation amount of water vapour. The body likes the amount of water vapour in the air to be about 40 to 60 per cent. of the maximum, and between these limits it is comfortable. On a winter's day when well wrapped up we may like the air down

about 45° F. and 40 per cent. saturated. But when this air has been taken through the heating pipes of a conditioning plant and warmed up to 60° F. or more, its percentage humidity drops as now it can take up more water before it is saturated. We should immediately register such air as being too dry. To prevent this the fresh air drawn into a conditioning circuit must be humidified. For this purpose it is drawn through a set of sprays. By warming the water supplying these sprays to a suitable temperature the proper degree of moisture can be imparted to the air.

Summer Conditions

Our English summers are extremely mild and equable. Under most conditions free circulation of the air without heating or cooling will secure comfort. If the temperature does run up over 80° F., to what we call heat-wave conditions then cold water may be put through the tubes which are used for steam heating in winter.

But in America far greater extremes are to be met. 95° F. in the shade is not uncommon. In addition to this the humidity of the air may be high as well. In the tropics such hot steamy conditions are always found. To meet these conditions we have not only to cool, but we must also dry. If not the cold air we bring in may actually be in such a state that it is like a wet mist.

One way of drying the air is by chilling the fresh air of the conditioning circuit by sprays of refrigerated water. But this has the drawback that the air must be chilled right down to the required dew-point, say about 50° F. to get out the proper amount of water. So it requires to be reheated up to a nice equable room temperature to prevent undue chill to occupants.

Actually the tendency is to cut the refrigeration to a minimum, and to keep the air temperature down. So English people especially complain of the very cold conditions of American rooms in summer.

Gas Refrigeration

There is however a type of plant which gives dry bracing summer air without undue chill. It consists of trays packed with silica gel. Over these the fresh, damp air from outside is brought. Silica gel absorbs water vapour so that the air is dried. The silica gel has of course a limited capacity for taking out water vapour. When it has reached saturation a change over gear draws the hot products of combustion from a gas burner over the gel and redries it ready for fresh service. It may be called gas refrigeration because of course it serves the same purpose as direct refrigeration of the air to remove water vapour.

Dust Removal

Fresh air always contains dust, especially in large cities. To free it and clean it, it is drawn over a packing of plates or rings which are filmed with oil. The air swirls against the oily surfaces and the dust sticks to the oil. Germ concentrations may also have to be considered. To guard against this the practice of drawing the air through water sprays which contain a germicide is spreading. Sterilisation carried out in this way should do much to arrest that bane of modern civilisation, the common cold.

Plant Layout

Figure 1 shows the usual arrangement of air conditioning plant. There is a main fan which draws air from the room down one shaft. Fresh air from outside is drawn down another. The outlet of the fan forces the conditioned air to the duct distribution system to the different rooms in the building. In winter if it is desired to warm the air, steam is passed through the steam coils shown. If under summer conditions it is desired to cool the air and to remove heat from it, refrigerated brine is passed through the steam coils instead of steam. The sprays serve to keep the moisture content of the air at the right level for human comfort. The mere fact of washing with water also helps to freshen up the air.

A NEW MULTIPLE-PURPOSE COMMERCIAL VEHICLE

Although in Appearance it is Like an Ordinary Platform Truck, it Can Be Converted into a Fully Equipped Fire Engine in a Few Moments

DESIGNED and constructed by a Portsmouth firm—Messrs. J. H. Sparshatt & Sons, London Road, Hilsea, Portsmouth—a remarkable new development in commercial trucks is now being marketed by them in conjunction with Messrs. Dodge Brothers (Britain) Ltd. Constructed and to all appearances like an ordinary platform truck, this vehicle is capable of conversion at a moment's notice into a fully equipped fire engine.

Capable of Holding 600 Gallons

The truck is built on to a 70 b.h.p. 3-ton Dodge long wheelbase chassis and is so constructed that by a simple mechanism the platform of the truck is raised, thus disclosing a strong canvas tank capable of holding 600 gallons of liquid. The container can be filled either from a hydrant or pond, whichever is the more convenient. Underneath, the chassis is fitted with a powerful ejector pump, delivering 100 gallons per minute through two hoses at a pressure of 100 lb. per square-inch.

A Demonstration

A demonstration of this vehicle was recently given at the Kew Works of Messrs. Dodge Brothers (Britain) Ltd. to prominent officials from the Home Office, War Office, Admiralty, and Air Force, who expressed considerable interest in its many uses. It will be obvious that such a truck would be of vital importance in the case of a National emergency, for by equipping industrial undertakings with a fleet of such trucks there would be available at very short notice a fully equipped vehicle for decontamination purposes in the event of poison gas or for fire fighting to combat the effect of incendiary bombs.

In addition, farmers and horticulturists will find the truck particularly useful for all agricultural work such as carting water to distant fields, swilling out cattle pens, and spraying fruit trees and crops to prevent infection. Further, the vehicle can be used for fighting rick and heath fires when, as is often the case, the district fire brigade would take a considerable time to reach outlying districts.

Priced at £507

The truck complete with full equipment and hoses is priced at £507, and is being marketed by Messrs. J. H. Sparshatt & Sons in conjunction with Dodge Brothers (Britain) Ltd., the builders of the engine and chassis.

The remarkably low price at which this vehicle is being sold should make it readily accessible to municipal authorities and industrial concerns and at the same time make a very real contribution towards National defence in case of emergency.

Showing the truck converted to a fire engine.

"Big Ben" Holds a Blue Riband

The Westminster Clock is Still the most Powerful and Accurate Clock of its Kind in the World

THE giant clock that stands sentry over the British Parliament buildings has become, through the efforts of the B.B.C., the most popular of the world's many time-keepers. "Big Ben" is actually the name of the huge bell upon which the hours are struck, but it is by this name that the clock has become so familiar.

Vulliamy, the celebrated clockmaker, was instructed to make the clock, but Dent heard about it, and asked to be allowed to submit a quotation. G. B. Airy, the scientist, was approached by the Office of Works and produced conditions of construction for purposes of tender. In 1851, Lord Seymour, Commissioner of Works, asked E. B. Dennison to examine the plans. He approved Dent's design of 1847, with modifications.

Of the many conditions, the most stringent were that the clock should keep time within a second a day and that the first stroke of the hour should be within a second of true time. Erected in 1859, the clock has been in the care of the firm of Dent ever since, a glowing tribute to both maker and designer.

The Movement

The clock room, standing nearly 200 ft. above the ground, is reached by a spiral staircase of 292 steps. The impression on entering is that of some power station rather than a clock chamber. The iron guard rail all around the movement, short iron ladders on either side and oil trays beneath, all help to create this impression.

Two cast-iron girders 15½ ft. long, braced together and bolted to two concrete pillars, form the framework of the movement. On the left-hand side is the train of wheels for driving the hour striking, on the right-hand, that of the quarter chiming, and in the centre the time-keeping mechanism. Each train of wheels is driven by a separate weight. Some idea can be gathered of the immense size of this machine from the great driving wheels which measure 3 ft. in diameter.

The striking and chiming mechanism is controlled by the locking plate system, the method usually employed in turret clocks. The quarter locking plate makes one complete revolution every three hours. Both hour and quarters are released by the time-keeping mechanism. At the hour the quarters are released twenty seconds before "time." There are five sets of lifting cams and five chiming hammers in place of the usual four. At the "quarter to the hour" and the "hour" the same bell has to be struck in succession, as such heavy hammers cannot be lifted quickly, the fourth bell is provided with two hammers.

The Hour Hammer

At the finish of the hour, the hour hammer is partially lifted in order that it may be released within a fraction of correct time. The enormous fans that govern the speed of the striking and chiming present an unusual appearance. Instead of revolving like the rest of the wheels, they are attached to huge vertical shafts that rise almost to the ceiling.

Much smaller, but of greater importance, is the time-keeping train. The escapement is of the double three-legged gravity type. The escape wheel consists of two thin wheels 12 in. in diameter each having three teeth or legs as they are usually termed. Placed side by side an inch apart, the two wheels are bolted together at the centre. A small fan is mounted upon the escape wheel spindle to minimise the drop of the wheel teeth. The two arms that convey impulse from the escape wheel to the pendulum are positioned between these two slender wheels.

Side by side with the large seconds dial in the centre of the movement is a large galvanometer connected with Greenwich Observatory. At appointed times the needle is deflected, enabling those in charge to compare "time." No automatic synchronisation or control takes place, but by means of electrical contacts, the clock telegraphs its own time twice daily to the Observatory, where its performance is tabulated.

On only five days in the year 1936-37 did the daily variation exceed one second.

The Pendulum

The pendulum hangs upon a cast-iron bracket fixed to the wall at the rear of the movement. The *original* suspension spring, 5 in. long, 3 in. wide, and only $\frac{1}{10}$ of an inch in thickness, is all that supports the 6-cwt. pendulum. The bob alone weighs 4 cwt. An overall length of 14 ft. only allows the upper half to be seen in the clock-room; the lower half vibrates in a steel chamber beneath the floor.

Heavy pendulums cannot be stopped for regulation without difficulty and inconvenience. For this reason a rating tray is fixed on the pendulum rod just above the

"Big Ben"—the world's most perfect timekeeper.

bob. By the addition of small weights (usually pennies) to this tray the centre of gravity is raised and a gaining rate produced. A losing rate is effected by subtraction. A recent investigation revealed a tray full of pennies. Temperature changes are overcome by the zinc and steel construction of the pendulum. The zinc tube is perforated to permit entry of air.

A considerable arc is described by this two-seconds pendulum. When the clock was last overhauled, the escapement was disconnected and the pendulum allowed to swing; it continued to swing for two days before finally coming to rest.

The Winding Apparatus

It used to take two men three afternoons every week to wind up the weights, and the hand winding mechanisms geared to each of the winding barrels are still in position for use, should they be required. Winding to-day only takes forty minutes. Beneath the centre of the movement is a 3-h.p. electric motor coupled to an ingenious automatic winder. The winder has three separate clutches, and connection to the barrels on which the weight lines are wound, is by chain drive.

Before winding can commence the indicators on both movement and winder have to coincide. All three weights are raised up the 174-ft. shaft together and automatically stopped when they reach the desired level. The striking and chiming weights each turn the scale at 2½ tons and the time-keeping weight at 1 ton.

One and a half minutes before each quarter the clutch is disengaged, and the winding ceases. One and a half minutes after the winding is resumed. This is, of course, controlled entirely by the clock. A system of power maintenance is necessary during the twenty minutes it takes to wind up the time-keeping weight. The motor drives a differential gear, one side of which raises the weight. The other side of the differential runs in an opposite direction and exerts a force equal to that of the weight on the main wheel. The pendulum is thereby kept vibrating under normal running conditions.

Mounted above the centre of the movement is a massive girder bracket which supports a set of four bevelled wheels driven by the time-keeping train. A long horizontal shaft leads from each of the bevelled wheels to one of the dials. A separate set of motion wheels for giving the hands a 12 to 1 ratio is fixed on each wall. Also mounted on the girder bracket is a small windlass for hoisting the heavier parts during overhaul. (This was incorporated in the original design.)

The Dials

Four dials each 22½ ft. in diameter grace the 40-ft. square tower. Viewed from inside these dials resemble gigantic cast-iron cobwebs filled in with opalescent glass. Each minute space measures 1 sq. ft., and the hour figures are 2 ft. long. An inner wall coloured white, about 5 ft. from the dials, forms the background. At one time the clock controlled the gas lighting for the dials, but high-power electric lamps are used to-day.

The minute hands, made of tubular copper, braced at intervals, are 14 ft. long, and together with the gun-metal counterpoise at the centre, weigh about 2 cwt. each. The hour hands are made of gun-metal, are 9 ft. long and weigh about 6 cwt. The counterpoises for the hour hands are attached to the hour hand shafts between the dials and the backgrounds. They resemble two light gun barrels fixed side by side. In the course of a year the minute hands travel about 100 miles.

Forty-one steps above the clock is the belfry. The hour bell is hung in the centre and the four quarter bells, one at each corner, a little above the hour bell. Nine ft. in diameter, "Big Ben" weighs 13 tons, and the weights of the others are respectively 3 tons 18 cwt., 1 ton 13 cwt., 1 ton 6 cwt., and 1 ton 1 cwt. The hammer for the big bell weighs 4 cwt., and the quarter hammers each weigh about one-fortieth of their respective bells. The hammer arms are braced girders and they pivot from the crown of the bell.

On the edge of the hour bell a crack is clearly visible, and just above the crack is a square hole from which a portion of the bell was removed for examination. Analysis proved that the crack was only on the surface. Reports as to how far away the clock can be heard vary, but it has been credited with a distance of 13 miles.

Swinging jauntily above the bells is the B.B.C. microphone. Although completely dwarfed by the surrounding mechanism, it has immortalised this wonderful clock.

THE MODEL ENGINEER EXHIBITION

THIS year's Exhibition will be held at the Royal Horticultural Hall, Vincent Square, Westminster, from Thursday, September 16th, to Saturday, September 25th, 11 a.m. to 9.30 p.m. daily, Sunday excepted.

It will be opened by Admiral Sir Reginald Bacon, who is this year presenting a silver cup for the best piece of strictly amateur work. Four Championship Cups are offered for the best entries in the classes for locomotives, general engineering models, sailing ships, and steam and motor ships. There are also other special cups, medals, and prizes for other work of outstanding merit. Two novel prizes this year are cups for the best road transport model and the best piece of model theatre-craft.

The Society of Model and Experimental Engineers will have their 72-ft. railway track in operation, with steam locomotives hauling passenger traffic. Model aviation will be represented by the Society of Model Aeronautical Engineers, who will show some of the most successful model planes of the year, both petrol-engined and rubber-driven. Speed boats will be featured by the Model Power Boat Association.

"Electric Wiring Tables," by W. P. Maycock, revised by F. C. Raphael. Price 3/6, 93 pages. Published by Sir Isaac Pitman & Sons, Ltd.

THIS handy little book is made in the shape of a diary so that it can conveniently be carried in the pocket. The present number is the seventh edition, and considerable alterations and additions have been made in certain of the tables due to the reduced current ratings in the Tenth Edition of the I.E.E. Wiring Regulations. The book contains, as its name implies, tables for the use of electrical engineers, and in addition to such details as Standard Wire Gauges, Standard Conductors, Dimensions of V.I.R. Cables, etc., it includes a number of interesting ready reckoners relating to wires and cables, meter calculations, lamps, and so on. There is also a table of the ratings of the majority of usual domestic appliances. No practical engineer should be without this handy book.

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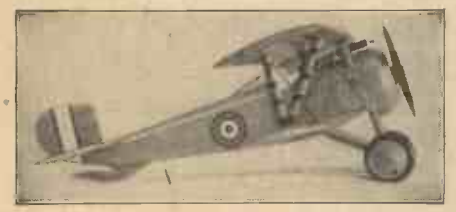

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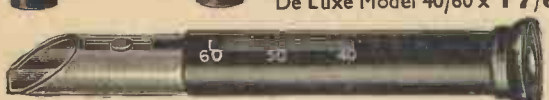

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GARDEN WOODWORK

By "Handyman"

Some Easily-constructed Articles for the Small Garden are Described in this Article

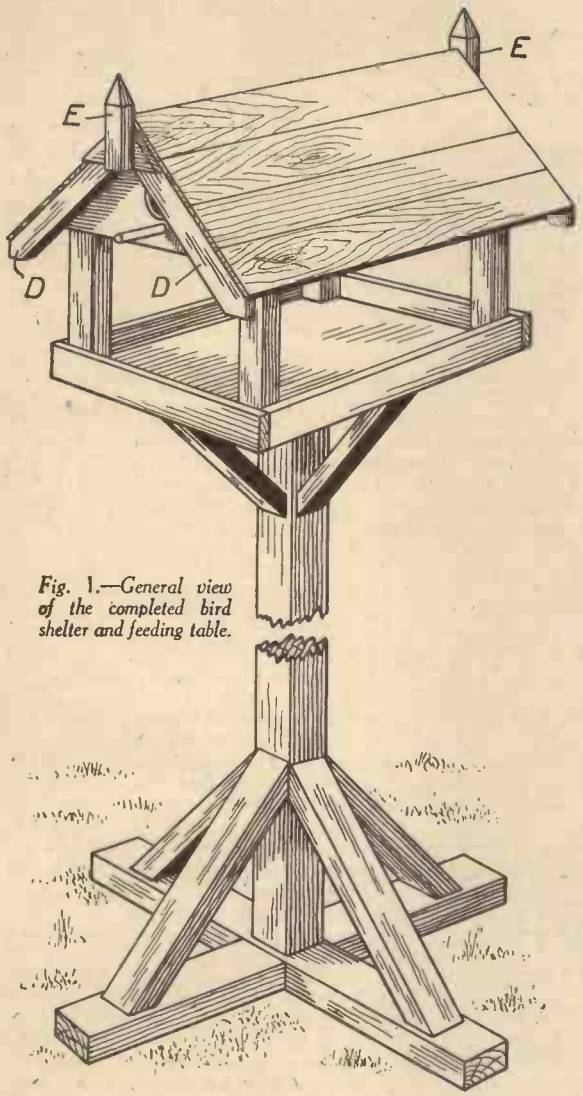


Fig. 1.—General view of the completed bird shelter and feeding table.

AT this time of the year there are usually several odd jobs in the garden which the handyman can conveniently undertake, and these include various pieces of garden woodwork. That long-promised bird shelter; a staging for potted plants to cover the bare brick wall; a small cold frame, and perhaps a "trug" basket, to mention a few, can easily be constructed from ordinary deal.

A Bird Shelter and Feeding Table

It will be seen, by reference to Figs. 1 and 2, that the shelter, which is supported on a central post, is provided with an enclosed compartment under the roof forming a roomy nesting box for any of the small wild birds which frequent our gardens. The construction of the shelter is shown in Fig. 2.

For the corner uprights cut four pieces of 2 in. by 1½ in. batten, each 10 in. long, and saw the top of each to an angle of 45 degrees to allow for the slope of the roof. The floor, *A*, of ½-in. wood, measures 18 in. long by 15 in. wide, and on top of this, at the four corners, the uprights are nailed or screwed. Cut the side strips, *B*, from 2-in. by ½-in. wood, and nail these to the uprights, and also to the edges of the floor.

The two gable ends can be sawn to shape from ½-in. wood to the dimensions given in Fig. 3, after which a 2-in. hole can be cut in one end, with a pad-saw. Just below this hole bore another one ½ in. diameter to take a piece of dowel rod which forms a perch. Nail the gable ends to the uprights at a distance of 7 inches from the bottom ends. The upper floor, *C*, is the same size as the lower floor, but has its four corners cut away to fit the four uprights. It is nailed to the gable ends.

Fitting the Roof

Each side of the sloping roof, which is 22 ins. long and 12 ins. wide, can be formed from three or four boards of ⅜ in. wood nailed in place, allowing an equal amount of overlap at each end. The barge-boards *D* can be cut from ½ in. wood to the dimensions given in Fig. 4. Nail these under the ends of the roof boards as shown in Fig. 1.

The small finials, *E*, are 5 in. long and can be fashioned from pieces of 1½ in. by 1 in. wood. These are nailed to triangular pieces of wood which in turn are screwed to the top corners of the roof edging. The roof can be covered with a piece of tarred felt held down at the edges by pieces of narrow lath nailed on.

The supporting post for the shelter should be from 5 ft. to 6 ft. in length, and at least 2½ in. square.

The cross-shaped piece at the foot of the post is formed with two pieces of 3 in. by 2 in. wood, each 2 ft. long, with a halved joint in the middle. Drive a long stout screw through the centre of the joint and into the end of the post. Cut the sloping supports, which are 14 in. long, from 2½ in. by 1½ in. batten, and after carefully sawing the ends to an angle of 45 degrees, nail them in place, as indicated in Fig. 1.

Through the centre of the floor bore a hole, and fix to the top of the post with a stout screw. For the supporting brackets cut four pieces of 1½ in. by 1 in. batten, each 6 in. long, and after sawing the ends to the required angle, screw them to the sides of the post and to the floor, as shown in Fig. 5.

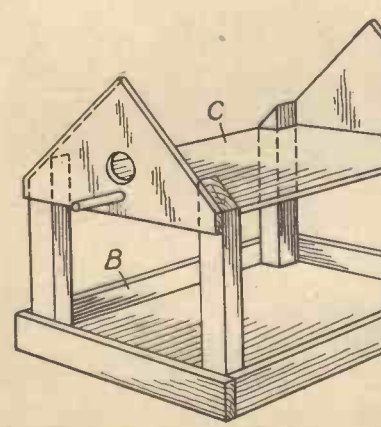


Fig. 2.—Details of the framework for the shelter and table.

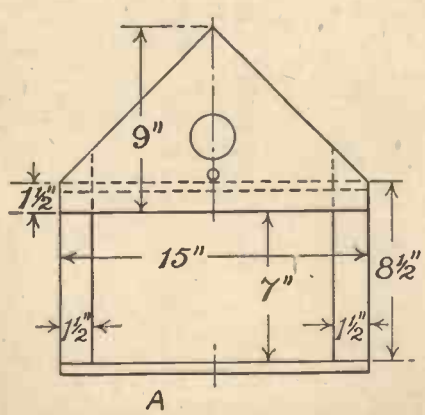
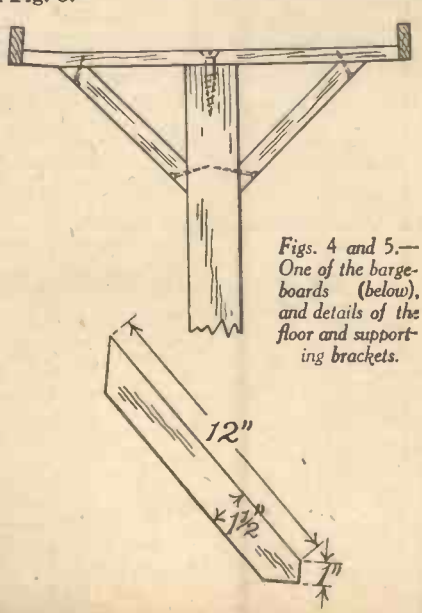


Fig. 3.—The front gable ends and uprights.



Figs. 4 and 5.—One of the barge-boards (below), and details of the floor and supporting brackets.

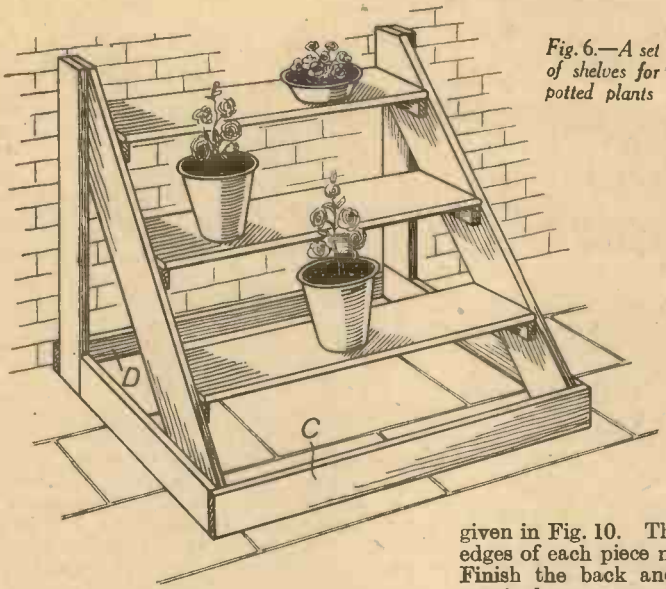


Fig. 6.—A set of shelves for potted plants

If the finished shelter is intended to stand on a lawn it would look very attractive if coated with white paint, but two coats of creosote can be given, if preferred.

Shelves for Potted Plants

A set of shelves with a few potted plants, as shown in Fig. 6, form an effective covering for part of a bare brick wall in the garden. Three shelves are provided, and planed deal ¾ in. thick can be used throughout the construction.

It will be seen that the shelves are supported by triangular-shaped side frames. Cut four pieces of 3 in. by ¾ in. batten 2 ft. 2 in. long, and saw one end of each piece to form halved joints, as at *A*, Fig. 7. Fix each pair of battens together with two screws through each joint.

The two sloping parts are 4½ in. wide, and can be cut to the length indicated at *B*, Fig. 8, the ends being sawn at angles of 45 degrees. The sloping pieces are fixed to, the L-shaped frames with two screws through each end.

The three shelves, which are 7 in. wide, can be cut to a length of three to four feet, according to requirements. The ends of the shelves rest on fillets screwed to the sloping side pieces, and two stout french nails driven in through the side pieces into the ends of the shelves fix the latter firmly in place.

To strengthen the side frames, cut a suitable length of 3 in. batten, and nail it across the front of the stand, as at *C*. A similar cross-rail, *D*, can also be nailed to the side frames at the back. The completed stand can be painted or treated with creosote to protect it against the weather.

A Small Cold Frame

The frame shown in Fig. 9 is of simple construction, and is provided with a hinged top-light.

For the sides, front, and back parts of the frame, planed deal ¾ in. thick can be used, the two sides being sawn to dimensions given in Fig. 10. The top, front, and back edges of each piece must be planed square. Finish the back and front boards to the required measurements (Fig. 12), and then nail the parts together so that the bottom of the frame stands level. To strengthen the frame a piece of 1½-in. square batten can be nailed in each corner, as at *A*, *A*, (Fig. 11).

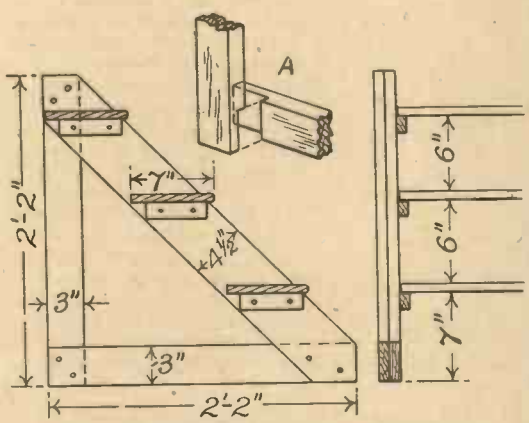


Fig. 7.—Details of construction of the side frames.

The Top Light

The framing for the glazed top, which is 3 ft. 7 in. long and 1 ft. 8½ in. wide overall, can be made from 1½ in. by ¾ in. planed batten. Cut the four pieces to the required lengths and make halved joints at the corners, as at *B*, Fig. 13. The two "sash"-bars can be cut from 1 in. by ¾ in. stuff, the ends being halved and let into recesses cut in the front and back parts of the frame. Fix these joints with galvanised screws.

For supporting the glass, rebates can be formed by nailing to the framing and "sash" bars pieces of ⅜-in. square strips wood, as indicated in Fig. 14. The three pieces of glass can be puttied in place in the same manner as an ordinary window pane.

Three stout galvanised hinges can be used for hinging the top-light to the backboard of the frame. Props cut from garden sticks can be used for supporting the top-light when raised for ventilation purposes.

A Small "Trug" Basket

Several uses can be found in a small garden for the "trug" basket illustrated in Fig. 15, which can be constructed chiefly from ordinary packing-case wood, ½ in. thick.

For the sides, cut two pieces, each 1 ft. 6 in. long and 4 in. wide, and mark them out to the shape and dimensions given in Fig. 16. Saw the ends to the required size, (*A*, Fig. 17) and nail them between the ends of the side pieces. Plane the bottom edge of each end piece to a slight angle so that the bottom of the basket will rest flat against them. A piece of five-ply, cut to the measurements given at *B*, Fig. 17, will serve for the bottom of the basket, and is nailed to the sides and ends.

Cut the handle supports, *C*, to the required length, and round off the top corners as indicated. To make the handle saw a piece 10½ in. long from an old broom handle, and with a brace and centre-bit make recesses, the same diameter as the handle, halfway through each support, *C*, near the top ends. Screw on the supports, push the handle in place, and fix each end with a 1½-in. screw.

For holding garden tools, cut a piece of wood 2 in. wide to fit between the handle supports, as shown in Fig. 15, and nail it in place. Strips of leather can be nailed on each side of this cross-piece to form loops for holding small garden tools.

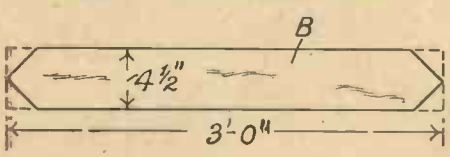


Fig. 8.—One of the sloping boards which support the shelves.

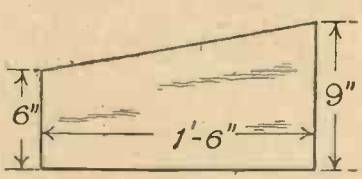


Fig. 10.—One of the frame sides.

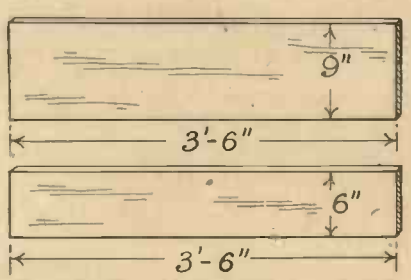


Fig. 12.—The front and back boards of the frame.

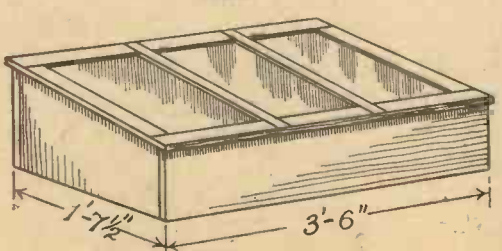


Fig. 9.—The completed cold frame.

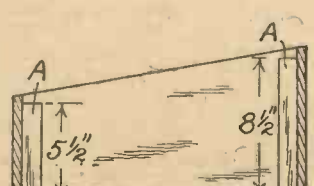


Fig. 11.—Section, showing the corner strengthening pieces.

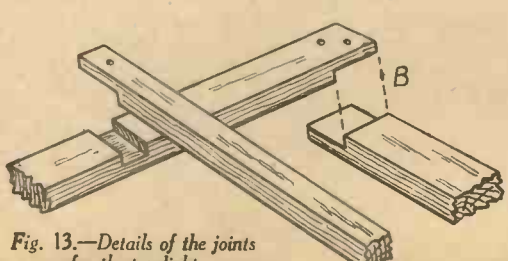


Fig. 13.—Details of the joints for the top-light.

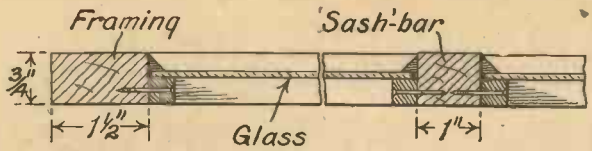
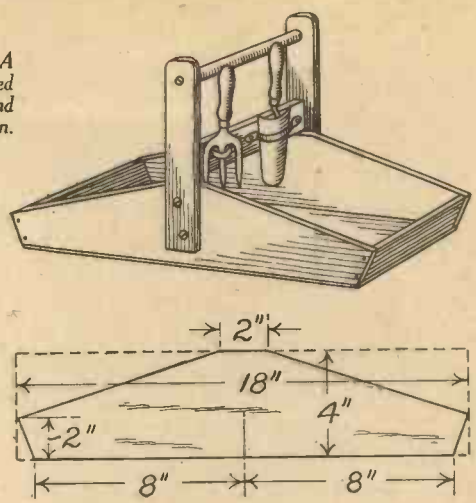
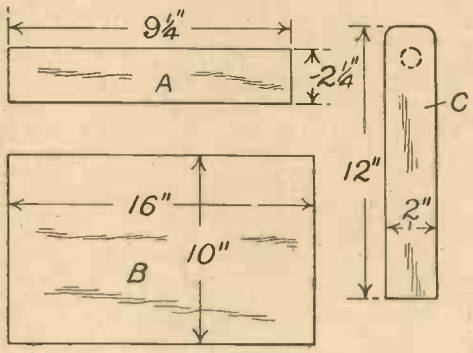


Fig. 14.—Section of part of the top-light, showing fillets for holding the glass in place.

Figs. 15 to 17.—A view of the finished "trug" basket, and details of construction.





If a larger basket is required, the dimensions given in the diagrams can, of course, be increased to meet requirements. The finished basket, with the exception of the handle, can be given two coats of creosote or other wood preservative.

Other Suggestions

The pieces of simple woodwork described in this article by no means include all the useful appliances for garden use which the handyman can make. For instance, a small wheelbarrow, a rose arch, shrub tubs, and a pigeon cote, can all be constructed by the same simple methods. Other appliances will, no doubt, occur to the reader as occasion arises.

NEW INVENTIONS

The following information is specially supplied to "Practical Mechanics," by Messrs. Hughes & Young (Est. 1829), Patent Agents, of 9 Warwick Court, High Holborn, London, W.C.1, who will be pleased to send readers, mentioning this paper, free of charge, a copy of their handbook, "How to Patent an Invention."

Automatic Disinfection

THE fact that the telephone mouthpiece comes into close contact with a multitude of lips makes it a possible disseminator of harmful germs. Alive to this danger, an American inventor has added to the expedients already devised to protect the public from such an evil. His idea is a mouthpiece formed of the usual vulcanised rubber material. Incorporated with this is an antiseptic which the patentee claims is rendered active by the exhalations from the body of the person using the 'phone. Therefore, every man, unconsciously, may be his own disinfector.

Tong Twister

THOSE familiar Siamese twins of the fireside—the tongs—are destined to play an additional part. Their supplementary rôle is the removal of obstinate stoppers from bottles. According to a new device, they are to be made after the usual pattern, being formed of one piece of metal bent at the top. But in the sides there will be indentations providing means for gripping a stopper. Thus, with a twist and a tug, the tongs will contend with the stopper which, limpet-like, refuses to budge from the bottle.

By the way, it is appropriate to recall that St. Dunstan—a holy man who was interested in practical mechanics—is said to have used the tongs he employed at his forge for a purpose other than that for which they were designed. It is alleged that with these improvised red-hot pincers he tweaked the nose of his Satanic majesty.

Dining Cars for Babies

SPEAKING of bottles, I am moved to allude to an invention which has for its object the nutrition of infants in motor-cars. Juvenile travellers, when on a long journey, naturally require nourishment. The hungry babe is now catered for by means of a feeding appliance which can be attached to the dashboard of a car. Electrically heated, the device ensures that the temperature of the liquid is congenial to the internal economy of the budding bairn. And so, as far as the very young are concerned, every motor-car may be a dining-car.

A Good Sign

THE enterprising tradesman makes use of every space on his premises available for advertising his wares. His blind, for example, offers an effective opportunity for publicity. To this he sometimes adds a signboard hanging from the edge of the blind. Hitherto, the customary plan has been to suspend a detachable or swinging valance. Such an arrangement, however, may involve an infringement of bye-laws, owing to the board hanging so low that it endangers the heads of passers-by. A recently patented contrivance furnishes improved means for supporting signboards affixed to shop blinds. The device comprises arms to carry the sign, pivoted in brackets or plates at the end of the blind lath. There are means for effecting an interlocking action between the arms and brackets. This enables the arms to be locked in alternative positions. As a consequence, the sign can be held vertically both when the blind is down and when it is rolled back into its box. In the latter position, it appears above the ordinary fascia.

Verily a sign of the times.

Wafer for Wayfarers

THE wafer is extensively used by the manufacturing confectioner in the production of luscious sandwiches. Normally it is somewhat fragile and apt to be crushed. Moreover, the appetising contents are too easily squeezed out. To prevent these disadvantages, an improved wafer has been patented. In this new article, the usual pair of thin flat wafers are interleaved with a wafer corrugated or fluted. This reinforcement of the outside covers enables the wafer biscuit to resist a certain amount of pressure. At a picnic it may not be sat upon with impunity; but the hiker who takes it with him on his jaunt will be likely to find it intact.

Cold Mutton and Hot Jazz

A CONSIDERABLE portion of a housewife's time is spent in the kitchen. Ordinarily, the wireless set is not found in the culinary department. But there has now appeared a refrigerator with which is embodied a radio. This is installed in front of the top of the refrigerator and, to match the hardware upon it, the frame and knobs may be made of chromium. Henceforward, the refrigerator, in addition to keeping the comestibles cool, will produce hot jazz for the delectation of the fair cook. In the officers' mess the band plays while the Colonel is feeding. Should not the industrious housewife enjoy a musical selection while preparing the meal for her happy warrior?

How to Shelve the Heat

IT is not a far cry from the refrigerator to a method of keeping pantries cool in tropical weather. Various proposals have been put forward to utilise the domestic water-supply for cooling meat safes. These devices are usually constructed as separate articles with cooling pipes arranged to form grids or shelves. A development of this plan has been evolved. This comprises sheet-metal containers made to form shelves for larders, etc. These containers are connected with the water supply system. When the water is drawn off at the house taps for ordinary use, it flows in from the road main through the containers, enabling the various edibles to keep cool. If it be desired to switch off the cold, the water flowing into the containers can be dammed or diverted.

Although this invention may produce a temperature only distantly akin to that of the North Pole, it will be sufficiently low to arouse the jealousy of the cucumber.

DYNAMO.

CONJURING

By Norman Hunter

SOME PRACTICAL PIECES OF APPARATUS AND THEIR USES

Fig. 1.—This frame has two glasses, one behind the other. The intervening space is filled with sand, making the frame appear empty although containing a picture. When the frame is reversed the sand runs away out of sight and the picture is revealed.

PICTURE and photograph frames can be prepared in a number of interesting and ingenious ways for the purpose of producing magical effects. Yet they are such familiar and everyday objects that their appearance does not suggest that they have been made specially for conjuring purposes.

One of the most popular types is known as the sand frame. Fig. 1 shows in a general way the operation of this frame, the purpose of which, like most magical frames, is to cause the appearance of a picture behind the glass.

In this frame there are two glasses, one behind the other, with a little space between. The wooden frame on three sides is solid but the fourth, one of the narrower sides, is hollow and contains a quantity of fine, dry silver sand. Reference to Fig. 2 will show that when the frame is held with the sand compartment at the top, the sand quickly runs down between the two glasses, thus hiding whatever picture is in the frame. When the frame is reversed so that the sand compartment is at the bottom, the sand trickles quickly and silently away, leaving the picture visible.

Dry Sand Essential

It is important in making a frame of this kind, to be sure that the sand is quite dry, otherwise it will not run freely. To this end the sand should be heated in an oven for a while. If at any time the sand in the frame shows signs of clogging, through the frame having been kept in a damp place, the entire frame may be warmed in an oven to restore the dryness of the sand. The back of the frame is covered in this instance, not with the ordinary fancy paper usually found in frames, but with a piece of glasspaper. This glasspaper almost exactly matches the sand when between the glasses, and the frame will appear to be exactly the same whether genuinely empty or containing a picture hidden by the sand.

So much for the actual construction of the frame. As with every piece of magical apparatus, however, it is as much the way it is used as the method of its construction that produces a convincing effect upon an audience. The simplest way to use the frame is to put into it a picture or photograph, reverse the frame and allow the sand to run down and hide it. The frame is shown as empty and covered with a cloth, being secretly turned upside down in the process. When the cloth is removed the picture appears.

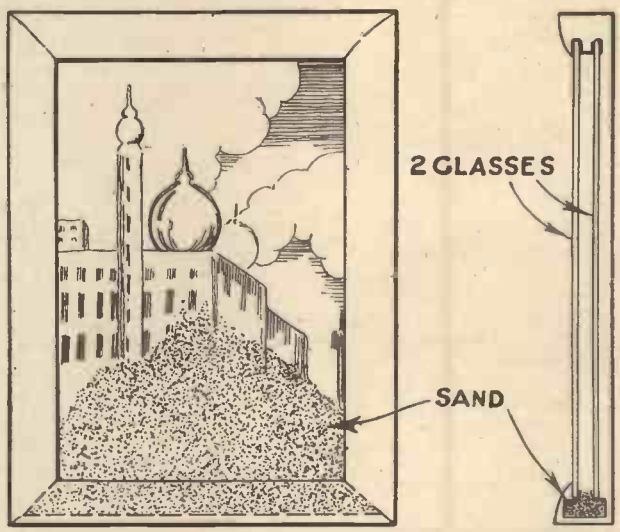


Fig. 2.—(Left) Sand running down and revealing the picture. (Right) A section showing how sand runs out from between the glasses, and back again.

Needless to say the picture to appear in the frame is one chosen apparently at random by the audience. The choice of picture is forced by the performer. That is to say he offers the choice in such a way that the audience cannot but choose the one he wishes. Details of a practical force will be given later in this article.

More Spectacular

Presented in this somewhat bare way, however, the frame is not being used to its best advantage. A more subtle method is the following.

Take the picture to be used and attach it to the backing of the frame with a touch of paste, taking care that the picture will be right way up when the sand runs out from between the glasses. Run the sand out and insert loosely in the frame a photograph of some other subject. The performer's own photo or that of some famous person could be used for this. The frame is brought forward and shown to contain a picture. Holding the frame facing squarely to the audience the conjurer opens the back and lifts it right up. The picture attached to the backing remains concealed as shown in Fig. 3. The loose photograph is removed and discarded and the performer looks through the glass at the audience who, seeing that the glass is clear and transparent, are convinced that there is nothing in the frame. Now the conjurer closes the frame. But he does not do this by bringing down the back, for that would expose the second picture. What he does is to lift the frame up and forward as shown in Fig. 4. This brings the frame back towards the audience and at the same time reverses it so that the sand runs down, unseen of course, to fill the space between the glasses. The back having been secured, the frame is then turned round sideways and shown to be apparently empty. To produce the picture of course all the magician has to do

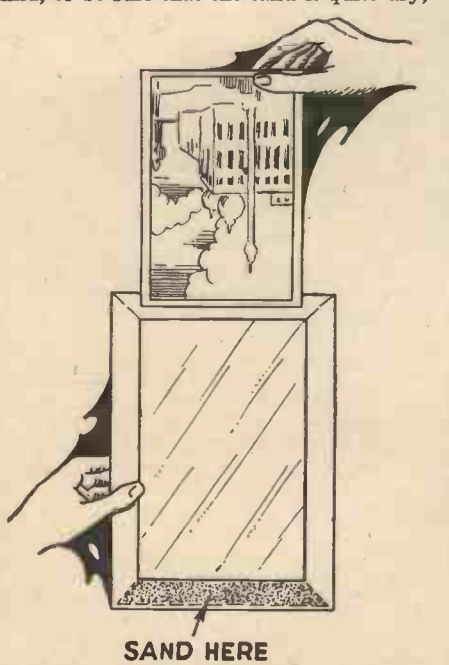


Fig. 3.—The back of the frame showing the sand out of sight and the picture fastened to the back.

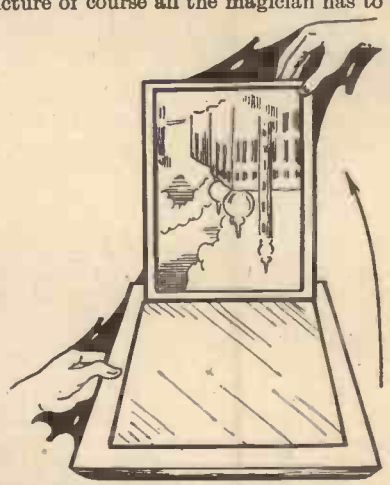


Fig. 4.—The frame being closed over the picture with the back of the frame towards the audience.

WITH PICTURE FRAMES

(The Well-known Conjurer of "Maskelyne's Mysteries" Fame)

Further Articles on the Secrets of Conjuring will appear Regularly and Exclusively in this Journal.

is to turn it upside down again in covering it with a cloth. Or, again, he can simply turn it back towards the audience with a topsy-turvy movement which turns it upside down as well, and rest it either on a small easel or against some object such as a candlestick on the table. In this case the mere act of turning it round reveals the picture, which can, of course, be removed if desired.

Another Type of Frame

Another form of frame is shown in Fig. 5. This, although not possessing so many advantages as the sand frame, is easier to make and very simple to operate.

The frame is prepared by cutting away a portion of the back of the top part as shown in Fig. 6. This recessed portion must be slightly wider than the opening in the mount. A piece of black silk; the kind

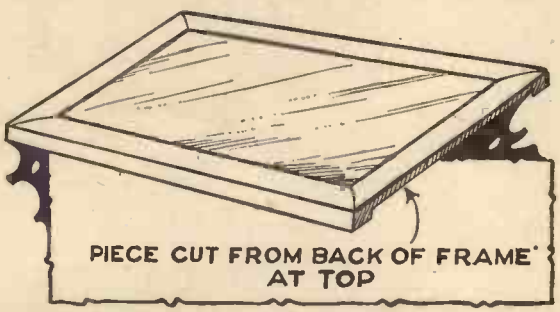


Fig. 6.—Showing the piece removed from the frame.

used for umbrellas is excellent for the job, is then cut to fit within the frame. The edges are neatly hemmed and a button or small ring is sewn in the centre of the top edge. The cardboard or wooden backing of the frame, which is of the type used for photographs, has a small piece cut out to accommodate the button on the piece of silk.

The operation of the frame should now be evident. A picture is attached to the back of the frame, which, by the way, must be black, the loose blind is laid over the glass with the frame face downwards on a table, the button is pushed up under the backing and the blind smoothed out, after which the back of the frame is closed. In this condition the frame appears to be empty, the blind appearing like the backing of the frame. It is covered with a cloth and, when this is removed, the button on the blind is nipped through the fabric, and so the blind is withdrawn, revealing the picture in the frame. The blind remains in the cloth which is tossed aside, well out of reach of the audience of course.

The Blind

Fig. 5 shows the blind being withdrawn, the covering cloth having been omitted for the sake of clearness. If desired some colour other than black may be used for blind and backing. A piece of dark brown or green watered silk does very well, or even a light buff colour may be used. It is not important providing backing and blind match exactly.

In my own performances I use a frame of this type to produce a picture of a well-known London building chosen apparently haphazard by the audience. The choice is forced to fall on St. Paul's Cathedral, a picture of which can be seen in the frame in the photograph. This is how the force is accomplished.

A number of plain postcards are printed, each with the name of a well-known building, the Tower Bridge, Westminster Abbey, etc. and, of course, St. Paul's. We will suppose that there are eight in all. Seven more post cards are then printed, each with the name St. Paul's, and one extra card is printed with one of the other buildings, say, Westminster Abbey. The cards are arranged as shown in Fig. 8, which is a sectional diagram of the cards laying face downwards on the table.

It will be seen that if the cards are picked up in a packet and held with the name on the bottom one facing the audience that the seven different cards are at the back, with the second Westminster Abbey one in front of them and the seven St. Paul's cards in front of them again. The conjurer starts reading out the names on the cards, and as he does so he takes the cards one by one from the back and puts them in front of the heap. When he has gone through all the different cards he comes to the second Westminster Abbey card. This not only convinces the audience that all the cards in his hand are different, but also gives him his cue to stop and tells him that the seven cards now on the back of the packet are all marked St. Paul's.

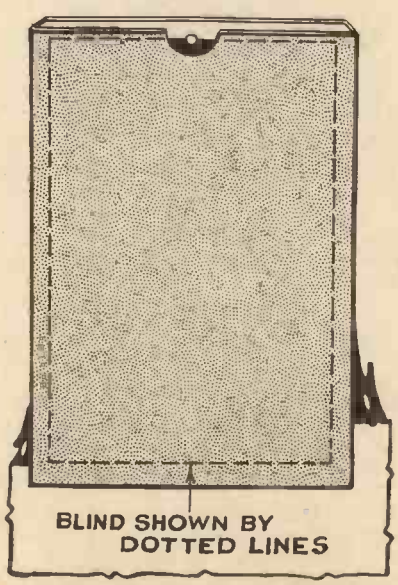


Fig. 7.—The pull-out blind in position, back view.

Fig. 5.—A frame with a draw-out blind. The blind hides the picture and is drawn out inside a cloth used to cover the frame.

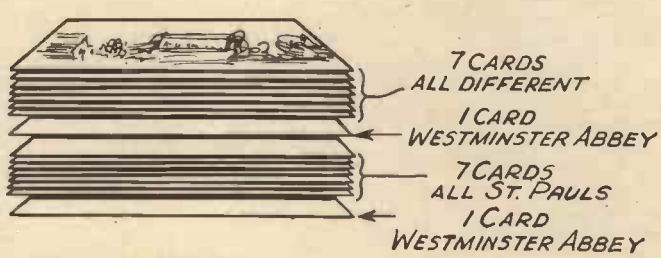


Fig. 8.—The cards arranged for "forcing" the choice on the audience.

Forcing a Card

He can now proceed in either of two ways. He can spread out the cards and offer them fanwise for someone to take one. Needless to say, he spreads only the top seven, and it is not a difficult matter to ensure that one of these is taken. Or, he may ask someone to call out "stop" as he deals the cards faces downwards on the table. He commences, of course, from the back of the packet and lays the cards down slowly without showing their faces. Someone is certain to call "stop" before the seventh card is reached and, of course, whatever card the performer is stopped at is marked with the name St. Paul's, or whatever name he has arranged to force.

This method of determining in advance the choice of the audience while apparently giving them a free selection will be found valuable in a great many tricks. The names of people or colours may be forced, or numbers, names of countries, almost anything you like.

The "Empty" Frame

Reverting for a moment to the sand frame, and more particularly the method of using it in which the picture to be produced is kept hidden behind the back of the frame; this method could be used with an

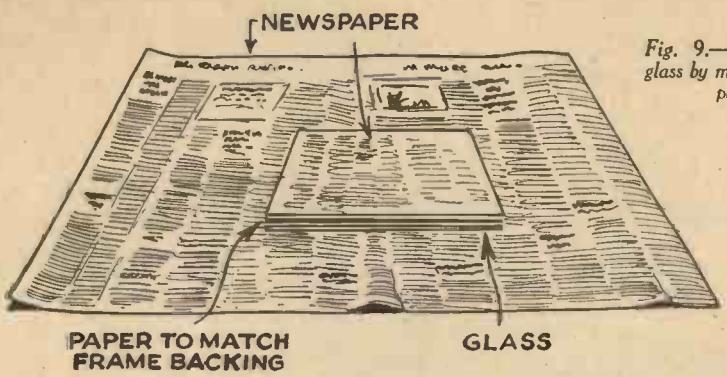


Fig. 9.—Masking the glass by means of newspaper.

unprepared frame. In such a case, however, the frame could not be shown empty after the visible picture had been removed. An experienced performer would be able to convince the audience without doing this, however, but another subterfuge is sometimes employed to simulate the appearance of an empty frame at this stage. On the table, or on a tray, is a piece of glass cut to fit loosely in front of the glass in the frame. This piece of glass is covered with paper to match the back of the frame, and on top of this again is pasted paper to match the tray or the cloth. Even newspaper is sometimes used, the glass in this case being laid on a folded newspaper. At a reasonable distance the covered glass is not perceptible (Fig. 9).

The visible picture having been removed from the frame and the frame closed as previously described, back towards the audience, it is then laid on the table face downwards and over the loose glass while a cloth is exhibited. The cloth is laid aside and the frame lifted and with it the loose glass. This glass, being held in front of the glass in the frame, hides the picture and presents to the audience a surface of glass backed by paper exactly the same as the back of the frame, and so the frame appears to be empty. This, coupled with the fact that a picture has just been removed from it, is sufficient to impress upon the audience the idea that the frame contains nothing. The frame is again laid down and the cloth draped over one arm. The frame is then picked up, this time without the loose glass, and wrapped in the cloth, care being taken not to let the audience catch a glimpse of the picture.

These directions sound more complicated than the actual movements. By going through them with a frame no difficulty will be experienced.

Our final frame idea is a development of the draw-out blind frame, but in this case the blind instead of being drawn out of the frame, is wound up rapidly on a spring roller.

The Spring Roller

In order to accommodate the roller, which is simply a small window blind suitably shortened, the frame needs to be of large size. I have one designed for use in a Chinese conjuring show. The frame is cut from plywood and decorated in Chinese style, as shown in Fig. 10. Behind the flat frame is a shallow box, and at the top of this is fitted the spring roller blind. Fig. 11 shows these features. The frame in this form is used not to produce a picture, but a china plate which is hung within the box by means of a wire plate hanger.

In the trick in question a duplicate plate is smashed and the pieces caused to vanish, after which the plate, restored again (actually a second plate), appears suddenly in the frame. The sudden appearance is produced by the rapid rolling up of the spring blind.

The back view of the frame, shown in Fig. 11, indicates the position of a small pocket electric battery. This is wired through a flat bell push on a long flex to the semi-circular compartment seen in Fig. 10 at the base of the frame. This is a flash device and enables a brilliant flash to be produced at the moment the blind is released. This adds considerably to the effect and makes it quite impossible for the keenest eye to detect the movement of the blind.

Fig. 10.—Frame designed in Chinese style and fitted with a spring blind. A picture, plate or other article in the frame remains hidden until the blind is released.

Fig. 11.—A back view of the spring blind frame. The bell push is connected to a flash apparatus worked with a battery and produces a bright flash of fire in front of the frame at the same moment as the blind is released.

The Flash Device

The flash device I use myself consists of a flash lamp bulb holder set on a tiny flat tray of tin. In this holder I use either a cheap flash bulb or one of those little fuse bulbs sold for wireless purposes. The bulb is screwed into the holder and the bell switch pressed to make sure contact is established. The glass of the bulb is then gently broken with a pair of pliers and about half a teaspoonful of magnesium flash powder is carefully poured round the filament of the lamp. Now when the switch is pressed the exposed filament glows red hot for a split second and sets off the powder. A new bulb must be used every time.

The spring roller blind has the ratchet removed so that when drawn down it will fly up again as soon as released. A tiny screw eye in the lath has a length of cotton tied to it. This cotton, when the blind has been pulled right down, is carried over the heap of flash powder and wound round a screw head in the lower part of the frame. When the powder is set off it burns the thread and releases the blind. Thus the whole operation of the frame is performed by one movement. The flat bell push on its long flex is laid on the floor near the apparatus and is operated by the performer himself pressing his foot upon it at the right moment.

Commencing the Trick

At the beginning of the trick one plate hangs behind the blind in the frame. The duplicate, also in a wire plate hanger, is suspended in front of the blind from a tiny hook in the top of the frame. The whole frame is fitted to the top of a bamboo pole, which in turn is fixed to a solid and fairly heavy base. The frame could equally well be fitted to a shorter stem and used to stand on a table, and if desired the flex could be carried behind the scenes and the flash set off by an assistant.

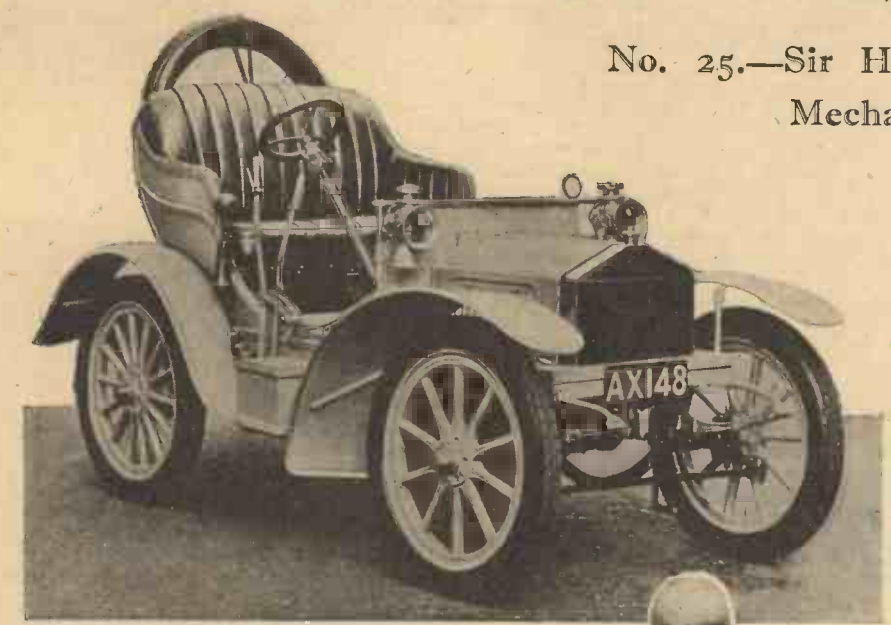
In a future article I hope to give a method by means of which the broken plate may be apparently restored, minus one piece, which has been given to a member of the audience to hold. The piece when fitted to the restored plate is found to fit exactly, thus seemingly proving that the same plate has been restored.

Wind-driven Power Plants in U.S.S.R.

THE mass production of wind-driven power generators started in the U.S.S.R. in 1934 has proved to be highly economical. In 1936 alone over 1,300 of these generators (of 2·5 and 6·5 h.p.) were installed on the collective and state farms. The construction has now been commenced of a powerful wind-driven power-house of 20,000 k.w. capacity on the summit of Ai-Petri in the Crimea. Wind-driven generators of 100 h.p. have been installed in Balaklava, in the Crimea, and in Kara-Bugaz, on the Caspian. During the Third Five-Year Plan it is proposed to extend the production of wind-driven power generators and the construction of wind power-houses in different parts of the U.S.S.R.

MASTERS OF MECHANICS

No. 25.—Sir Henry Royce—A Master of Mechanical Perfection



The forerunner of the "Rolls-Royce." The first Royce car of 1904. It had two cylinders and developed 10 h.p.

THE name "Rolls-Royce" has, in these modern days, come to denote something more than excellence in motor-car construction. It has developed into an expression of superlativeness, into an epithet which is nowadays used wherever the English language is spoken to signify a condition of high and unsurpassed excellence. "Rolls-Royce" has, indeed, assumed the status of a new adjective in our language and doubtless it will pass into history as such.

But did the little newspaper lad who, at the age of ten years, dragged himself at an early hour from his bed, morning after morning in order to deliver periodicals in the suburbs of a great town, ever dream attaining to immortality? All that young Frederick Henry Royce thought about at that immature age was the hardness of his life and the difficulty of gaining sufficient food to nourish his growing body.

Life to him was severe and full of troubles. Perhaps that was why even after years, when wealth, fame and success had thrust their laurels upon him, Sir Henry Royce remained a simple, deeply thoughtful and unassuming man, an individual who was entirely without "side" and one who had at heart the careers and affairs of his staff and workpeople.

Royce's life-story, although there is nothing spectacular about it, constitutes one of the romances of the engineering and industrial world. The founder of the famous automobile engineering firm was born on March 27th, 1863, the son of a miller in humble circumstances. Royce's grandfather was also a flour miller and doubtless he himself would have been put to the family occupation if it had not been for the premature death of his father, an event which spelt poverty and distress to the Royce family over many weary years.

His Start in Life

Young Royce was only nine years of age when his father died and in the following year it was found necessary for the lad to sell newspapers. Later he had some real luck. He received a recommendation which procured him a "safe" position as a messenger-boy in the Post Office, and here again, if Royce had been merely an ordinary sort of diligent lad contented with the security and slow progression which his occupation held out, the famous partnership of Rolls-Royce would never had been formed.

The lifelike statue of Sir Henry Royce erected at Derby in 1922.

But Royce was not an ordinary lad. He had within him that creative fire, that indescribable itching for mechanical constructional work and this, coupled with a decided ability for design and draughtsmanship, drove him out of the Post Office service and landed him, at the age of fourteen years, as a junior apprentice in the Peterborough works of the old Great Northern Railway Company. In this occupation Royce revelled. He learned all about locomotives and their making. He was instructed in the use of mechanical tools and constructional appliances. The elements of engineering design were disclosed to him, and small avenues were laid open for the exercise of his creative mechanical ability. Royce's troubles were by no means over at this stage of his life, however. His family still felt the pinch of poverty, and lack of money compelled him to leave the railway works at Peterborough before he had completed his apprenticeship.

Royce, now well into his teens, had to fend severely for himself. He managed to travel up to Leeds and, after a period of trials in that city, he succeeded in getting himself taken on as a mechanic in a gun factory. At Leeds Royce worked sixteen hours a day and often did "overtime" in the bargain. His wage was a mere pittance, but the lad worked hard and gained as much experience as he possibly could.

To London!

The next move of Royce was to London where he had applied for and obtained the job of tester with one of the first of the metropolitan electric lighting companies. Royce's life was easier now and although his wage was but small, he had hours of leisure at his disposal. Decidedly the lad was not one to waste his "off" hours. He entered himself for courses of systematic evening study at the City and Guilds College in Finsbury, and in the years immediately following his appointment as tester to the London Electrical Company he consolidated and extended his practically-acquired knowledge by theoretical study and regular technical instruction.

Royce put down a large proportion of his success to those formative years which he spent in Leeds and in London. The going was hard and the path rough, but he surmounted the many difficulties which bestrewed his pathway and apparently, he never regretted these early trials.

In 1882, when he was barely twenty years old, Royce had made such technical progress and had given such unmistakable signs of competence and ability that he was appointed chief electrical engineer in charge of the pioneer electric lighting of the streets of Liverpool.

His Own Master

Upon the completion of the Liverpool undertaking, Royce decided to strike out in life for himself. He had visited Manchester and had seen for himself the many favourable opportunities which that industrial district held out to the trained engineer. Royce's idea was to begin for himself the manufacture of electric motors and dynamos which were at that time in rapidly-growing demand. Capital for the projected enterprise was lacking, but Royce had very few fears on this account. His schemes were sound ones and his ability to carry them though unquestionable. Consequently it was not long before the youthful

enthusiast was able to procure the wherewithal to commence engineering operations for himself.

It was thus at the age of twenty-one years that F. H. Royce founded the firm of Royce, Limited, mechanical and electrical engineers and specialists in dynamo and electrical crane construction. Royce's first factory comprised a low-built brick building situated in Cooke Street in the Hulme district of Manchester. The factory was closely hemmed in by house property and there was little or no room for expansion. It is interesting to note that these humble premises in which Sir Henry Royce commenced his manufacturing operations and in which was built his first motor-car, the forerunner of the famous Rolls-Royce vehicles, still survives in almost its original condition, although the Royce concern vacated the building many years ago.

Royce, Limited, of Manchester, was successful from its very inception. The success of the concern was due, in the main, to the thoroughness of the work turned out by it. Royce, too, had the gift of inspiring his workmen and associates with the ideals of mechanical perfection. As a consequence, Royce, Limited., rapidly forged ahead and became known throughout Lancashire and subsequently over a wider area as manufacturers of thoroughly dependable products.

Inception of R.R. Cars

An important chapter in the history of motoring has its origin in those old Cooke Street premises of Royce, Ltd., in Hulme, Manchester. After the turn of the twentieth century, when motor vehicles became more popular, it was quite a familiar occurrence for such vehicles to break down and to compel their drivers to push them to the kerbside for mechanical adjustment or repairs.

Royce, as he walked along the Manchester streets to and fro from his newly-established factory, was struck by the frequency of mechanical trouble in the motor vehicles of the day and his strictly methodical and highly-gifted engineering mind caused him to wonder whether it would be possible for a motor-car to be commercially produced which, would seldom, if ever, develop a mechanical breakdown. Evidently Royce decided that such an ideal motor vehicle was within the bounds of practical possibility, for, about this time, we find him busy in the drawing office of his factory on the design of a motor-car engine and of a chassis to accommodate it.

Shortly afterwards, the firm of Royce, Limited added another department to itself—its "automobile department." The growing demand for motor vehicles had convinced Royce that by producing commercially a car of super-excellent qualities he would not only be furthering the prestige of his Company, but, also, of extending the concern's activities.

The First Car—Enter Rolls

After various components and engines had been tried out experimentally, Royce put on the market his first car in 1904. It had a two-cylinder engine which was rated at 10 h.p. From the beginning the model was entirely successful. Into its construction, Royce placed the whole of his mechanical experience, ability and energies. If the car succeeded, thought Royce, the name of Royce, Limited, would become better known. If the vehicle proved a failure, well, the experience gained in its construction would not be wholly lost.

A pioneer motorist of the day, the Honourable C. S. Rolls, the youngest son of Lord Llangattock, of Monmouth, had his attention directed to the Royce car. He gave it a practical trial, and so enthusiastic did he become over its performance that he immediately got in touch with Royce and offered to sell all the cars which the latter could produce.

The Hon. C. S. Rolls was in business for himself as C. S. Rolls & Co., and in 1907 there was formed one of the most memorable partnerships which the world has ever known. The automobile department of Royce, Ltd. was combined with the concern of C. S. Rolls and Co., the new organisation becoming Rolls-Royce, Limited, Royce himself was installed as chief engineer and works director of the new concern, whilst Rolls took upon himself the task of administrator and publicist. The firm of C. S. Rolls & Co. had an enterprising business manager, one Claude Johnson, who was, incidentally, the capable Secretary of the Automobile Club of Great Britain and Ireland. When the Royce and the Rolls

The original premises in Cooke Street, Hulme, Manchester, in which Sir Henry Royce began his operations. Behind the boarded-up window he had his little office and through the wooden doorway the first Royce car went forth into the world.

organisations amalgamated, Rolls took Johnson over with him, making him the commercial manager of the new concern.

Despite the commercial genius of Claude Johnson and the pioneer motoring activities of Rolls, there is no doubt that the fame of the new Company was reared upon the engineering abilities of Royce. When, in 1910, Rolls met an untimely death as a result of an aeroplane disaster, Royce took upon himself the entire practical direction of the concern and, as a reward for his activities, was able to witness its continual expansion.

Aeroplane Engines

From an early date, Royce had been interested in aeroplane engines. Hence, when the Great War came, his organisation was able to produce some of the most dependable aero-engines which it was possible to obtain.

Success never spoiled Royce. Even when, in 1930, he was created a baronet, he still remained first and foremost a trained and practical engineer and designer, and an individual of substance and of leisure afterwards.

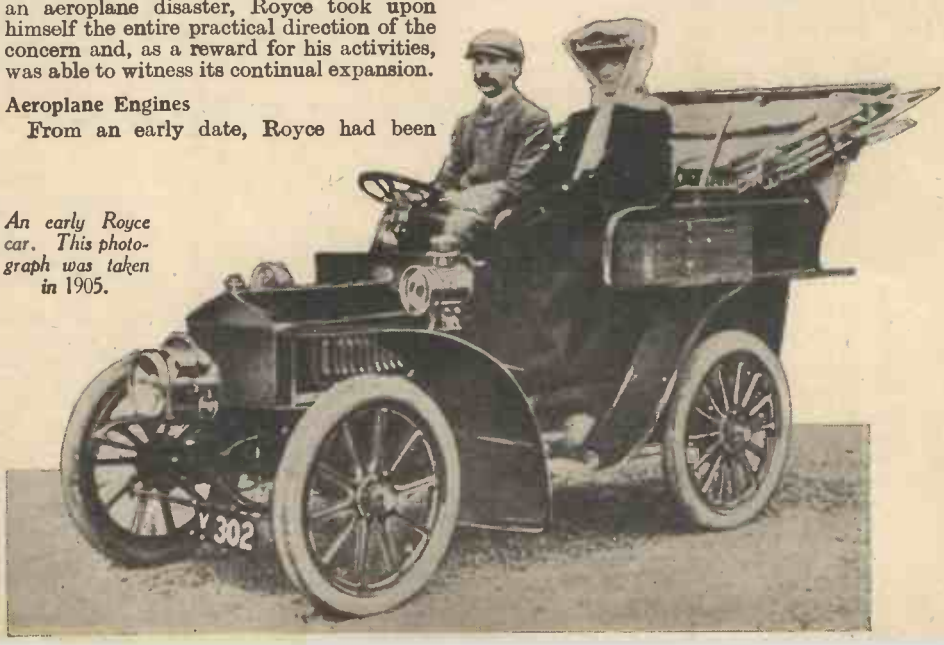
During Royce's active association with his Company, an association which he carried on even during the days of his retirement, every responsible engineer and mechanic entering the Rolls-Royce factories at Derby was presented with a copy of the "Rolls-Royce Bible." This consisted mainly of letters written by Royce in which he inculcated the necessity of thoroughness and excellency in all the tasks which came to the hands of his employees.

Smashing Bad Parts

At one time, it is said, Royce went round his factory armed with a heavy hammer, with which implement he would deliver a smashing blow upon any article or component which did not, in his opinion, come up to specification. Later Royce, so to speak, mechanised this hammer tradition. He had installed at his factories specially designed "smashing machines"—machines which subjected automobile material and parts to excessive strains and, if they succumbed to such harsh treatment, almost completely destroyed them. By means of this rigorous treatment of raw materials and manufactured parts, Royce was able to keep up his tradition of "the best and the finest," a tradition which has sent his name to the furthermost corners of the earth.

Sir Henry Royce died on 22nd April, 1933, at the age of 70. He had lived in retirement for some years at West Wittering, near Chichester, but even in his seclusion in that rural district he maintained at his residence a fully-equipped drawing-office, staffed by expert designers from the Derby works of his famous company.

Sir Henry Royce was one of the very few people and probably the only practical engineer to have a statue set up in his honour during his lifetime. Such a tribute to his engineering genius was erected at Derby in 1922. It represents Royce the man, not the idealised individual.



An early Royce car. This photograph was taken in 1905.

Fig. 1.—The author's monocoque petrol model just after taking off.

NOTES ON PETROL-DRIVEN MODEL AEROPLANES

By C. E. B.

A New Monthly Feature

A Monocoque High Wing Model

IN July, Fig. 1 of these notes depicted a 6 ft. span model of mine, powered by a 6-c.c. "Baby Cyclone" engine. Fig. 1 of this month shows the model flying overhead and gives a general impression of its appearance in the air. This model has an oval monocoque fuselage built up on a method that I described some months ago. Briefly it has a backbone of balsa with balsa half oval formers glued on to each side. Stringers of $\frac{1}{4}$ in. × $\frac{1}{4}$ in. strip balsa are then glued along the formers at about $\frac{1}{2}$ in. distances from each other. The whole is then covered first with a skin of $\frac{1}{16}$-in. sheet light-weight balsa and then with silk and finally doped. Plastic wood is used inside to strengthen highly stressed parts of the fuselage such as nosepiece and where undercarriage fittings are located. I suggested that the main dimensions of this model, which by the way is an excellent and stable flyer, would be useful for any one designing a suitable model for a 6-c.c. engine, whether the fuselage was made up in monocoque form or rectangular.

The model weighs 4¼ lb., but, of course, is very "clean" and therefore does not require a great deal of power to fly it. A rectangular fuselage will have a little more head resistance but can probably be produced at a slightly reduced weight, thus producing the same result.

Inverted the Engine

Since taking the original photograph in which the engine was shown mounted upright on its detachable elektron mounting, I have inverted the "Baby Cyclone" engine on a later type of mounting so that the thrust line is a little higher. This has allowed a reduced amount of downthrust and as the thrust line is now nearer the centre of resistance of the main plane has less tendency to pull the nose up into a stall. Reference to Fig. 1 in the July issue of PRACTICAL MECHANICS will make this quite clear.

The model is more stable and gets into its gliding angle more quickly after the power is off. I have now had many flights with this model followed by very pretty flat glides and good landings, whereas at first there was a slight tendency towards longitudinal instability in certain circumstances. One cannot over-impress upon the beginner the importance of correctly locating the thrust line on a petrol model so that when the power is on it causes a gentle climb, and when the power is off the model drops into its natural gliding angle. There are a great number of models built with no particular thought given to this point. Certain overseas models are offenders in this respect.

It is not surprising that models incorrectly designed in this important and fundamental point, do the most curious dives and zooms after the power ceases. The model under discussion has a mainplane 6 ft. span and 12-in. chord with a "thick" section 1$\frac{3}{16}$ in. at thickest part, 4 in. from the leading edge. The dihedral angle has 8½ in. measured from each wing tip to a horizontal line through the centre section. The wing has a marked undercamber. The fuselage is 43 in. long and the tailplane is slightly tapered with a 8½ in. chord at the centre and 7 in. chord at the tip. The span is 32 in. The fin is 11½ in. high and 9¾ in. long and is made up from a balsa outline of 3-ply laminated balsa ¼ in. thick. The centre is cut out for lightness.

This type of fin does not warp easily in hot weather. The fuselage is 7½ in. deep at the deepest point below the wing.

Dihedral Angle

I have recently been flying a fair amount with a small gathering of petrol models and their owners at an aerodrome beyond Leamington Spa. Certain of these models have beautiful flat glides owing to a light wing loading and generally excellent design *provided* the weather is calm.

But on more than one model, as soon as the weather freshens up a little, there is a marked tendency for the model to fly well for a short time and then to drop a wing slightly and start a bank. This rapidly increases until the model gets into a spiral dive. I had a biplane that did exactly the same thing.

The reason, of course, is that the dihedral angle is not sufficient. The average person does not like to spoil the look of his model, and in many cases people believe that a large dihedral ruins lift.

Actually the amount of lift lost is not worth considering provided the model has a normal light wing loading.

For those who find their models lose direction and then drop a wing, and for

those models that for no apparent reason end up with a spiral diving flight after a good beginning, I would urge them *to try* a good hefty dihedral in spite of all their beliefs and theory against it.

I have heard many people say that they are sure they can cure the sort of instability I have described by other methods. I have seldom seen them do it. Granted, that it can be done, by redesigning the whole machine and building another, but to try various first aids to a model so afflicted will generally cause other troubles.

a thing they do not like! It is flying results that all of us are after and not looks. If you have never done so just try this dihedral business unless, of course, you fly a "parasol," when a lesser dihedral is correct.

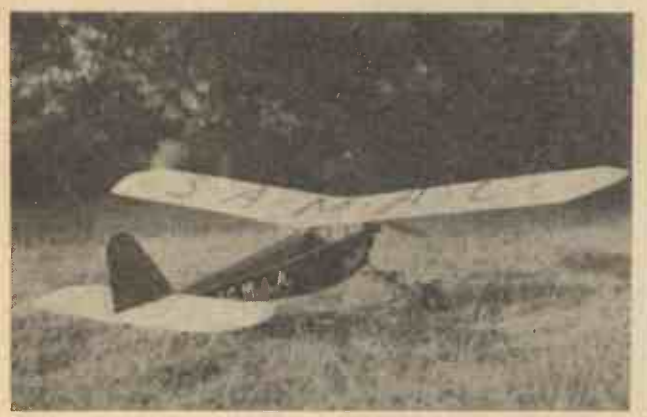
But there are other difficulties to overcome in a "parasol" that does not normally make it a very good beginner's model.

As a general guide for different types of *high wing* models where the thrust line is not far below the wing, and for good stability or windy days, I suggest 8 in. from wing tip

neither fly nor glide, and he sought me out as I had originally designed the model. As a result he saw the reasons and rebuilt to the original and promptly put in over fifty flights and gained much satisfaction in about two to three weeks!

A South African Model

The pretty little model shown in Fig. 2 was made by Mr. V. C. Gracie of South Africa who kindly sent me the photograph together with some others of the model in flight. This little model is powered by



Figs. 2 & 3.—(Left) A small South African model fitted with a 2·4-c.c. "Elf" engine; (Right) The author's small "Kub" in flight. This model has a 2·3-c.c. "Spitfire" engine.

Have you ever noticed that most of the well-known petrol models that fly well and go on doing it regularly have increased their dihedral angle from the early efforts of their constructors!

Performance Before Appearance

Why not try it the other way round and hang the looks, or even build two wings if you hate a large dihedral. Use the small dihedral for good and dead calm weather and put on the wing with the large dihedral for the not so calm weather.

If you do this be careful to keep two fins and remember to also change these. For, do not forget that the large dihedral angle shows a large side area forward and this *must* be balanced by a suitably large fin at the rear, or trouble will develop in a sideslip.

It is often difficult to get people to believe

to ground level, when the wing is placed on the floor on its centre section for a 5 ft. span wing, and 8½ in. for a 6 ft. wing span—whilst 12 in. is suitable for a 8 ft. span wing. *But do not forget that a larger fin must be fitted to balance this increased dihedral.*

The "P.M. Petrel"

By the time this appears in print I suppose the "Petrel" competition for its £50 prize will have been flown. It will be remembered that I described the troubles of a builder, who shall be nameless, but who will no doubt have a quiet chuckle when he sees this.

He originally altered the design in wing section, less dihedral, and a different tail section, so that the model lost its designer's original aim, i.e. to make a slow flying powered glider of it. The model would

a Canadian 2-c.c. "Elf" engine. I have two of these excellent little engines in models of my own.

The 2·3-c.c. Class

A certain amount of trouble was originally experienced on the new British 2·3-c.c. "Spitfire" production engines. This engine has now been fitted with a plain piston like a lot of the successful American engines. I must admit that it has made a great improvement on my latest "Spitfire" which now develops a fierce thrust. Provided it wears as well as it runs it should have an excellent future. I have now run this latest "Spitfire" for some time, and its power is just as good if not better than when I first had it.

Fig. 3 shows a little 5 ft. span model that I built, called the "Kub," being flown by a "Spitfire."

The Passing of Marconi

IT is with deep regret that we record the death of His Excellency the Marchese Guglielmo Marconi, G.C.V.O., LL.D., D.Sc., at the age of 63.

His First Experiments

The Marchese's first experiments in wireless were conducted in 1895, and since that time radio, as it is now more commonly called, has made tremendous strides. It was only in 1901 that signals were first transmitted across the Atlantic, between Poldhu, in Cornwall, and St. John's, Newfoundland, a date which is now regarded as the culminating point of Marconi's pioneer work. Other important inventions which resulted from his activities are the horizontal aerial (patented in 1905); the tuned spark system (1912), which enabled long-distance signals to be made more successfully and which resulted in the first messages being transmitted to Australia in 1918.

During Recent Years

Of recent years his main activities have been aboard his steam-yacht, the *Elettra*, and many successful short-wave experiments have been carried out and have resulted in improvements in existing apparatus, with the aid of his various expert assistants. Marconi was awarded the Nobel Prize for Physics in 1909, and the Albert Medal of the Royal Society of Arts. In 1914 he was nominated by the King of Italy to be a member of the Italian Senate, and in June, 1929, was created a hereditary marquis by the King of Italy.

The late Marchese Marconi.

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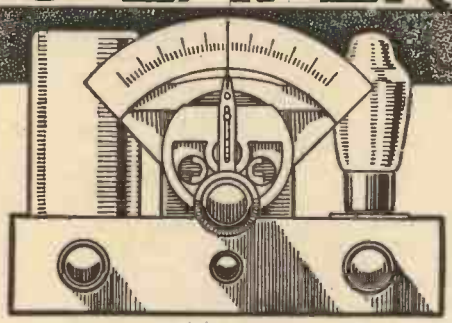


PRACTICAL HOME RECORDING

How Gramophone Records may be Made at Home with Particular Reference to the Two Simplest Systems for the Amateur

THERE is nothing mysterious or tricky about the home recording of broadcast programmes or items rendered by the members of your own family or friends, and the lack of popularity of this interesting hobby is undoubtedly due to the failure which has attended many efforts which have been made without correct preparation. If the process is carried out correctly, and a little thought given to the various details, there is no reason why records should not be made at home which are every bit as good as those which can be purchased, although the limitations regarding "studio" space and the acoustics of the ordinary room will naturally prevent the musical reproduction from reaching the same high level. There are various processes available, but the two systems with which we have had most success, and which are easiest to understand for the beginner are the Feigh, supplied by Electradix Radios, and the Simplat supplied by the V. G. Manufacturing Co. These two systems may be regarded as the two best examples of the various schemes which are available to the amateur, the first employing the aluminium blank and the second a composition disc resembling those which

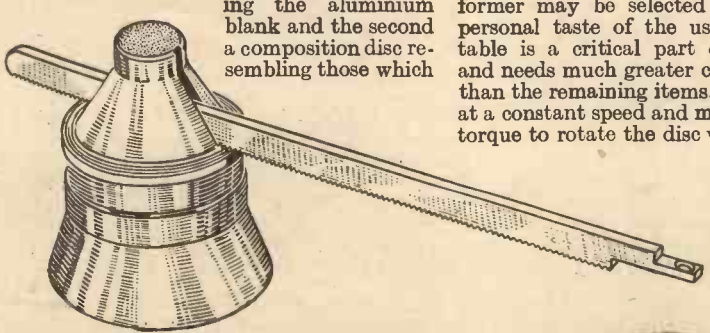


Fig. 1.—This is the complete Feigh tracking device referred to in this article. The details are shown separately in Figs. 6 and 8.

are supplied by the big record companies. This gives the best results from the point of view of permanency and quality, although it must not be inferred from this that the aluminium blank is not productive of good results. The latter is, of course, very much easier to use, and if the correct method of recording and playing back is adopted it will give results which will satisfy all normal requirements. If, however, you desire to record some individual talent with a view to submitting it to someone in order to obtain an audition, then the composition type of disc is to be recommended. Furthermore, it must be understood that there are other suitable systems for the amateur. These two are merely mentioned as they describe the two distinct systems and are known to the author, and no opportunity has been afforded for trying any others.

The Main Requirements

The main items needed for satisfactory recording, with any process, are microphone, amplifier, and turntable. The two former may be selected according to the personal taste of the user, but the turntable is a critical part of the equipment and needs much greater care in its selection than the remaining items. It must revolve at a constant speed and must have sufficient torque to rotate the disc whilst cutting is in process. It is remarkable what a really loud passage will do to a disc which is being turned by a weak motor. With an aluminium blank and a diamond cutter it is possible to stop a well-known synchronous turntable, and even a single spring motor which under all normal gramophone conditions gives highly satisfactory results, will give sufficient drag to a disc which is being cut to render it useless for reproduction. There are, of course, many suitable motors on the market, and apart from the available power it is essential that no vibration is transmitted to the turntable. If there is any, a pattern will be cut with the recorded item which will be reproduced in the form of a "wow" throughout the disc. A good gramophone motor, of either the clockwork or electric type, may be converted for the purpose by replacing the turntable with a very thick and heavy one, provided there is sufficient torque available. Special recording motors may be obtained for the purpose.

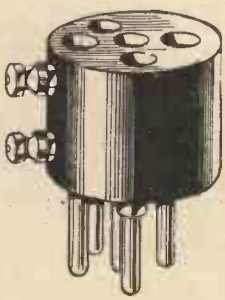


Fig. 2.—A pick-up adapter enables a microphone to be connected to any receiver not provided with pick-up terminals or sockets.

To prevent slipping, when there is sufficient torque available, a rubber mat may be placed between the disc and turntable surface. One of the moulded mats with a pattern is preferable to the smooth rubber type, and these may be obtained from any good gramophone dealer.

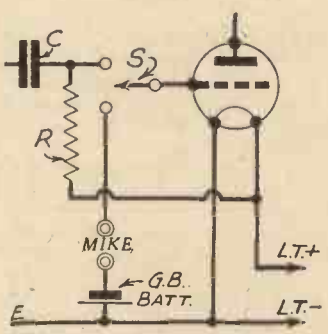


Fig. 3.—How to connect a microphone to a battery detector stage, with change-over switch.

Fig. 4.—A novel hand loudspeaker, which may be used as a moving-coil microphone. This is a Wharfedale product.

Microphone and Amplifier

The amplifier should deliver at least 2 watts if a good substantial cut is desired on the wax-type disc, and naturally a volume control must be fitted. Any ordinary radio receiver may be used for recording, if pick-up terminals are provided. Even if they are not, a microphone may be joined in the grid circuit of the detector

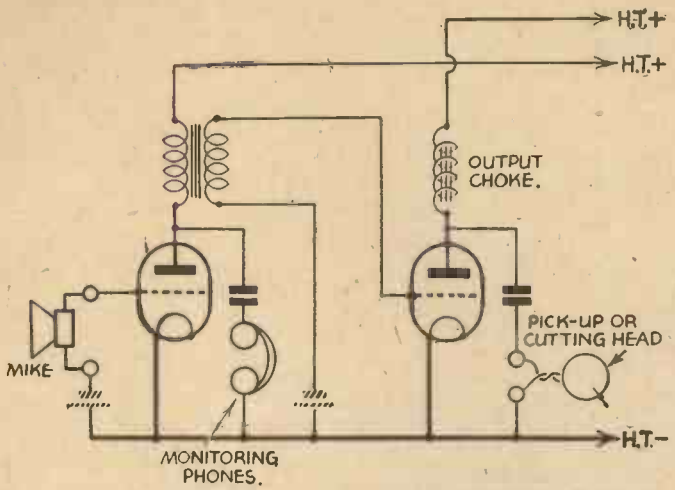


Fig. 5.—General circuit arrangement for home-recording, showing headphones for volume control adjustments. The volume control may be on mike or transformer.

or L.F. stage by means of a pick-up adapter inserted between the valve and the ordinary valveholder. A 4-pin adapter is used with a battery valve and a 5-pin with a mains-type valve. The choice of microphone is wide, but in general, only the moving-coil and carbon types may be joined to the amplifier through extension leads. Other types, such as the piezo-crystal or condenser types, will have to be connected by the shortest possible lead, or a separate small "head" amplifier will have to be made up so that a short lead to the grid may be provided. A screened output lead may then be taken to the amplifier. The moving-coil microphone will prove very sensitive and has a wide angle of reception, and a good moving-coil speaker may be used for this purpose provided the diaphragm is not too large. The carbon types will require a bias or voltage applied to them, and the makers' instruction should be followed in this respect.

The pick-up or cutting head should be joined in the output circuit in place of the loud speaker, and the filter-output connection should be employed as in Fig. 5.

The Pick-up

Any good pick-up may be used, but its weight may have to be modified. In most cases it will have to be increased for the cutting, and with the aluminium blank it may have to be reduced when playing back. This may easily be accomplished by adding a rod to the carrier arm with a sliding weight made from a piece of round rod. The best positions will have to be found on trial as pick-ups vary in their individual design and no definite rules can therefore be laid down. To enable the volume to be controlled to suit the disc it may be necessary to add a pair of 'phones. The average pick-up will sound something like a small loud-speaker, and this may enable the user to gauge the volume when one or two trial cuts have been made. If 'phones are used, they should be joined in the last stage but one, using the filter-fed arrangement. It will still be necessary, however, to make trial cuts to find just what volume is the maximum which may be recorded, and during the playing of the item it will be necessary to regulate the output so that if there is a sudden increase in volume it may be reduced slightly to avoid overloading. This naturally leads to a modification of the light and shade, or tone value, of the item, and this is one of the reasons why the expansion circuit is so popular with gramophone record reproducers. It will obviously be preferable for someone with musical knowledge to control the volume, preferably with the score before them, so that they can anticipate the changes in volume and regulate the cutting accordingly. However, these are details, and we must get on to the actual recording.

Diamonds and Sapphires

An ordinary steel needle (such as is used for ordinary record playing) may be used for cutting, but best results are obtained with a sapphire or diamond cutter. A sapphire needle may be obtained from Electradix for 3*s*. 6*d*., and a diamond for 7*s*. 6*d*., whilst the V.G. sapphire for the composition disc costs 7*s*. 6*d*. and 12*s*. 6*d*. If an ordinary steel needle is to be used, select one of the medium-tone type (not a loud tone or thick one). Play two sides of an ordinary 10-in. record, and the slight wear on it will have raised a flat which will assist in cutting and will prevent it from digging in, a detail which will often occur if a new needle is used. In view of this, the needle must be left in position, otherwise the worn part will be turned and it will be useless for recording.

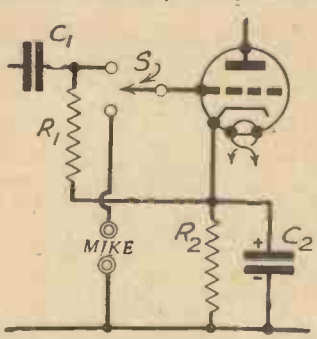


Fig. 7.—Connections for a mains (indirectly-heated) detector stage.

Cutting the Grooves

To enable the grooves to be traced on the record blank, some form of gear is required. The simplest is illustrated in Fig. 1 and is obtainable from the Electradix company for 21*s*. 6*d*. It consists of a small gear-box which clips on to the spindle of the motor and a rack which is inserted in a slot in the head of the box. A spiral is cut at this point and the teeth of the racked rod engage in this. A small stiff wire must be fitted to the side of the pick-up, and passed through a hole cut in the end of the rack so that it may be pulled along. In the case of a bakelite pick-up a small nut and bolt will have to be inserted in the side, and the wire soldered to the head of the bolt. If desired, Electradix can supply the gear complete with pick-up and diamond cutter. The V.G. gear consists of a parallel-tracking device which is mounted behind the turntable and driven through a belt from a fitment placed over the motor spindle. In recording on the aluminium blank a thin trace of vaseline or paraffin should be smeared across the disc beforehand, and it should be ascertained that the hole in the centre is a good tight fit over the motor spindle. A thin piece of paper wedged between spindle and disc will ensure non-slip properties. No preparation is required with the Simplat disc. If the needle bears too heavily on the record, undue surface noise will be obtained in the play-back. If too light, many of the softer parts of the item may not be heard, but this latter point seems to depend upon the pick-up characteristics. When the item is concluded, the aluminium blank can be left as it is, although I have found that a rub with a piece of hard cloth such as serge, smeared with vaseline, helps to remove slight particles of metal which may be adhering to the sides of the grooves. The Simplat disc may also be played back just as it is, but it is possible to lengthen

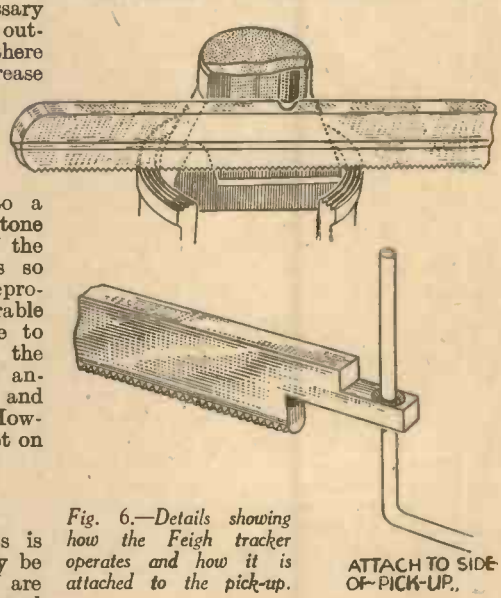


Fig. 6.—Details showing how the Feigh tracker operates and how it is attached to the pick-up.

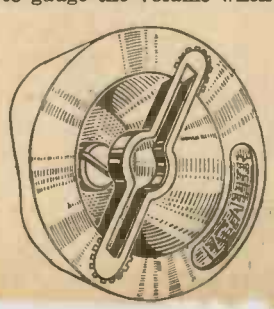


Fig. 8.—The simple clamping device at the foot of the Feigh tracker.

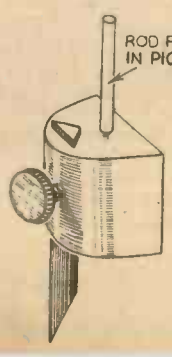


Fig. 9.—If the triangular type of fibre needle is obtained an adapter of this type must be used. Fibre needles may now be obtained, however, with a round shank.

the life of this by wiping with hardening and polishing fluids supplied by the makers. By this means the record is rendered almost as permanent as the standard disc and upwards of 200 playing times are ensured. Without the hardening process the record will give about 15 or 20 reproductions before being rendered too rough to be of further use. The hardening fluid is wiped over, following the makers' instructions carefully, and then a polishing fluid is used. The process only takes about five minutes, and may be hastened, if desired, by placing in a current of warm air.

Reproduction

With both of these systems, it is preferable to play back the discs by means of a non-metallic needle. There are many types on the market, but the aluminium disc requires a tough needle with a fine point. These may be obtained from Electradix for 2*s*. 6*d*. a dozen, or the B.C.N. needles, obtainable from any gramophone stores, may be used. The weight of the pick-up must be reduced to a minimum to avoid wear on the points. The Simplat makers supply a special trailing needle which fits the groove cut with the sapphire and this naturally avoids damage to the disc.

Such items as microphone technique must, of course, be left to the individual, but a few tests on a record blank (half an inch is enough) will soon enable the best position for performer and microphone to be found. The aluminium blanks cost 4*s*. a dozen in the 6-in. size and 7*s*. a dozen in the 10-in. size. The Simplat blanks are available in five sizes, from 7 in. to 16 in. in diameter, the prices ranging from 2*s*. to 8*s*. each.

LATHE WORK FOR AMATEURS
By F. J. CAMM
96 Pages
1/- or 1/2 by post from Geo. Newnes Ltd., Tower House, Southampton Street, W.C.2

New London Recording Studio

Specially Built for Recording Sponsored Programmes

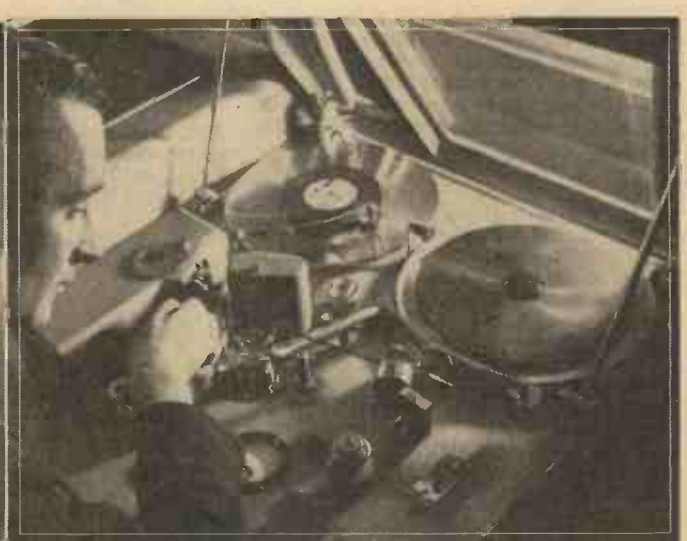
THE accompanying illustrations show a general view of the new J. Walter Thompson Studio and part of the equipment which is used, beneath Bush House in the Aldwych. This studio has been built especially for recording sponsored programmes, and it is claimed that it is the only one of its kind in Europe. Designed to incorporate the very latest principles, the studio and its accompanying rooms bristle with novel features. The walls of the studio are panelled in such a way that the panels may be reversed, and one side is "quilted" to reduce echo, whilst the other side is panelled to provide echo, and thus any desired studio acoustics may be obtained in an instant. The effective area of the studio may be modified by means of panels adjusted at angles in the lower section of the wall, and the roof as well as the walls are insulated from the main building. The floor is also insulated, being built over a swimming-bath which at one time was used by employees in this building. Velocity microphones are used in the studio, and in addition to a monitoring room there is a "dubbing" or editing room in which are a number of special disc recorders as well as sound-on-film recorders. The latter utilise the Philips-Miller system in which film stock is employed, but instead of the sound variations being photographed on to emulsion in the usual way a stylus cuts away a thin coating of graphite, thus combining the advantages of the mechanical system with those of the sound-on-film system.

Other Advantages

This system also has the advantage that the record may be played back instantly, and at the opening demonstration Foster Richardson, the well-known singer, recorded an item which was reproduced through the loud speakers in the studio almost before he had time to sit down. The advantages of such a scheme, which needs no processing of any kind, are obvious. The special recorders are fitted with two heads so that two copies may be made at one time, or the second head may be used to play back in another room whilst the record is being made. The control engineer, by means of a remote control, can intersperse any desired sound effects from the gramophone record discs or films in the "dubbing room" without leaving his room at the opposite end of the studio, whilst announcements may be dropped in when desired from another room.

Other details of the studio worth mentioning are the special sound-proof doors and the rubber-sprung floor, which is built upon layers of rubber alternating with thick layers of cork down to a depth of 2 ft. Although below ground-level the air is kept pure and at constant temperature by means of an elaborate air filtering system which takes in air from the roof of Bush House, eight storeys above the level of the street. Messrs. J. Walter Thompson, who are responsible for this studio and the work conducted in it, are justly proud of the high efficiency which has been obtained not only in effecting the building of the studio in such a central position, but in the many technical details which have been incorporated.

A general view of the studio, with a band session being recorded.



The recordist checking a recording a few seconds after it has been made.

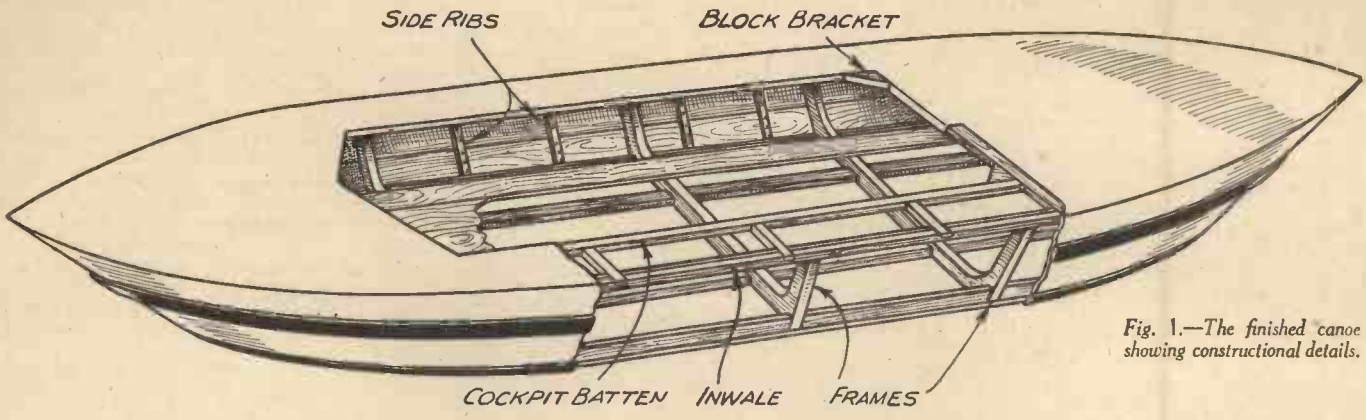


Fig. 1.—The finished canoe showing constructional details.

A 14 FT. 2/3-SEATER CAMPING

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THIS canoe has been designed to meet the needs of those who require a craft that can withstand some rough usage, and the conditions usually met with at the seaside.

For inland waters it will be found that due to its flat bottom and light draught it can be used on almost any piece of water, and may be punted where there is insufficient depth to get paddle immersion. The decked sections allow room for storing camping gear and equipment.

Everything necessary for its construction can be purchased in even the smallest town, and the method of building is such that very little skill is called for.

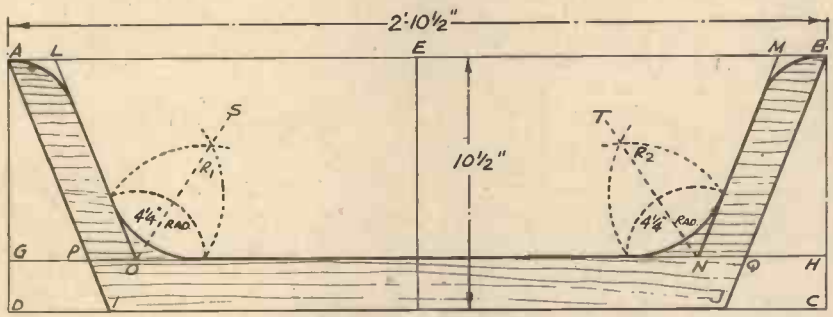

Fig. 2.—Details of the frames.

Materials

All timber specified is considered as planed on all sides, and sizes refer to the finished size after the planing operation. This is most important as unless the materials stand up to specified sizes, trouble will arise in building, so specify this when ordering.

Timber

1 piece ¼ in. plywood, 3 ft. × 3 ft.; 4 planks selected deal, 15 ft. long, 6½ in. wide, ⅝ in. thick; 1 piece oak 3 ft. long, 2 in. × 2 in.; 10 battens of deal, each 15 ft. long, 1½ in. wide, ⅝ in. thick; 2 battens deal, each 15 ft. long, ¾ in. wide, ⅝ in. thick; 3 planks selected deal, each 14 ft. long, 9 in. wide, ⅝ in. thick; 2 half round battens beading, each 15 ft. long., 1 in. wide; 4 pieces deal, each 10 ft. × ¾ in. × ¾ in.; 2 pieces of deal, each 14 ft. × ¾ in. × ¾ in.; 2 sheets ¼ in. plyboard, 5 ft. × 4 ft.; 1 piece deal, 6 ft. long, 2 in. wide, ½ in. thick; 2 pieces oak, 6 ft. long, 1½ in. wide, ¾ in. thick.

Screws

1¼ gross 1 in., No. 8; ½ doz. 1½ in., No. 8; ½ doz. 2½ in., No. 8; ½ gross 1¼ in., No. 6; 2½ gross, 1 in., No. 6; 10 gross ½ in. No. 6.

Sundries

4 lb. white lead; 2 lb. putty; ½ pint linseed oil; 10 yds. tape, ¾ in. wide.

Paint

3 lb. grey priming; 2 lb. undercoating for finishing hull colour; 2 lb. grey hard gloss paint; 2 lb. hard gloss paint colour to choice for hull; 1 lb. hard gloss paint, colour to choice for deck.

Total Cost, £4 9*s*. 3*d*.

Making the Frames (Three Required)

Cut a rectangular piece of plyboard ¾ in. thick and measuring 34½ in. × 10½ in. as represented by the rectangle in Fig. 2, by *A B C D*. Make sure this is square; important measurements are taken from the edges. Along the top edge mark *E* which is the centre, and in a similar manner mark *F* along the lower edge *DC* join *EF* with a pencil line. We now have a centre line and since both sides of the frame balance all points marked on the right hand side must be an equal distance from *EF* on the left hand side, we use this centre line to check the balance of our work.

Along the lower edge *D C* mark *I* 4¼ in. from *D* and *J* 4¼ in. from *CIF* and *F J* should each be 13 in., join *AI* and *BJ*. Now up *D A* mark *G* 2 in. from *D* and up *C B* mark *H* 2 in. from *C* join *G H*. Along *G H* and 2 in. from the point *P* where it cuts *AI* mark *O* and in the same way mark *N* on the other side. Along the top edge mark *P* 1½ in. from *A* and *M*, 1½ in. from *B*, join *L O* and *M N*. Saw carefully along *A I* and *B J* leaving the pencil mark showing. With a pair of dividers bisect the angles *O* and *N* and make the dividing line over 5 in. long, measuring from *O* mark *R* 1, 5 in. from it and from *N* mark *R* 2, 5 in. distant, *R* 1 and *R* 2 are the centres for the radius about the angles *O* and *N*, so setting the dividers at 4¼ in. radius these may be marked in.

The surplus wood may now be cut away with a bow saw, so in cutting out start at the point *L* and cut down *LO* as far as the radius, then round and along the centre part of *O N* to the next radius, round this and up *N M* finishing at *M*.

The corners at *L* and *M* should be rounded off to a gentle curve. The planks will be fastened to the edges *A I*, *IJ*, and *J B*, and since we have to cut notches to receive seam battens, we shall mutilate these edges so must at this stage mark off

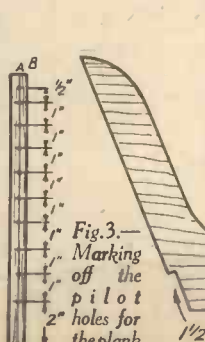

Fig. 3.—Marking off the pilot holes for the plank screws.

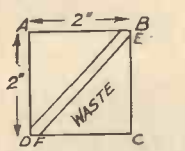

Fig. 5.—The stem and stern posts.

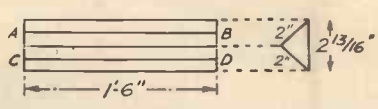

Fig. 6.—The seam battens fitted into position.

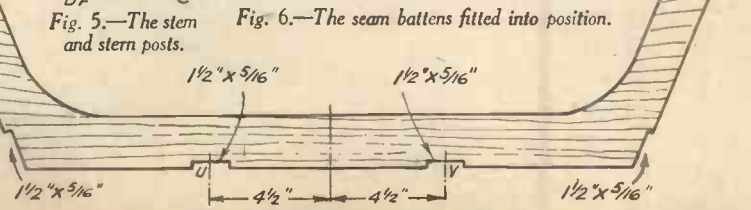

Fig. 4.—Notches cut in the corners and bottom edge.

and drill the pilot holes for the plank screws. In Fig. 3 *B J* is assumed to be either of the sides *B J* or *A I*, and since they are both alike it will suffice to show only one.

Mark a central line right up the edge which will be $\frac{3}{8}$ in. from either side and 2 in. from *J* or *I* according to the side, make a dot, then others every inch up, until you have nine points marked, the last or tenth will only be $\frac{1}{2}$ in. distant (these markings are shown in Fig. 3), mark out both sides exactly alike, and drill $\frac{3}{32}$ in. for 1 in. depth. We can now cut the notches to take the chines and bottom seam battens. At the corners cut notches $1\frac{1}{2}$ in. × $\frac{5}{16}$ in., as shown in Fig. 4, then measuring from the centre line along the bottom edge mark a point $4\frac{1}{4}$ in. each side of it, these will be the centres for

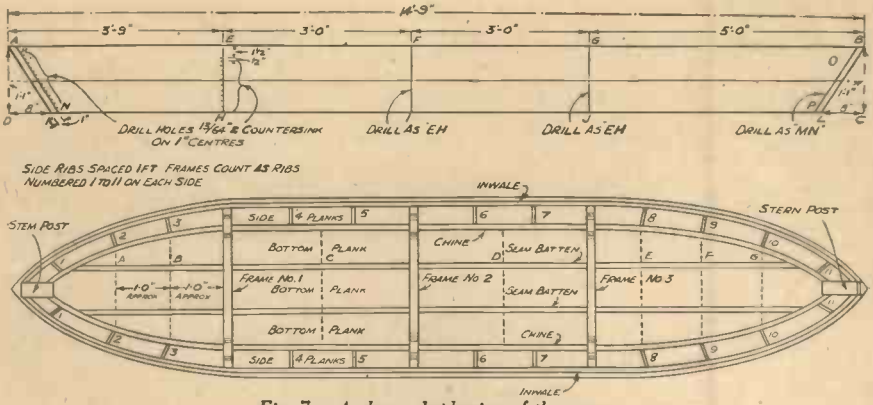

Fig. 7.—A plan and side view of the canoe.

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$1\frac{1}{2}$ in. × $\frac{5}{16}$ in. slots which should be 9 in. apart, measured centre to centre, these slots are shown at *U* and *V* (Fig. 4). The edges of the frames should now have two coats of paint and can be laid aside.

Cutting the Side Planks

We require four planks cut 14 ft. 9 in. long and $6\frac{1}{2}$ in. wide, $\frac{5}{16}$ in. thick, and the first job will be to take two of these lengths and place them edge to edge on boxes or trestles and by means of cord lashed round them draw the edges together. Tack a few odd laths across them with fine panel pins, say one every 2 ft., the two planks, edge to edge are represented in Fig. 7 by the rectangle *A B C D*, which should be 14 ft. 9 in. × 1 ft. 1 in. See that it conforms to this dimension and that the ends are square.

Along the lower edge *D C* mark *K* 8 in. from *D* and *L* 8 in. from *C* join *A K* and *BL*, saw along *AK* and *BL* carefully and take every care when nearing the end of the cut not to fracture the bottom edge. Along the top edge *A B* mark *E* 3 ft. 9 in. from *A*, then *F* 3 ft. from *E* and *G* 3 ft. from *F*, the distance *G* to *B* should be 5 ft. Along the bottom edge *K C* mark *H* 3 ft. 1in. from *K*, *I* 3 ft. from *H* and *J* 3 ft. from *I*, the distance *J L* should be 4 ft. 4 ins. Now join *E H*, *FI*. and *G J*, these will be the positions for the frames and may be drilled as shown on *EH* 13/64 in., and countersunk; it will be noticed that these drillings are the same as on the frame edges except that there is one more hole at the bottom.

When the frame drillings are complete mark *M N* 1 in. distant from and parallel to *A K*, and similarly *OP* 1 in. from *BL*. Drill holes along these lines the first 1 in. from the bottom, and spaced every 1 in. apart all the way up, in all 14 holes each to be drilled 13/64 in. and countersunk.

This completes the work on these two planks, and the other pair may be taken in hand, and may be marked out from the pair just completed; in fact if means can be provided for accurately clamping them together, there will be no need to mark out at all for the holes in the finished planks may be used as guide holes for drilling, and the method of cutting off the ends will be obvious. Remember however, that the countersinking of all holes will be done on the opposite side to the first pair, but if the clamped planks are turned over right away and countersunk before unclamping, a mistake cannot very well be made.

The planks may now be sandpapered up and given a light coat of paint after which they should be laid aside flat.

Making the Stem and Stern Posts

Obtain two lengths of oak 2 in. × 2 in. × 18 in. long and square up the ends. Take one of these lengths and mount it vertically in the vice, the end will then appear as the square *A B C D* in Fig. 5. Join the diagonally opposite corners *B D*, then about $\frac{1}{2}$ in. distant towards *C* and parallel with *B D* mark *E F*, and with a fine saw split the piece in two vertically, sawing between the lines, keeping the saw inclined if anything towards *E F*. The wanted piece is of course *A B D*, and when the two posts have been sawn out they may be drilled. Mark a line up the sides *A B* and *A D* parallel to the corner *A*, and 1 in. from it Fig. 5. Mark points all the way up, starting with the first 2 in. from the bottom, and afterwards spacing them 1 in. apart, drill for a depth of 1 in, $\frac{3}{32}$ in. diameter.

It should be found that on placing a pair of planks together as in Fig. 7, and placing

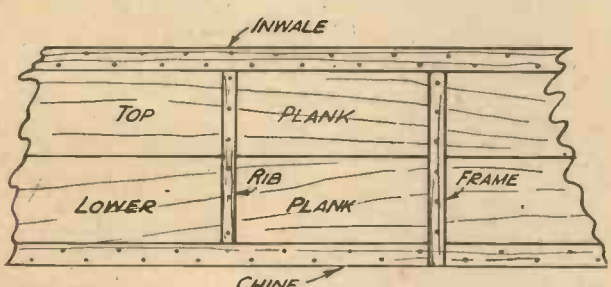
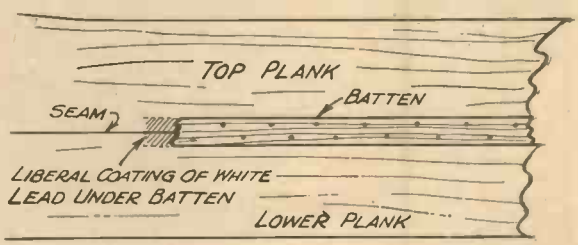
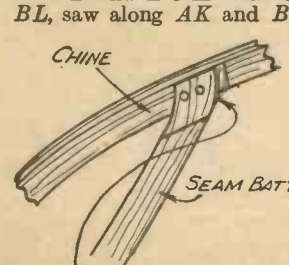


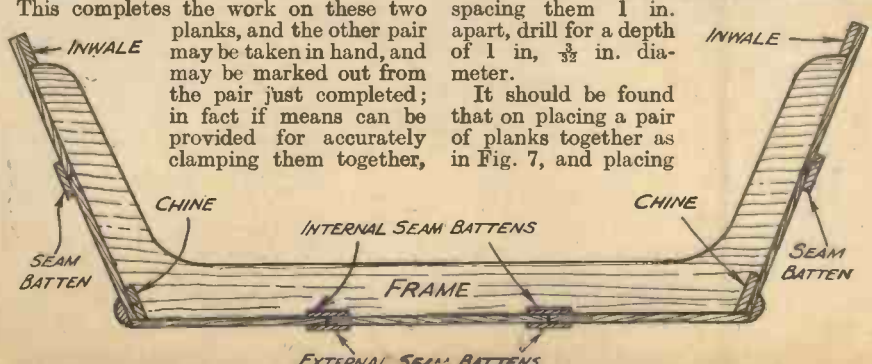
Fig. 8.—Part of the side showing how the inwales, ribs, and chines are fitted.

Fig. 9.—(Right) Making a waterproof joint.





Figs. 10 and 11.—(Left) Securing the end of the seam battens to the chine. (Right) A section through the canoe amidships.



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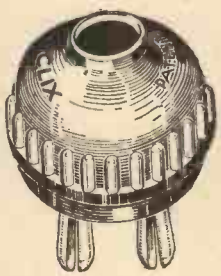

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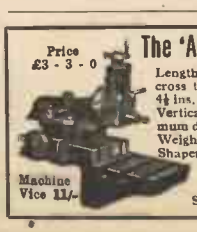

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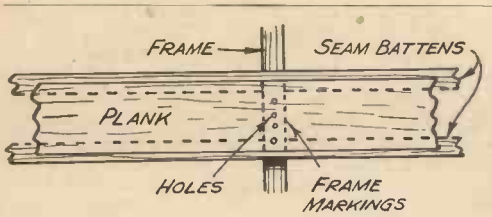

Fig. 12.—A section of the plank where it crosses a frame.

a drilled surface on one of the posts underneath the plank drillings the holes in the two should line up, there will, of course, be a slight surplus of post over, but this is trimmed off afterwards. To facilitate assembly fit these posts up for a trial so having prepared them, mark on the back of one stem and the other stern, and taking the pair of planks for the right hand side, place them together, and put the stem post in position under the drillings *M N*, corner *A* facing forwards and insert the full set of screws which should be 1 in. No. 8. Mark on the ends of the post where the plank edges come along the top and bottom edges at *A* and *K*.

Deal in a similar manner with the other post at the stern end drillings *O P*, and then remove both posts and mark the faces that have been in contact with the planks "right." Next assemble the other set of planks and repeat the whole operation, using of course the other surface, and when removed mark this "Left." When the marks made where the plank edges came to are compared on each side of the post, they should meet at the corner *A*. The surplus posts may now be cut off along the lines marked and they are completed.

First Stages of Assembly

The bottom side planks and frames are the first components to be assembled; place the two lower planks on the floor side by side, taking care that they are the right way round, that is, countersunk sides outwards, and stem to stem.

Take one of the frames and secure the left hand plank to it as follows. Using the centre frame position *F I*, pass a 1 in. No. 8 screw through the second hole from the bottom and enter this into the lowest drilling in the edge of the frame drive about half in. Next take the right hand plank, and secure that to the other edge of the frame in a similar manner; now put in the remainder of the screws on each side, half driving them with the exception of the bottom screw which is not put in until after the chines are fitted. The other frames are now fitted in the same way, in positions *E H* and *G J*.

Now take the stem post and making sure you have it the right way round, smear it with white lead and secure the front, drillings of the left hand plank to it. Next by means of a piece of rope placed round the planks, draw the two ends together so that you can screw the end of the right hand planks to the other face of the stem post, here again insert plenty of white lead, and drive all screws tight.

The stern post may now be fitted in a like manner, and the screws in the frames driven right home hard.

The fitting of the top planks is simply a repetition of the work just done, and when complete the plank edges should butt nicely, but if there is a tendency to bulge slightly this will rectify itself later.

Fitting the Inwales, Chines, Seam Battens, and Side Ribs

The inwales are battens of deal 1½ in. wide and $\frac{5}{16}$ in. thick, running round the top inside edge of the sides, and it will be noticed that the frames do not extend right up to the top of the sides in order to leave room for this batten. Starting at the stem post, cut the end of the batten to an angle so that it fits against the post, run it round the top edge of the canoe with the lower edge resting on the top of the frames until the stern post is reached, and then cut off the end at an angle as for the stem. This batten is

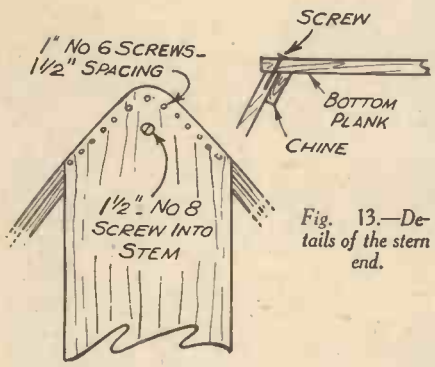

Fig. 13.—Details of the stern end.

secured with ½ in. No. 6 screws spaced every 2 in., and staggered as shown in Fig. 8, deal with both sides alike. The chine battens are fitted in a similar manner round the bottom edges, but run through the slots in the frames, they are produced from similar material and screw fastened. Fig. 10 should make this clear, whilst Fig. 8 is a plan view with these rails fitted.

Next fit the side ribs. These are made from ¾ in. × $\frac{5}{16}$ in. deal, and cut to fit between inwale and chine, as shown in detail in Fig. 9, and spaced one foot apart, the frames being regarded as ribs for spacing purposes, they are fitted with ½ in. No. 6 screws, six to each rib, and it will be found that these ribs will rectify any tendency of the planks to bulge as well as performing their normal duty, these ribs are shown in Fig. 7, numbered 1 to 11. When all the ribs are in the seam between the two planks should be covered on the outside with a seam batten, and is made from 1½ in. × $\frac{5}{16}$ in. deal screwed over the seam on the outside, and extends from stem to stern, the ends being bevelled off. It is secured with screws every 1½ in. staggered, the screws so placed that alternate ones are in opposite planks, the seam should be smeared liberally with a mixture of half and half white lead and putty, mixed to the thickness of soft butter with linseed oil, this mixture is known as "luting," and will be referred to as such in the future, the luting is of course done just before the batten is fitted, and not allowed to get set.

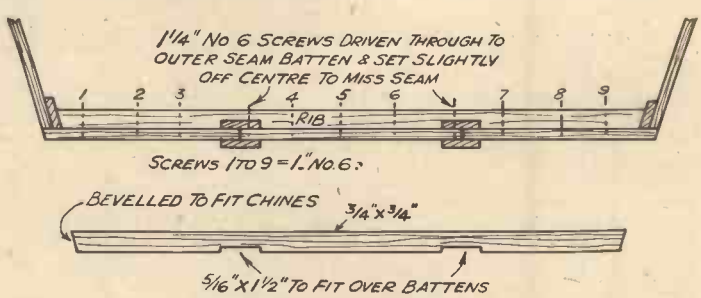

Fig. 15.—How the bottom ribs are cut.

The bottom seam battens may now be prepared and fitted. They are made from the same deal batten and drilled before fitting with staggered holes spaced every 1½ in. along their length, which should be 14 ft., these battens answer the same purpose as the side seam battens, but in this case we have a set on the inside as well as out, Fig. 7 shows the position of them, they are fitted into the slots in the frames, and secured where they meet the chine at each end by means of a wood block which is screwed to the chine and the batten, as shown in Fig. 10, the battens where they touch a frame are secured to it with a 1 in. No. 6 screw.

The chines and lower edge of the planks should be flush, so run a plane round them to square them up, and to see that the edges are flush with the bottoms of the frames, as the planks forming the bottom will land on, and be secured to these edges.

Fig. 11 is a section through the canoe amidships and clearly shows the location and purpose of the battens, chines, etc.

Planking the Bottom

For planking the bottom we require three planks of deal, 9 in. wide, $\frac{5}{16}$ in. thick, and each 14 ft. long. The first plank to fit is the centre, so proceed as follows. Taking a plank lay it along the centre line of the canoe (now upside down) it will be found there is a little over each end, and if the seam battens have been fitted correctly, the edges of the plank should lie along the centres of them. Mark across the plank the positions of each frame by drawing a double line representing the width of the bottom member, and draw a centre line between them, drill four 13/64-in. holes, equally spaced along it, this is shown in Fig. 12, which represents a section of the plank where it crosses a frame.

The plank should now be temporarily fastened to the frames with two screws per frame. Now mark out the plank ends, press each end down on to the chines, and holding them thus, mark round underneath the shape that the plank has to be trimmed to, but before removing it, mark each end stem and stern according to the end. Now remove it and saw out, cutting about ¼ in. wide, leaving a little to trim off afterwards. When ready to fit the plank, smear the frames and chines where the plank touches with plenty of luting mixture, and fit the plank first to the frames with all four screws per frame.

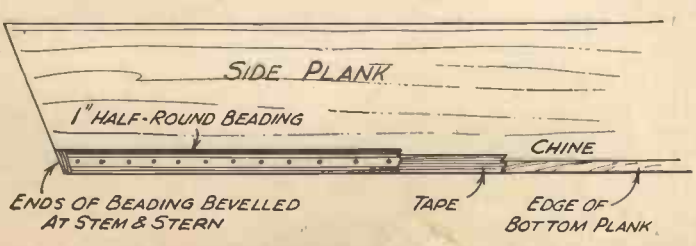

Fig. 14.—Location of the beading.

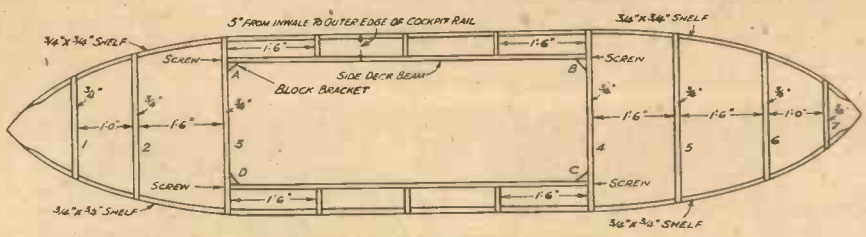

Fig. 16.—Fitting the deck beams.

Dealing now with the stem end, drill a 13/64-in. hole in it, so that a screw passed through it would enter the stem post, then proceed to screw it down with an 1½ in. No. 8 screw, this will bring the end into position, but the edges must be fastened to the chines, and this is done by carefully drilling a series of $\frac{5}{32}$-in. holes, spaced 1½ in. apart, round the edge of the plank over the centre of the chine, and screwing down with 1 in. No. 6 screws, make a small pilot hole in the chine with a fine bradawl, and drive the screws well in. Fig. 13 shows a plan view of the plank fitting at this point, and how the screws are driven slightly at an angle into the chine.

The stern end is dealt with in the same way, and the side planks are fitted in much the same manner, but of course in this case screws are to be fitted right round the chine edges, spaced 1½ in. When all planks are fitted carefully, plane off the surplus wood till the sides and bottom are flush. The stem and stern must now be planed down until the ends of the side planks no longer show corners, but are shaped to a gentle round off.

Fitting External Chines and Bottom Seam Battens

The two seams must be fitted with seam battens to cover them in the same way as the side seams, and are dealt with in the same manner, not forgetting to lute the seams first.

When they are fitted the canoe may be turned over, and the screws put into the internal battens so that the seams are sandwiched in between two battens.

With regard to the chines these are further protected by putting a half round batten along it, 1 in. wide, this is fitted right round the canoe from stem to stern so that the lower edge is flush with the bottom edge of the bottom plank, and covers the seam, first however, a piece of tape, ¾ in. wide, well soaked in paint should be placed round the joint, the beading may then be nailed on with small brass nails. Fig. 14 shows the procedure and location of the beading.

Fitting the Bottom Ribs

These are made from ¾ in. × ¾ in. deal, and are used to remove any tendency of the bottom to whip. Fig. 15 shows how they are cut, and fitted while the dotted lines in Fig. 7, *A* to *G* show their positions. Cut a length of the material slightly longer than the bottom of the canoe is wide at the point where it is to be fitted, and mark off the centre, now measuring each side of this point, mark off the slots as shown in Fig. 15, these will correspond with the bottoms of the frames, and must be $\frac{1}{8}$ in. deep. The ends must be cut at the same angle as the chines, and is best done by experiment, taking off a little at a time until the rib fits snugly in position.

These ribs are in line with the side ones, except between the frames where as only one is required, they are fitted centrally, fixing is by 1½ in. No. 6 screw passed through at each seam batten, but slightly off centre, so that it goes through the plank and not the seam, three 1 in. No. 6 screws are used between battens, as shown in Fig. 15, marked 1 to 9, the ribs are bedded on luting mixture.

As the next job is fitting the decks it will be very awkward to paint the interior so this should be done now. Give two coats of undercoating and one finishing coat of hard gloss paint. Grey is most serviceable for the interior and looks well.

Fitting the Decks

The canoe is decked forward from frame No. 1 to the stem and aft from frame No. 3 to the stern, the framework for these and

Fig. 17.—Fitting the deck beam.

the side decks is made from ¾ in. × ¾ in. deal, and the construction is simple. Take a length of this timber, about a foot less in length than the side of the hull, and screw this by screws placed every 6 in. right round inside the inwale from stem to stern, so that its top edge is ¾ in. below the top of the inwale, this is shown in Fig. 17. As the sides flare out at an angle, the top side of the shelf will not be horizontal, so a plane must be run round it to square it up in order that the beams which will bear on it get a good landing.

The deck beams are simply pieces of the

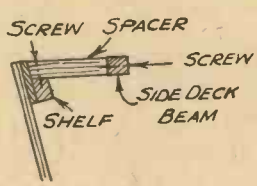

Fig. 18.—Method of fitting spacers to the side deck.

same material cut to fit where required, and the ends bevelled off at an angle equal to the inwales, they are secured with a 1½ in. No. 6 screw at each end, Fig. 16 should make the method of fitting quite clear.

The first beam to fit is the one over frame No. 1, next fit beam No. 2, 1 ft. 6 ins. in front of it, and then beam No. 1, 1 ft. in front of No. 2. No. 4 beam is directly over frame No. 3, then 5 and 6, 1 ft. 6 in. apart, and No. 7, 1 ft. aft of No. 6.

The side deck beams run parallel to the sides of the hull, and are secured to deck beams 3 and 4 with a flush joint further strengthened by small block brackets screwed on, this deck beam is 5 in. distant from the inwale, measuring from the outer edge of the beam to the inwale. Three equally spaced spacing pieces are fitted and secured, as shown in Fig. 18, which represents a section of the beam, 1½ in. No. 6 screws are used for fixing. The framework should be painted as soon as completed. The decks are covered with ¼ in. plyboard, which for the bow section extends to six inches past the last beam (No. 3), this last six inches is cut out in the form of a vee as shown on the deck plan, the stern section finishes square and flush with bearer No. 4.

The decks are fitted with brass brads, and the edges of the canoe over which they fit should be luted first. The side decks are covered in a similar manner, but if a joint has to be made it should be done over the centre spacing piece. Joints should be filled with putty or plastic wood, and when dry rubbed down. On the vee fore deck and across the back a moulding 2 in. deep and ¼ in. wide looks well fitted, of course on edge. Along the cockpit edges of the side decks a piece of 1½ in. × ¾ in. oak should be screwed on edge and a number of wide saw cuts about ⅛ in. wide and 1 in. deep, made in it at intervals of 6 in., making sure that the cuts on each side are opposite each other.

A piece of thick leather strap 1 in. wide and about 4 in. longer than the width of the boat from slot to slot, and having its ends turned over ½ in. and sewn, can be slipped into any of these slots to form an adjustable back rest. Floor boards are intended to lie on top of the frames, and are best made up of two 12 in. × ¼ in. planks, each 7 ft. long, laid side by side.

Painting

Two coats of undercoat and one coat of super gloss finishing paint should be given.

Paddles may be home made by letting blades of hardwood into slotted handles, the actual proportions being a matter of choice.

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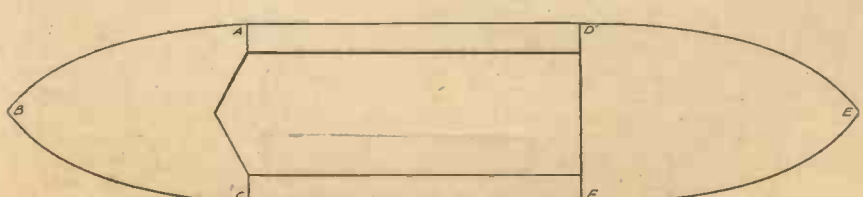


Fig. 19.—Details of the decks.

Some Notable Miniature Railways

By E. BEAL

The Second Article of a New Series.

BY describing his own layout in this series of "Notable Miniature Railways," the writer feels that a word of explanation and apology is necessary. In a word, the precedence is due purely to a matter of convenience, the requisite material being at the moment on hand. Indeed, it may be stated that the order in which these articles are published will have no manner of relationship to the importance of the systems described. Some of the best layouts will probably appear towards the end.

To many readers of PRACTICAL MECHANICS the West Midland Lines will already be more or less familiar, for it has frequently enjoyed publicity in these pages. Beginning with the present year, however (the old main division was dismantled during the Christmas holidays), the entire division has been reconstructed on lines which completely contrast with the former scheme. The actual space at the disposal of the builder consists of two medium sized rooms, one 11 ft. 6 in. × 13 ft. 6 in., the other 9 ft. × 13 ft. 6 in., together with a landing between the two which is 9 ft. wide. There are thus two divisions, and the larger one is now reconstructed except for certain buildings; traffic has been in operation for some months. The second division is still in its earlier form, but is about to undergo the same fate during the summer vacation.

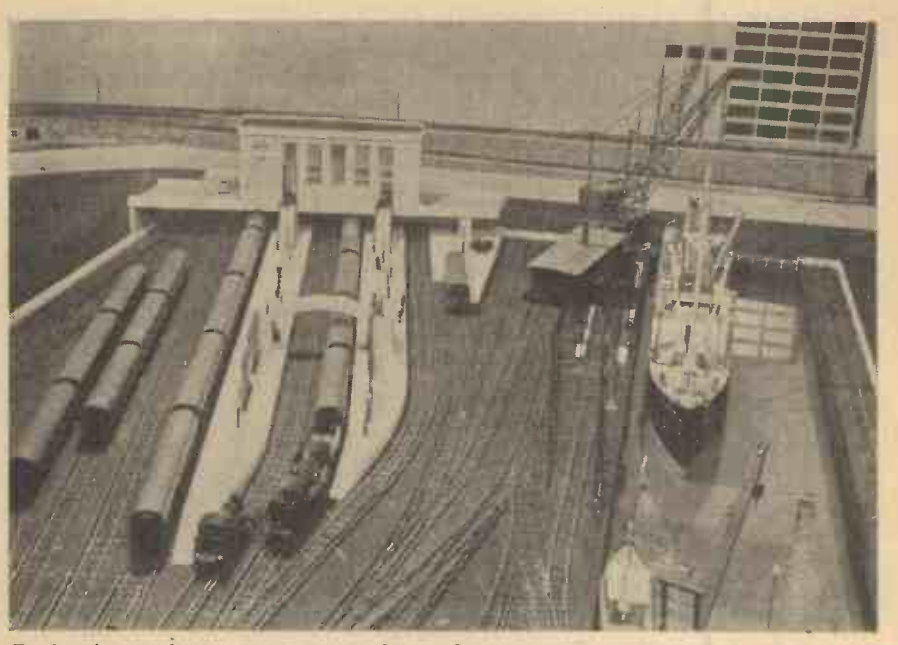


Fig. 1.—A view of the train terminus on the new division of the West Midland lines. The main line is in the background.

Double-track Layout

The former layout, was single-track throughout. The new layout is entirely double-track, and the second division will be the same. In re-building, several leading determinants have been strictly kept in mind. First, there has been an aim at perfection of track; secondly, an attempt at something new and much more perfect in the matter of the baseboard; thirdly, curves have been kept as far as possible to the maximum standard radius of 3 ft.; fourthly, the current supply system is that of the constant potential, wherein two sets of batteries are employed and the (normally) positive lead is common to the running rails, the negatives being fed to the conductors. On the main division there are three sections controlled by separate Reidmere controllers, one for the up line, one for the down and one for the various yards, which include the main depot yard, the industrial tracks on the west side and the hump yard on the south, the latter being also divided into three separate sections with dead-alive switches. One of these controls the reception tracks, another the business section of the hump, the third the departure tracks.

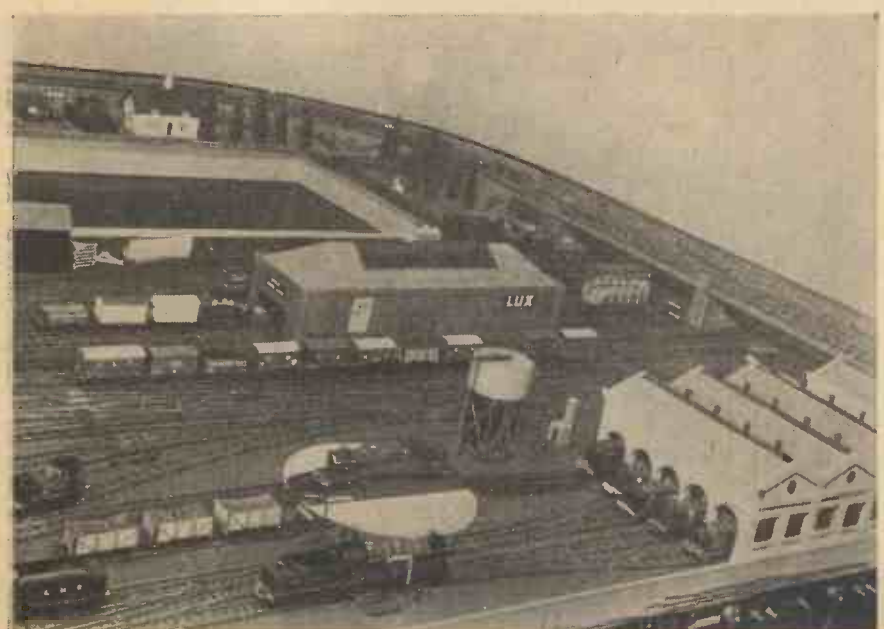


Fig. 2.—A somewhat intricate bottle neck, the entrance to the main terminus in the new division. The locomotive shed is in the foreground.

The Main Terminus

This was planned in consultation with Mr. Ian R. Frazer, B.Sc., and is laid down strictly in accordance with actual procedure, every movement of trains being adequately provided for in a sound and orthodox manner. The arrival tracks of the hump yard, as the plan Fig. 3 will show, are very extensive. They are entered on the up line on the north side of the layout by trains backing in; they then form a loop on which engines may be changed or reversed at will, and the pusher engine takes the trains over the three-arch bridge to the east and on to the hump. The departure tracks are similar, entering the main line by means of a crossover by the doorway. It is thus possible to handle approaching and departing traffic with the utmost convenience. One of the original gadgets is an adjustable gradient scheme, whereby the slope of the gravity tracks can be altered at will within a play of a half-inch by simply turning three screws. The main purpose of this scheme, once secured, is, of course, unlikely to be required again; but it was found a great convenience in providing precisely for the average velocity permitted by the running gear of the wagons. As now adjusted, these vehicles run exactly to the middle of the marshalling tracks without the need of any push, and without the introduction of any unslightly raised hump track. The points have been provided with correct levers, the rodding following a new system of the writer's which has for its main principle the use of very fine copper tubing through

which thin steel wire in integral lengths is threaded. There is thus no possibility of loss of play, no need of angle cranks, no necessity for any visible parts whatever with the exception of the levers and point-rods.

A Baseboard Innovation

Perhaps the main innovation on the new system is that of the baseboard itself. The need was felt for getting away from tongued and grooved boards, which warp and twist all ways, and from plywood, which is noisy, hard and (if sufficiently thick) costly. Finally, it was decided to use a pulpwood material known as Treetex. This has proved in every way faultless. It requires a slight extra amount of care in fixing, and must be securely battened underneath if any considerable weight is to be put upon it. But this is an easy matter. The advantages are that it is almost without seams—the whole layout consists of five pieces only. It will not shrink, twist or warp under any conditions. It is cheaper than wood itself, and is delightfully soft to work on, while of sufficient texture to retain any sprigs or screws fixed into it. But the best of its features is its surface. This is mottled or stippled in such a way as to give the very best appearance when painted. Whether a black-coloured asphalt yard, green fields, grey roads, or gravel-coloured ballast, the finish is perfect; and there is thus no need of any other simulation of any of these features. The method of treating the terminal yard, for example, was most simple. The Treetex was laid, the tracks were fixed in place, the rails (both running and conductors, and the conductor supports, all dipped in black paint. Then the whole was painted over with flat-drying black oils and the tops of the rails cleaned off.

The Layout Scheme

The scheme of the layout of the first division is that of a quadruple main line providing a continuous run and also approach and departure offshoots. The through station—the buildings of which are not yet erected but the platforms of which may be seen—is so arranged that when on the continuous run all trains take the fast inner tracks, and thus avoid the inconsistency of touching at the same platforms in repetition. The various roads of the main line are graded as required, the steepest incline being about 1 in 60. Five-foot trains of passenger coaches are the rule, and these, as well as heavy goods trains, take all inclines without trouble. The lift bridge, which was built by Mr. Frazer, is now located near the doorway, and forms the only impediment to the operating space throughout the room.

The proposed plan of the second division is shown in Fig. 4. It must be borne in mind that between the two layouts there is a straight double-track run of 9 ft. This will cross a lattice girder viaduct the whole of the distance. The main line scheme of this division will be even more elaborate than the one already described. There will be three levels, giving a variant from the high level of 6 in. and 3 in. There will be provision for a continuous run, so that time-table requirements may be adequately met, and this is secured by means of the cross-overs on the east side. The stiffest gradient will be 1 in 44, varying to 1 in 50. As a means of securing maximum length for the stations, these were arranged diagonally with an operating space between them, and again this space is broken by one impediment only—an opening bridge. An attempt has also been made to secure actual working conditions in both the depots on the second division. Coaching, locomotive and goods wagon facilities are fully provided for. The main station is located on a "wye," which has an avoiding line, so that trains may, if necessary, run right through from the extremity of the first division to that of the second.

Trackwork

Some notion of the fascinating complexity of the trackwork on the main depot of the completed division may be gathered from the pictures. In order to cross trains from the locomotive sheds to the goods yard, all three controllers are required to be set in unison. The introduction of double tracking on the main line has added unimaginable attractiveness to the operation of the layout; it is possible for trains to have a length of run on the continuous loops sufficiently prolonged to allow time for the setting of the yard tracks, which is a quite intricate task. There is a well-proportioned dock on one side of this depot, and the locomotive department is on the opposite side. Some notion of the locomotive stud and the rolling stock may be gathered from the photos.

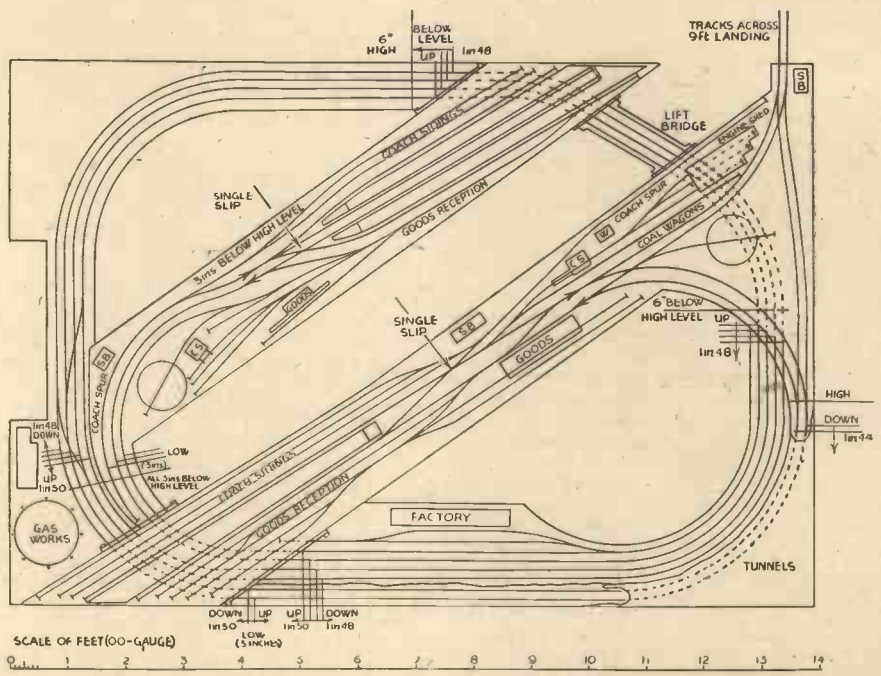


Fig. 3—A. layout plan of the completed section of the rebuilt West Midland Railway.

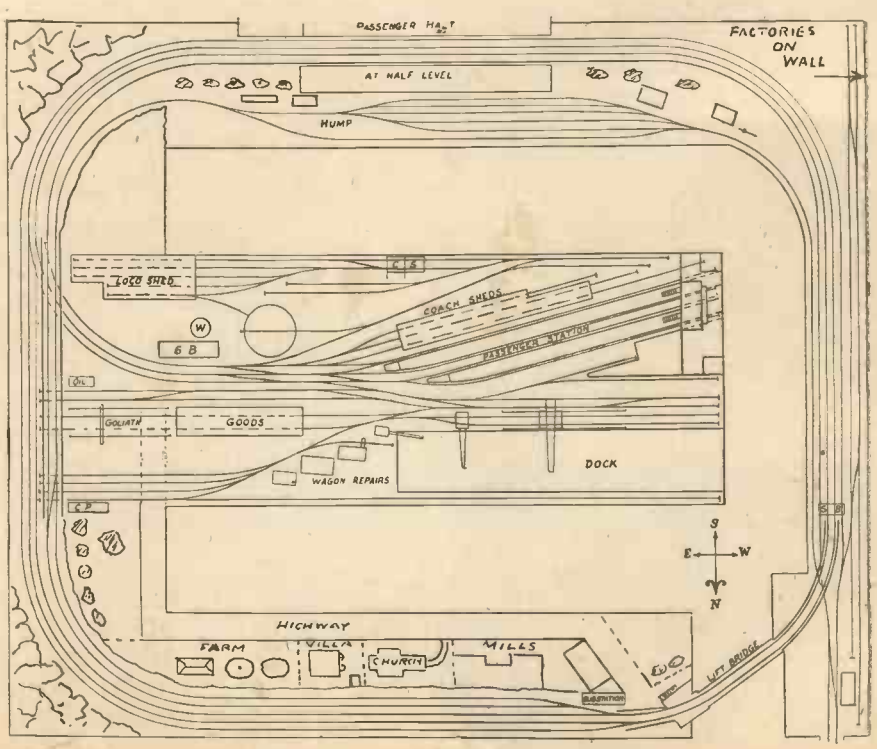


Fig. 4.—Proposed layout of the second division.

Is Thought Transference Possible?

By H. T. Kirby

The Study of Mental Telepathy Forms a Fascinating Field of Enquiry. Below We Describe Some Simple Experiments that Have Been Carried Out by Well-known Scientists

THE possibility of communication outside the ordinary channels between mind and mind, or by telepathy, as it is popularly called, is a subject which first attracted serious scientific attention about sixty years ago, when Professor, afterwards Sir William, Barrett brought to the notice of the British Association some remarkable experimental facts. It cannot be said that to-day our knowledge in this direction is much greater than it was at that time. And yet in these days, when we are turning our attention to the nature of the mind and the study of mental processes, can we afford to overlook so important and so fascinating a field of enquiry?

The intelligent man-in-the-street, although he might occasionally make use of the word telepathy in conversation, has strong doubts as to whether there exists any reliable evidence in favour of this type of communication. He has probably read that certain clever stage turns purporting to be based on "thought reading" are in reality dependent for their working on an elaborate but unperceived code of signals. He will be aware of instances where the same thought occurring simultaneously to two persons when together has been hailed as evidence of telepathy. He realises, however, that this sort of thing is due probably to the same cause operating in a similar manner to produce a like effect in persons of similar outlook and interests.

Let us at this stage consider the nature of the evidence which can be produced in support of the telepathic hypothesis. The term "thought reading," commonly employed in this connection, is somewhat misleading, for it must be understood at the outset that there is no evidence in favour of the theory that one person's mind can be continuously "read" by another. On the other hand, there exists in the literature of the subject very strong evidence that isolated ideas can be communicated through the agency of telepathy from mind to mind.

A Pack of Cards

The following is typical of the experimental procedure. The person who is the "thought reader" is referred to as the percipient, the one endeavouring to transmit the thought is the agent. A pack of playing cards provide suitable material. A card is turned by the agent who concentrates his thought thereon. The percipient, making his mind passive, tries to name the selected card. No word is spoken, and the percipient is, of course, placed so that he has no opportunity of seeing the cards. In the recorded experiments success is not always attained. It is a simple procedure, however, to estimate mathematically the value of these partial successes. The chances against naming correctly a selected card are 51 to 1. For two successive cards the odds against mere guesswork are $51 \times 51 = 2{,}601$ to 1. The classical experiments undertaken by Sir William Barrett include a typical case where 9 playing cards were correctly named out of a total of 14. The chances operating against successful guesswork here considerably exceed 1,000,000 to 1. A study of the results of these experiments provides no satisfactory explanation as to the mechanism by which the process is effected. It certainly appears that the method is "visual." Answers are often partly correct, and consistent inaccuracies are exhibited.

Five Symbols

In recent years an investigation has been undertaken at Duke University, U.S.A., with a view to the elucidation of this fascinating problem. In order to provide a ready basis of evaluation of results, a special pack of 25 cards was devised containing five similar sets of 5 cards each bearing a distinctive symbol. A rectangle, a circle, a cross, a star, and a pair of wavy lines were selected as being simple devices not likely to give rise to confusion.

It will be seen that with this pack, each card being repeated five times, pure chance will give one correct result in five. The system adopted was to make a large number of tests in the manner described. In say, a thousand tests, calling at random would give on the average 200 correct answers. This can easily be tested in practice, and it will be found that within narrow limits this proportion is maintained if a sufficiently large number of trials are made.

But if, in a given case, an average of, say, 300 correct answers per thousand was consistently obtained, it would be clear that we were witnessing the operation of some factor other than chance. Many thousands of tests, under stringent and varied conditions, were carried out, at first with the idea of discovering suitable subjects. Out of those tested, mainly students of Duke University, eight were found to possess the faculty to a considerable degree. The research work then proceeded with the selected subjects. No one who studies the results of the trials, which number more than 100,000 and cover a period of five years, can retain any doubt at all as to the reality of thought transference.

As to the explanation, this appears to be as far off as ever. The most obvious theory that occurs, especially in these days of familiarity with wireless transmission, is that telepathy may be dependent on some similar type of radiation. This hypothesis, however, is not supported by the experimental facts. It has been found that with some of the subjects whose powers were tested, that a high degree of accuracy far above the chance level, was obtained over great distances, in some cases hundreds of miles. Now, all radiation of whatever type, light, wireless or X-ray for example, has one characteristic in common, that its intensity varies inversely as the square of the distance. A simple example will make this clear. The received signal strength at a given point from a wireless transmitting station is reduced to a quarter if the distance between transmitter and receiver is doubled; at 1,000 times the distance the signal intensity is one millionth.

Transmission over a Distance

As it happens, with wireless transmission we are in the happy position of possessing amplifiers, which to a large extent, overcome the drawback of distance. In the case of thought transmission, however, so far no mechanical detector or amplifier has been devised, and it is quite clear that if communication is possible over, say 100 miles, then the intensity in the same room as the sending agent would be so great as to render transmission over the distance of a few feet a matter of certainty were the process dependent on the dispersion of some form of radiant energy. In actual fact, for a given subject, the average of successes is very largely uninfluenced by distance, and it would seem that we must look elsewhere for a solution.

The investigation undertaken by this American University has demonstrated that the person who is sensitive in this way is by no means a great rarity. If within the walls of a single institution a number of highly sensitive subjects can be discovered, it is a reasonable assumption that there are a good many people who possess this faculty and are totally unaware of it.

On arriving at this conclusion I resolved to carry out a series of tests, and I was fortunate enough almost at the outset to discover a suitable subject in my wife. A casual trial, using the ordinary pack of playing cards revealed the fact that she was able occasionally to name correctly an unseen card. She was often wrong, but an assessment of the value of the results mathematically indicated chances of many thousands to one against the probabilities of mere accident. Study of the results proved interesting, the errors no less than

the successes. An ace was several times given as a three. A glance at the card will show the probable cause of this confusion. The card bears three " pips," two in opposite corners, and one in the middle. An imperfect visual method of transmission might well render it as a three. Again, a card " A " would be named wrongly, but on my turning up another card " B," then " A " would be given for this card. No indication had, of course, been given to the percipient as to the name of the first card. Some sort of time lag appeared to operate.

The percipient was totally unable to say how her information was obtained. " It just comes to me," was her only explanation. It does not seem that lengthy and deep concentration on the part of the agent were necessarily required, for sometimes when I had turned over a card casually and selected another on which to concentrate, she would give the former card of which I had had but a momentary glimpse.

Further Experiments

Further experiment led to the discovery of a similar ability on the part of another member of my family. In this case the percipient was able to describe the building up of the ideas in his mind. Sitting in a relaxed position, eyes closed, he would see the shape of the pips, *i.e.* hearts, diamonds, etc., suggested by shadowy lines, fleeting at first, then persisting. He found difficulty in giving anything more than the suit, but succeeded very well with letters of the alphabet, being correct in approximately 50 per cent. of the trials. With numbers of two digits also he showed fair accuracy. As before, mistakes were of interest as providing some slight indication of the mechanics of the process. For example, the letter " X " was described as a " V " with " reflection," the number 37 was given as 87, again indicative of the operation of a visual factor.

These results show the necessity for the accumulation of further experimental data.

What are the requisite conditions that make for successful thought transference ? This is the elusive question to which we require an answer.

The process appears to depend upon extremely delicate mental adjustment. A calm, and at the same time, an alert mental state on the part of the percipient is required. Emotion of any description is detrimental. Any disturbance of familiar conditions by the introduction of changes in procedure has the effect of temporarily reducing the proportion of successful results.

It will be seen that experiments in this interesting and somewhat tantalising field of study call for the exercise of patience. The best method of approach is undoubtedly by a large number of trials under conditions where chance alone can give an easily calculated percentage of correct results. A good introduction is provided by naming the suit only in the pack of playing cards. Go through the whole pack at one sitting. Bear in mind that mere chance will give an average of one correct result in four.

The pack of playing cards has been suggested because it provides suitable ready-made material, but other ideas will occur if any indications are found that the subject possesses the faculty sought. For example, letters of the alphabet, simple numbers, distinctive colours, geometrical figures, and elementary drawings are all worthy of attention. In the latter case it is preferable for the percipient himself to draw the figure as he " sees " it.

A NOVEL TOOL SHARPENER

BY "HANDYMAN"

A Simple Device for Sharpening Plane Irons and Chisels

KEEN and accurately sharpened tools greatly facilitate the work of the craftsman, being conducive to greater ease and precision.

The secret of the maintenance of good cutting edges is to be found in frequent recourse to the oilstone, but it is not an easy matter to produce a flawless cutting edge entirely unaided by hand. However steady the hand of the workman, slight " wobble " invariably takes place and the perfection of the bevel suffers.

With the aid of a simple mechanical device designed to hold the tool at the correct angle relative to the oilstone surface, accurate and sharp cutting edges may be readily produced.

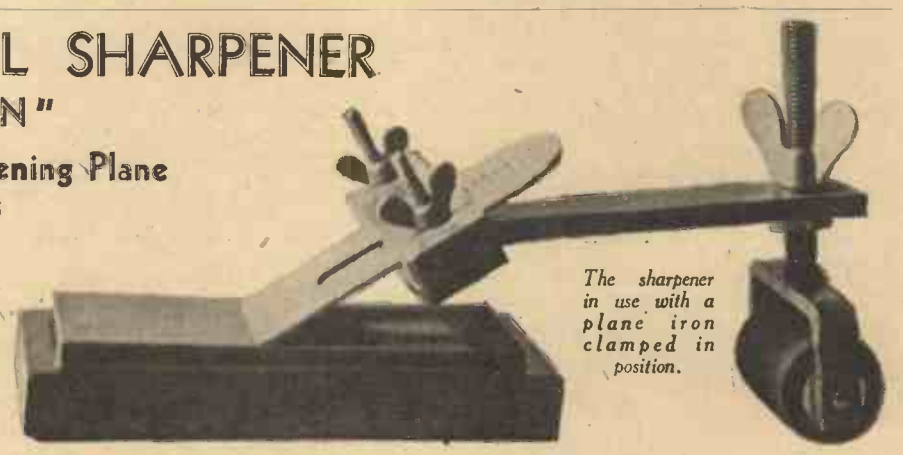
The plane and chisel sharpener illustrated is made from cheap and easily obtainable materials. The total cost of the instrument described was less than a shilling.

Construction

It is easily constructed even by the man with little experience in working with metal. The actual work involved may be summarised as being confined to drilling seven holes, making three bends in metal strip, and soldering at three points. The simple tool clamping device will hold all sizes varying from narrow chisels to a 2½-in. plane iron. The tool is quickly secured and released. The cutting angle is fully and readily adjustable. Re-grinding a blunt tool, as distinct from sharpening, is effected without fatigue by using a coarse stone. Where a rotary grinder is not available, an otherwise too laborious task is thus rendered possible.

The main " body " is a piece of mild steel 6 in. × 1 in. × ¼ in., a slight bend at about 30 degrees being made at 1½ in. from one end. Bending is assisted by heating to redness and hammering to the required shape, using a brick as an anvil.

The tool holder is made of two pieces of the same material 3½ in × 1 in. × ¼ in., drilled with a ¼-in. hole at ½ in. from each end, to take two threaded bolts, 1½ in. long, with round heads and fitted with wing nuts. This leaves a space of 2½ in. for accommodation of a wide tool blade. Mild steel strip is easily cut with a hack-saw. The tool holder is joined to the main stock by soldering one of the 3½ in. pieces " T-wise " to the end nearest the bend.



The sharpener in use with a plane iron clamped in position.

Soldering

The soldering is accomplished by " tinning " the cleaned surfaces, placing in contact and re-heating over a gas flame until the solder melts. When cool the two pieces will be firmly fused together. The best flux to use for soldering iron and steel is " killed " spirits of salts, or zinc chloride (poison), and it is essential that the surfaces to be united shall be filed bright.

List of Parts and Materials

Mild steel strip, 6 in. × 1 in. × ¼ in.
Mild steel strip 3½ in. × 1 in. × ¼ in. (two pieces).
Mild steel strip 6 in. × ½ in. × ⅛ in. (for roller bearing).
Two $\frac{3}{16}$-in. threaded bolts, 1½ in. long, round heads, with wing nuts.
One ⅜-in. threaded bolt, 3 in. long, countersunk head, with ordinary nut and wing nut.
Wooden roller.
Axle, 2½ in. × ¼ in. diameter brass rod; two washers to fit.

Adjustment of the grinding angle is effected with the aid of a ⅜-in. threaded bolt with countersunk head 3 in. long, fitted with ordinary nut and wing nut.

A hole for clearance is drilled in the main-stock end—if a tap is available a screw-thread may be cut to fit the bolt. In the absence of this tool, solder the nut over the hole by tinning and reheating as before. The bolt carrying the roller is adjusted by rotating, and clamped by a wing nut.

The roller may be made from a piece of wood 1½ in. in diameter, drilled centrally. In the model illustrated a cotton reel of similar size was utilised, the ridges being cut off and sand-papered smooth. The bearing for the roller is made of ½-in. × ⅛-in. mild steel strip bent to shape, drilled for ¼-in. brass rod for axle. This latter is fixed by soldering at the ends, or by " spreading " the metal by hammering, washers being fitted first to allow easy rotation of the roller. Alternatively, a small " G " clamp of ½ in. × ⅛ in. metal can be readily adapted for carrying the roller, the screw threaded rod being cut short and utilised as the axle.

The flat head of the ⅜-in. bolt is soldered to the centre of the metal strip forming the roller bearing. If this joint is made as described above, it will resist any strain likely to be imposed upon it.

A suitable finish is provided by two coats of green cellulose paint for the metal parts (except bolts and wing nuts, which should be left bright). The wooden roller should be stained black.

RUST-PROOFING IRON AND STEEL

SomePractical Methods for the Amateur

Steam treatment for screws! Rust-proofing a screw-head by holding it in a steam jet after heating it to redness.

MUCH of the metalwork employed by amateur mechanics and constructors is composed of iron or steel and, in many instances, it becomes essential that such metal parts should be preserved entirely free from rust and corrosion.

The commonest method of preserving ironwork from rusting is, of course, to paint or enamel it or to brush over it some coating of varnish which will serve to keep the air out of contact with it. Such methods have their advantages, but they cannot be applied in every instance. One of the drawbacks of varnishing or painting a metal surface, for instance, is that the appearance of the surface is changed, minute markings on the metal surface which it may be desirable to preserve are filled up and a film or skin of foreign matter is laid on the surface of the metal. Paints, varnishes, and enamels all tend to crack away from the metal surface in time and thus to expose the bare metal underneath to rusting influences.

Altering Its Composition

Steel may, of course, be rust-proofed by altering its composition. By incorporating, for example, certain proportions of nickel and chromium with ordinary steel we obtain the well-known "stainless steel" which is in a high degree not only rustless but also untarnishable. Such procedures, naturally, do not come strictly within the category of rust-proofing methods for iron and steel and they are merely referred to by way of incidental interest.

The best way of rusting-proofing iron or steel is to rust it! The statement may appear to be paradoxical at first, but, nevertheless, it is a perfectly correct one. Iron (and steel, also, for it is merely a special form of steel containing carbon and traces of other elements), when it is exposed to moist air containing traces of carbonic acid (carbon dioxide), forms on its surface the well-known and characteristic "rust" which consists mainly of iron oxide mixed with iron carbonate. There are, however, more iron oxides than one. There is, for instance, a black iron oxide containing a minimum proportion of oxygen. If, by chemical means, the surface of the iron and steel is oxidised to this black oxide an exceedingly fine and hard coating of the oxide is formed which resists all further oxidation. Hence iron in this chemically-oxidised condition becomes highly rustproof and changes very little in appearance.

Oxidising Iron Articles

We may oxidise iron articles by heating them to redness and then holding them in a jet of steam escaping from a kettle of boiling water. This process is, indeed, the basis of the Bower-Barff process of rust-proofing iron and steel articles. By means of it, the iron becomes coated with an extremely fine layer of black iron oxide which resists all further oxidation. On the small scale, this method of rust-proofing is only suitable for treating nails, screws and other small articles which can be conveniently held in a small steam jet after being heated to redness.

Another method of rust-proofing steel or iron articles consists in immersing them for a few minutes in a bath of molten saltpetre. Here again, however, the method is only applicable on the small scale to diminutive articles. It has been employed frequently for the blueing of clock hands, a quick dip of the articles into the molten saltpetre being sufficient to obtain a blue-black colouration on their surfaces.

Coslettising at home. A simple method of applying this well-known rust-proofing process on a small scale.

A very serviceable oxide-coating on iron and steel articles may be obtained by rubbing the articles over with a paste made of thick oil and fine sawdust and in heating them on a shovel or an iron tray over a slow fire until the oil paste burns completely away. The articles are then scrubbed under hot water and dried quickly. A dull greyish-black

finish—the characteristic "burnt-oil finish"—is thus obtained. It is suitable for all indoor metalwork, but it is doubtful whether iron and steel articles so treated would stand up to rusting influences in permanently exposed situations.

The Use of Oil

All the above "oxide coatings" on iron and steel are much improved in rust-resisting efficiency as well as in appearance by having oil rubbed over them. The oil is absorbed and tenaciously retained by the extremely fine particles of black oxide formed on the iron or steel objects much in the same way as dye is absorbed and retained by cloth. This extremely fine oil film, together with the fine particles of black oxide present upon the metal surface, confer very high rust-resisting properties to the latter.

By far the most popular rust-proofing method for iron and steel articles is the coslettising process, a method which was originally devised in 1907 by Thomas Watts Coslett, an English chemist, but developed in America. Coslettising is very simple to carry out. The iron or steel articles to be treated should be well-cleaned, preferably by having been previously immersed in a bath of weak sulphuric or hydrochloric acid for a few minutes to dissolve away their surface impurities. After a brief rinse in clean water, the cleaned articles are immersed in the hot coslettising bath which consists of a moderately dilute solution of phosphate of iron (*ferric phosphate*) containing a small amount of phosphoric acid.

To prepare this solution we may add about a dessertspoonful of phosphate of iron to every quart of water used. The phosphate of iron will not dissolve in the water alone, but on adding a few drops of phosphoric acid to the water it will dissolve readily.

Coslettising

The method of coslettising is clearly brought out in the photograph accompanying this article. The coslettising bath is heated by being rested over a saucepan containing boiling water. The articles to be coslettised should be immersed in the bath for about half an hour, being frequently turned over in order to ensure that the chemical action takes place equally all over their surfaces. The steel and iron articles turn grey almost immediately after they have been immersed in the bath. Bubbles of hydrogen gas are evolved from their surfaces, but the metalwork is not dissolved away.

After half an hour's immersion in the hot (nearly boiling) coslettising bath, the articles should be withdrawn, well washed

Obtaining a "burnt-oil" finish. A straightforward method of rust-proofing steel and iron articles by covering them with a paste of sawdust and oil and by heating them on a shovel over a slow fire.

in water and dried. At this stage they will have a grey colour, but on being rubbed over with oil they will acquire a soft dull-black finish and will be absolutely rust-proof. The fine "film" formed on the metal surface is composed of a mixture of iron phosphate and iron oxide. This protecting "skin" is so exceedingly thin that it follows the contours of every microscopic irregularity on the metal surface. Yet it is hard, tough, and extremely wear-resistant.

Coslettised iron and steel may, of course, be painted, varnished or enamelled, such surface films adhering extremely well to the treated metal surface.

The commercial rust-proofing process known as "Parkerising" is merely another form of coslettising and was originally developed in America by the Parker Company, of Detroit. It consists essentially in the employment of patented mixture of iron and manganese phosphates in the rust-proofing solution. Another similar modification is the process known as "Bonderising," which is commercially employed to form a base-coating on iron and steel for finishing with paints and lacquers.

For amateur use, however, the process of coslettising is efficient, inexpensive, and easy to apply. The phosphate bath need never be discarded. All it requires are occasional additions of phosphate of iron in order to keep it up to strength.

"Granodising" Process

By immersing iron and steel in a hot solution of zinc phosphate acidified with phosphoric acid, rust-proof coatings may be formed. This particular bath lends itself to electrolytical employment, the "granodising" process of rust-proofing consisting simply in making the iron or steel article under treatment the cathode or negative electrode of the bath, the positive electrode being a plate or rod of carbon. Iron and steel articles which have been "granodised" in this manner acquire a dense black coating which is highly resistant to all atmospheric influences. An advantage of the granodising process is that it can be applied to articles of zinc, cadmium and other metals, in addition to those of iron and steel. The granodising electrolytical process can be operated on a small scale by means of a six-volt accumulator, the distance between negative and positive electrodes in the bath being kept as small as possible. Granodising gives a thicker coating to the metal surface than coslettising and the thickness of the rust-resisting film formed on the metal may to a large extent be governed by the current strength of the bath and the duration of the treatment.

THE EYES OF TELEVISION

How Photo-Electric Cells play an Important Part in the Transmission and Reception of Televised Scenes

THE remarkable success of the public television service in Britain in recent months has given a new popular interest to photo-electric cells, which are sensitive to visible light and play an important part in the transmission and reception of televised scenes.

Their development began with the work of Elster and Geitel, who by 1895 had discovered both the high sensitivity to visible light of potassium sensitised by a hydrogen discharge and the use of gas magnification to increase the output. From that date until 1929, photo-electric cells used for all engineering purposes were Elster-Geitel cells, having cathodes of sensitised potassium and a gas-filling of argon or other rare gas.

About 1929 the high sensitivity of the cæsium-oxygen-silver cathode was discovered and by 1932 had completely replaced the sensitised potassium cathode; but gas-filling was still used to increase the output, although it is less effective than in cells with potassium cathodes.

But meanwhile another development was proceeding. About 1920 the G.E.C. turned their attention to photo-electric photometry, that is to say, the use of photo-electric cells in place of the eye for measuring the light output of lamps. They realised at once that the gas-filled cell was unsuited for this purpose, because its output is never a simple function of the light incident on it. They therefore determined to develop the vacuum cell in which there is no gas-filling, and sensitivity is sacrificed to accuracy. All photo-electric photometry is now conducted with vacuum cells, and most of it—at least in this country—with cells of types developed by the G.E.C.

The advantages of vacuum cells over gas-filled cells in everything but sensitivity proved to be so great that ever since the new cathodes made the gain derived from gas-filling less important, the G.E.C. have looked forward to a time when gas-filled cells would be abandoned for all except special purposes and vacuum cells would become the standard cells for all normal uses. They have done everything they could to hasten the arrival of that time.

The prescience was justified when television became a fact. For here at last was an art of great industrial importance for which gas-filled cells were definitely useless in view of the high frequencies involved, and only vacuum cells could be used. They were in a position immediately to supply cells already developed and suited for the new art. Their experience enabled them also to produce immediately cells adapted for special television purposes, such as the large cells for spot light scanning.

The same technique enabled them rapidly to make use of the suggestion to use secondary emission, rather than gas-filling, to increase the sensitivity—a suggestion that had been made many years ago, but remained dormant until the discovery of the great efficiency of the cæsium-oxygen-silver cathode as a secondary emitter as well as a primary cathode. They quickly developed a suitable cell, using a single stage of secondary emission, and electron multipliers, using many stages, in the manner first suggested by Slepian and developed by Zworykin.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 699, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the sender. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

SILVERING BRASS

"I HAVE a recipe for silvering brass composed of 1 oz. mercury dissolved in 2 oz. nitric acid (commercial) and 20 oz. water added when fumes cease. This mixture silvers immediately, but does not last, as after 7 or 8 hours all traces of silver disappear.

"Would the addition of nitrate of silver improve the mixture? Can you recommend any improvement or alternative mixture? I intend manufacturing the mixture for sale, and would it be profitable as a spare time job? Are the fumes mentioned poisonous?" (A. J. U., Foula.)

THE "silvering" process which you describe is a very well-known one, but it is of no practical value, since, as you yourself point out, the layer of deposited mercury on the surface of the brass quickly disappears. The mercury film is lost mainly through the volatilisation of the metal, although a little of it sinks into the brass and is thus lost to view. The "silvering" can be rendered somewhat permanent by varnishing the bright surface of the metal.

The addition of silver nitrate to the mercury solution would not have any desirable effect. On the contrary, it would result in a greyish or blackish deposit being produced on the brass.

We do not advise you to attempt to make the mercury silvering solution commercially, for the reason that the results obtained from the use of the solution are impermanent and, therefore, disappointing. Bear in mind, also, that all soluble salts and compounds of mercury are highly poisonous and, as such, come under the new regulations for the sale and distribution of poisons.

The red fumes evolved when mercury dissolves in nitric acid are very definitely poisonous when breathed in any other than small quantities.

ANHYDRONE

"I HAVE recently seen in 'Practical Mechanics' an account of a new, or newly marketed chemical with a very great power of absorbing damp.

"Could you tell me about it?

"I believe it was quite a new thing—not simply a new form of some well-known substance." (E. H., Bucks.)

THE material to which you refer is anhydrous magnesium perchlorate, which is sometimes known by the trade name, *Anhydrone*. It is an extremely powerful absorbent of damp and moisture and is, therefore, an energetic drying agent. It is a rather costly material, its retail price being in the neighbourhood of 2*s.* 6*d.* per ounce. Supplies of magnesium perchlorate may be obtained from The British Drughouses, Ltd., Graham Street, City Road, London, N.1.

FLASHLIGHT POWDER

"CAN you tell me the ingredients and process used in making flash powder for photographic flashlight work? I believe there are two kinds, one very rapid burning and the other almost smokeless, but more slow burning. If this is so, could you give me particulars of both." (H. S., Bucks.)

THERE are several varieties of flashlight powders, the simplest of which is fine magnesium powder. This is blown into a flame and it gives a comparatively long illumination period. A mixture of 6 parts of magnesium powder, and 9 parts of potassium chlorate makes a rapid burning flashlight mixture. Another effective mixture consists of magnesium powder, 16 parts, potassium perchlorate 10 parts, potassium chlorate, 2 parts, and potassium nitrate (saltpetre) 12 parts.

The greatest care should be taken when compounding flashlight mixtures, and they should be made in small quantities only. It is essential that all the ingredients should be perfectly dry, otherwise the flashlight powder will ignite badly, and will splutter badly when burning.

A DISAPPEARING INK

"I AM anxious to obtain a formula for an ink which will, in the course of 24 to 48 hours, become invisible. This is to be used in obtaining a special effect in a mystery film which a group of amateurs (including myself) are producing.

"We have tried a number of different solutions including copper sulphate and powdered gall without success and we know that there is such a solution, as I have a faint recollection of using one some years ago, but cannot remember the ingredients now. The only thing of which I am certain is that the ink vanished within 24 hours after writing, and I seem to have a faint remembrance of zinc (oxide or chloride?) being one of the ingredients, but cannot say for certain." (G. R. C., Ayr.)

YOU require a disappearing ink, not an "invisible" one. About the most satisfactory ink of this nature is the following one:

Dissolve in 100 parts of water 1 part of lead nitrate (or acetate) and approximately ·1 part of uranium acetate. After complete solution has been effected, dissolve in the liquid ·1 part of bismuth citrate and then add drop by drop a moderately strong solution of sal ammoniac until the liquid becomes clear. Finally, add to this solution a few drops of a strong gum arabic solution.

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and

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PELMANISM eliminates from your mind those weaknesses and failings which handicap so many people in every sphere of life. Amongst these mental handicaps are:

—Indecision	—Shyness
—Forgetfulness	—Feeling of Inferiority
—Mind-Wandering	—Procrastination
—Morbid Thoughts	—Depression
—Self-Consciousness	—Lack of Confidence
—Timidity	—Weakness of Will

and many others could be mentioned. There is no need for these failings to haunt your life. There is no need for you to be a failure in a world full of opportunities. Pelmanism will rid your mind of these obsessions and failings and give you a new outlook on the "glorious possibilities of life."

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—Will-Power	**—Resourcefulness**
—Judgment	**—Courage**
—Concentration	**—Tactfulness**
—Moral Courage	**—Presence of Mind**
—Observation	**—Punctuality**
—Business Acumen	**—Personal Magnetism**
—Salesmanship	**—Decision**
—Self-Confidence	**—Forcefulness**

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And it develops your mind as a whole and gives you a balanced and well-poised brain.

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Pelmanism is a sure way to success if you will give it your loyal effort, your honest endeavour, and a regular and definite amount of time until you have completed the Course. A sustained effort over a period of but a few weeks will yield you dividends that will last you your whole life through, and give you a steadying encouragement in times of stress, indecision, or fatigue.

We shall be glad to send you a copy of "The Science of Success," 48 pages, post free. You can make just a bare application by letter or postcard. Your inquiry will be regarded as a confidential communication. You are sure to be interested in at least one of the people who, in "The Science of Success," speak highly of Pelmanism from practical experience.

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Finding wifey in tears 'midst a flood,
Thomas turned not a hair (he's no dud),
But remarked with a smile,
"You stop your leak, and I'll
With FLUXITE nip the pipe's in the bud!"

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Written characters in this ink are quite invisible until they are exposed to the fumes of sulphuric acid or washed over with a very dilute solution of this acid. Thereupon they turn brown, but fade away in the course of a few hours, the fading time depending upon the intensity of the sulphuric acid treatment.

Other disappearing inks can be made from various aniline dye solutions to which a little bleaching powder and a few drops of hydrochloric acid have been added. Such inks fade especially in the presence of sunlight. A solution of oxalic acid containing a little hydrochloric acid will often (although not always) bring about a rapid fading of characters written in ordinary blue-black ink when washed over the latter.

It should be noted that even "invisible" inks show faint traces on glazed paper. For complete fading or invisibility, the characters should be written on unglazed paper.

PLASTICS

"CAN you give me any information regarding the following plastics—'Catalin,' 'Formica,' 'Plaskon'? I am most interested in 'Catalin.'

"Can you also tell me, if and where it is possible to obtain any of these plastics in Britain?

"I would like to know how to make 'casein.' I believe it is a product of milk, but don't know how it is produced." (E. J. R., Edin.)

The plastic compositions which you mention are of American origin and you may have difficulty in obtaining them in this country. They are synthetic resin products obtained by the condensation of phenol with various compounds, such as casein, formic acid, etc. For further particulars as to whether they are retailed in this country, we advise you to write to Messrs. F. A. Hughes & Co., Ltd., 204–206 Great Portland Street, London, W.1, or to General Plastics, Inc., North Tonawanda, N.Y., U.S.A.

Casein is best obtained by the coagulation of milk with rennet. A quart of good clean milk should be maintained at blood-heat (about 98·6° F.) and one or two ccs. of rennet added. The milk should be stirred and it will begin to coagulate. After the coagulation process has been completed, the separated casein is filtered off and dried slowly in a warm oven.

Rennet is best obtained from dealers in dairy products and the like.

Casein can also be precipitated from milk by the addition of small amounts of acetic, lactic or sulphuric acids, but for all plastic-manufacturing processes, the "rennet casein" is found to be the best.

THE P.M. CANVAS CANOE

"I AM thinking of building the P.M. canvas canoe as described in the July issue.

"I understand the method of construction as explained in the text, but do not quite follow how you manage to get items 1 and 5 in the list of materials.

"I follow the other items and find that when they are put to their correct uses I have the 11 ft. keel of 1⅞ in. by ⅞ in. deal and the centre ribs and side ribs (16 ft. in all) of 2 in. by 1 in. all to be made from items 1 and 5.

"Items 1 and 5, as you no doubt know, are

12 ft. deal, 2 in. by 1 in.

9 ft. length 2 in. by ½ in. deal.

I thus do not follow how the keel and r could be made from this amount of material.

"I would be pleased if you could advise me on this point.

"Could you also tell me the approximate figure for the cost of the entire list of parts so that I can have a check on my dealer?" (J. B., Cheshire.)

WITH regard to the first question, the materials list should read two 9 ft. lengths 2 in. by 1 in. for item 5, therefore another 9 ft. length is required.

The cost of materials varies somewhat with locality, but should not exceed £2 5*s.*

Canvas suitable for the canoe is obtainable from G. J. Montague and Son, 144 Bayham Street, Camden Town, N.W.

Two grades are suitable. Balloon fabric at 1*s.* 1*d.* per yard; White duck (superior) at 2*s.* per yard.

The widths are in each case 40 in. and 8 yards will be required.

BUILDING A MOTOR-BOAT

"I AM constructing a motor-boat with a hull the same dimensions as your folding outboard motor-boat, as described in the 'Practical Mechanics' dated May, 1937. This boat will not be folding, and in it I want to instal a 350 c.c. o.h.v. A.J.S. motor-cycle engine. Will you give me details as to whether a direct drive, or a geared drive, by utilising the three speed gear box as fitted to the machine, will be best?

"I should obtain a gearing of about 5 to 1. Please give me type of propeller for above engine. May the line of propeller be at any reasonable angle to the keel of the boat?

"Have you any idea as to how one can fix the above engine, etc., as an in-board or out-board motor, and which would be most efficient?

"Could you kindly give me the addresses of firms supplying fittings and materials for use with the engine, etc., as described?" (F. S., Bath.)

WE regret that the scheme you suggest is not really practicable, for the following reasons:

(1) The engine is too large and heavy for the class of boat.

(2) As it is air cooled, a fan would have to be fitted and even this method is not really satisfactory for anything but very short runs.

(3) The propeller could not be at 90 degrees to the keel as there would not be enough shaft height to install the motor and in any case there would be insufficient immersion for the propeller.

The only way would be to fit an inclined shaft and put the engine well forward.

The most suitable propeller would be a 10-inch reversing one supplied by Messrs. Wortham Blake, Whetstone, London, N.20, who also supply all fittings.

We do not advise you to carry out the scheme, which we feel would end in disappointment. The total cost of fitting a fan to the engine, purchase of propeller and shaft, installation and sundry fittings would be in excess of the cost of a second-hand light weight out-board motor which would be far more satisfactory.

FOLDING SPEED BOAT

"WITH reference to your folding speed boat.

"I have tried several timber merchants for the plywood you specify, but I find I am unable to get sheets longer than 7 ft. Would you kindly tell me where I can obtain it in the necessary 10-ft. lengths?" (B. M., Sussex.)

THE plywood necessary can be obtained from Messrs. J. Williams and Son Ltd., Christchurch Road, Colliers Wood, London, S.W.19.

It has to be specially made up, as it is special marine quality built up with waterproof glue. It is, however, expensive.

Masonite is suggested as an alternative and is obtainable in any quantity from the same firm. They will quote you for either on receipt of your inquiry.

ACIDS

1. "HOW do acids—nitric, sulphuric, hydrochloric, etc., dilute and concentrated—react with non-metals? I know that nitric acid forms iodic acid with iodine and sulphuric acid with sulphur, but do not know if nitric reacts with other non-metals.

"2. Is water a poor conductor of electricity? If so, why is one more liable to an electric shock when touching electrical apparatus with wet fingers than with dry ones? If water is not a poor conductor, why must sulphuric acid be added to water before electrolysis can take place?

"3. Can you recommend a wireless and/or television book which gives full details, in a non-technical way, of how these inventions work?" (H. M., West Kensington, W.14.)

1. TO answer this question would entail the writing of quite a substantial volume. There are about twenty non-metallic elements and many of them react with the acids you mention in a variety of ways. We feel sure, therefore, that you will realise that your query could not possibly be answered here. Generally speaking, the non-metals are difficultly soluble in mineral acids, but for details of their interaction with these acids, we must refer you to any modern textbook of inorganic chemistry.

2. *Pure* water is a very bad electrical conductor, but when it contains a trace of dissolved salts, acids or other impurity, the liquid usually becomes an effective conductor of electricity. The moisture on the skin is highly charged with chemical salts. Hence it conducts electricity reasonably well—sufficiently well, in fact, to pass a death-dealing amount of electricity to the body.

3. *The Wireless Constructors' Encyclopædia*, 5*s*.; or by post, 5*s*. 6*d*. *The Television and Shortwave Handbook*, price 3*s*. 6*d*., by post 4*s*. Both books are obtainable from the Wireless Book Dept., Geo. Newnes Ltd., Tower House, Southampton Street, Strand, W.1.

CHEMICAL EXPERIMENTS

"1. COULD concentrated solution of chloride of lime be made with powdered chloride of lime, if so, what is the method of mixing?

"2. Is it possible to make saturated solution of acetate of lead, and if so, how? The above solutions are used for accumulator plates. No. 1 being used for turning red lead and sulphuric paste into lead peroxide on positive plates. No. 2 being used in conjunction with zinc to form crystals for the negative plate. The information I have at hand is rather meagre on this part of the experiment." (C. P., Stockwell, S.W.9.)

1. IT is not possible to make up a concentrated solution of chloride of lime (bleaching powder), since this material is not very soluble in water. The best you can do is to place some chloride of lime

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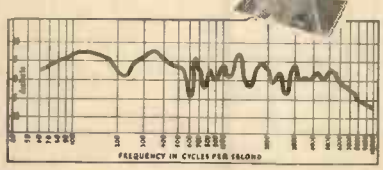

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For listeners who listen carefully, but have no time to build the sort of set they like, this new range of sets is marketed.

Although not special "one-station" receivers—on the contrary they have world-wide range — their quality of reproduction is well ahead of normal standards.

Prices, which will be publicly announced shortly, will be no higher than those of ordinary receivers.

Any improvement on the well-known Stentorian's amazing ability to "straighten" a long-range set's output curve has by many been considered unlikely. That feat has, however, been achieved this year in an unmistakeable manner — as a few minutes' listening will show you. Prices remain extremely reasonable.

Senior (Type 38S) . .	42/-
Junior (Type 38J) . .	32/6
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Midget (Type 38M) . .	17/6

The first three are also available in handsome cabinets; Senior and Junior cabinet models are also incorporating distortionless constant impedance volume controls and button switches for "Long Arm" remote switching. Your dealer will gladly show them.

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The makers, in their determination to maintain high quality and precision workmanship, are deliberately restricting output irrespective of demand. There will, however, be enough Stentorian sets to provide stocks for many good dealers.

HIGH PRAISE FROM WELL-KNOWN EXPERT

Mr. F. J. Camm, the well-known scientist, has expressed the following opinion:—

"In search for the ideal a product remains the best of its class only whilst there is no other standard by which to judge it. In the design of speakers, as in all scientific matters, we must either progress or retrogress—we cannot stand still. The measure of progression is the degree of improvement over previous efforts. Once again it is my pleasure to congratulate your engineers on the immense step forward which you have made with the new 1938 Stentorians. This is an even greater improvement on your 1937 models than the latter were over the 1936 models, and the listener is fortunate indeed in having at their command a speaker sensitively responsive from the lowest to the highest frequencies encountered in radio. Good and bad sets will be improved by it. It is an important advance in speaker technique."

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BLUSHING

FREE to all sufferers, particulars of a proved home treatment that quickly removes all embarrassment, and permanently cures blushing and flushing of the face and neck. Enclose stamp to pay postage to Mr. M. Temple (Specialist), "Palace House," 128 Shaftesbury Avenue (2nd Floor), London, W.1. (*Est. 35 years.*)

bottle, fill the bottle up with *cold* water and then shake the liquid until no more of the chloride of lime dissolves. The filtered liquid will then comprise the strongest obtainable solution of chloride of lime. If you attempt to dissolve the chloride of lime in hot water, it will partially decompose and will give off a proportion of its active element—chlorine.

2. You can make lead acetate by dissolving lithage (lead oxide) in acetic acid and by concentrating the filtered liquid from this operation until it crystallises out. To make a saturated solution of lead acetate, dissolve lead acetate in hot water until the liquid will take up no more. On cooling, crystals of the salt will be deposited and the clear liquid above them will comprise the required saturated lead acetate solution.

PROTECTING A BICYCLE PUMP

"I AM enclosing sketches of a device which I have recently made and fitted to my own cycle with great success. The device is easily slipped on and off and definitely does protect the pump from being stolen.

"I should be much obliged if you would let me know if you think it a marketable proposition, and if so, what firm would be the best to approach for manufacture?" (A. M. D., Lincs.)

THE improved clip for preventing theft of inflators from cycles forms fit subject matter for protection by Letters Patent, providing, of course, that the invention is novel, which is believed to be the case.

You are advised to file an Application for Patent with a Provisional Specification which will give you protection, at the least cost, for about 12 months, during which time it should be possible to ascertain if the invention is likely to prove a commercial success. After the invention has been protected, you can approach likely manufacturers of cycle accessories, such as Terry's of Redditch. It would be advisable to submit a well-finished sample, since manufacturers are more likely to be interested in an actual sample than a drawing.

STARGAZING FOR AMATEURS

(*Continued from page* 652)

The abnormal period of Comets 1937 (Wilkes-Peltier) though uncertain, shows some resemblance to those of the comets of 1532, 1661 and 1779. The discovery of a new comet was reported at the time of writing these notes. It was then in the "Dipper" (Draco) and nearest approach to the Earth on August 10th was predicted; naked-eye visibility was also expected.

* * * * *

Investigations of certain seemingly starless areas in the Milky Way where it traverses the southern constellations Argo, Centaurus and Scorpio, suggest that our solar system may be moving in a vast non-luminous nebula. It is further deduced that, prior to plunging into this gloomy region of space, the Sun and planets were without their attendant comets and meteors; the latter being supposed to belong to the dark nebula.

ELECTRADIX BARGAINS

A Plain Scale MAGNETIC 1½" COMPASS for experimenters. Indicates current flow, aerial bearings, visual tuning, &c. See P.W. p. 438, June 29. Bevel glass, brass body. A British item for **9d.** only

TELESCOPES. Navy Telescopes, hand spotters, 25/-; Gun type 17/6.

STICK PERISCOPES, 3½" × 1½", mirror with cover and swivel holder, 9d.

IMMERSION HEATERS. 110 volts, 2/6; 220 volts, 3/6; Hot-plate, 110 volts, 500 watts, 3/6; 660 watts, 5/-; 3-heats, 220 volts hand Motor Blowers, 17/6; Wax Heaters, 100-250 volts, 15/-; Bowl Fires, 220 volts, bronze finish, 9/6; ½ kw. Bar Fire, 7/8; 1 kw. 220 volts, 17/6; Elec. Curling Tongs, 220 volts, 5/-; Elec. Heating Pads, cloth 9" × 7", with flex and adaptor, 12/6.

TELEPHONES for **HOUSE, OFFICE, GARAGE,** and Field Sports. Table, Wall and Waterproof Portable, from 10/-. Headphones for short-wave radio, etc., 2/9 pair. Telephone wire 55/- mile.

SWITCHES. We have some super-grade ultra-short switches. Contacts on ribbed pedestals D.P.C.O., 7/6. Resistance Box Switch Panels box base R.L. 8-way arm, 7/6. Larger type with two sets of mounted 10-way studs and arms, 9/-.

CONTROLS. 20-way Stud Switches on panel, two contact arms and ring for 10 amps. 7-way Stud Switches on 2½-in. panel, in and out sockets, 1/9. 10-way D.P. ebonite mounted, 8 amps., 5/6. 12-way D.P. ditto, 5 amp., 4/-. Aerial D.P.C.O. on ebonite, 3/6.

LIGHT DUTY Switches for Wave-change and Semi-rotary D.P.C.O., 6d. **R.A.F.** Switch Boxes for 3 circuits, rocker type, 1/3. 6-way Rocker-toggle, 2/-. 8-way ditto, 3/6. Yaxley and Rex Wave-change D.P., 3-way, roller contact, new, 1/3. Bulgin 3-point Wave-change, 9d. Tunewell S.P. on-off semi-rotary, 8d.

MAGNETIC SWITCHES. Automatic. 2 to 4 amps., 7/6; 6 amps., 10/-; 10 amps., 12/-; 15 amps., 14/-; 20 amps., 16/-. Relays, 8/6.

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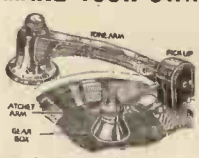

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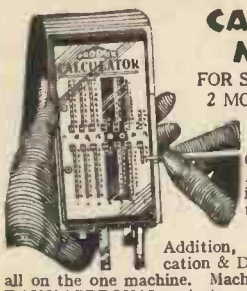

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