Fair Comment

FLYING SAUCERS AGAIN

RESULTING from a paragraph in one or two Toronto newspapers, world-wide prominence has been given to a report that Avro Canada, North American branch of the famous British firm, is working on a flying saucer project. Even Reuter reported that Field Marshal Montgomery inspected a model of the machine when he visited Avro Canada's plant at Malton. Some of the reports have been accompanied by full descriptions and even illustrations. The British Press was not slow to give further impetus to the belief that flying saucers are in course of production.

Daily newspapers are always seeking something sensational for their headlines, and this news was seized upon with avidity by news editors, cropping amongst tape reports at a time when there was nothing spectacular going on in the criminal courts, political pyrotechnics had temporarily abated and news generally was flat. Technical journals, however, need to be more cautious before they hallmark such reports by publication of articles which might give the impression that the information was fact. This journal is constantly searching the world for news of the latest scientific developments and inventions to keep its readers' knowledge up to date. When we read the report of the flying saucer project in the American Press we adopted the usual cautious editorial policy of accepting it cum grano salis.

That does not mean that we entirely rejected the report as being a further example of the usual sensational American journalism, for often there is a scintilla of fact buried in their quagmires of imaginative writings. Accordingly we wrote to A. V. Roe, Canada, Ltd., and we are able to say on the authority of that company that the flying saucer reports are largely imagination. The company wrote to us as follows in reply to our letter: "We appreciate your request for information regarding the reports on the 'flying saucers,' which we understand have been given some world-wide prominence, but regret our inability to help you. Nothing has ever been released by our company or the Government of Canada on this subject."

Anything, therefore, which has appeared must be taken as pure conjecture. This does not mean that aircraft companies are not devoting attention to the subject of, circular planes; for some of the earliest aircraft had circular wings. The drawing published in America shows a plane more resembling a horseshoe than a saucer. It does not revolve as the flying saucer is presumed to do, although the central power unit does. It is claimed that it will fly at a speed of 1,500 m.p.h., or about twice the speed of sound. It cannot be said at once that such a plane is entirely practicable. The rotation of the central disc containing the power unit, presumably a turbo-jet, would provide a means of control and possibly greater stability both longitudinal and lateral than is possible with normal aircraft.

Air is drawn through ducts in the front of the machine and after compression some is fed to the main engine in the revolving disc and the remainder to the combustion chambers arranged around the periphery of the saucer, whilst exhaust gas from the central power unit is expelled through ducts at the rear of the horseshoe.

In the early part of this year Air Vice-Marshal Smith stated that consideration was being given to flying saucers and later the president and general manager of Avro Canada in an interview said: "Like all other aircraft companies which want to stay in business, we are directing a substantial part of our effort towards new ideas and advanced designs. Like other firms, we have a number of such projects under way. One of them can be said to be quite revolutionary in concept and appearance." All very non-committal, although it does not rule out the possibility that the company is producing a saucer; it may be that some leakage has occurred which it is anxious to disown.

It cannot be denied, however, that up to the present no one has produced a jet engine which will propel an airplane in level flight faster than sound.

625-LINE TV TRANSMISSIONS

SIR ROBERT RENWICK, president of the Television Society, recently announced that it would shortly be building an experimental 625-line transmitter to provide a service to amateurs and the radio industry which will possibly help the export market. Receivers intended for the Continental standard of 625 lines can be better demonstrated and tested on a radio signal under working conditions. With the approval of the radio industry the society has undertaken to operate a suitable transmitter, and discussions have taken place with B.R.E.M.A. on a suitable site and the design of the equipment.

ART ATTACK!

THIS journal is not, of course, interested in Art as such, but it comes within our purview when we find a few pieces of twisted wire affixed to a concrete slab exhibited in London under the title of the "Unknown Political Prisoner." Wire and concrete are mechanical subjects and we are entitled, therefore, to comment on this latest example of futuristic art which gains for its lucky creator the princely prize of £4,500. Most of us are taught to draw and equally we are taught that our drawing should convey what it is without having to write under the drawing of, say, a flower, that it is a pansy. I have some sympathy for the visitor, so unappreciative of art, that he wrecked it. I was equally amused by the remarks of the magistrate who tried him for this lapse, and who asked if there was any evidence if the defendant was mentally unstable. With a twinkle in the editorial optic it did occur to me that the question was misdirected. Surely it is one which should have been asked of the prize donors? — F. J. C.
THE brain of a living organism has several important functions to perform. It receives messages and information from different parts of the organism, analyses them, and if necessary, sends out instructions to the parts concerned. If a hot poker is picked up by the wrong end, a message indicating this fact is sent to the brain which immediately responds by sending instructions causing the poker to be dropped. The brain cannot respond instantaneously, since the messages have to travel at a definite speed along the nerve channels. Another property possessed by the brain is that of storing information; we call this, memory. Above all, however, the brain can reason, and from known facts deduce a logical argument or produce an original idea. The last named property, that of reasoning, varies from one species of animal to another, and also from one individual of a species to another of the same species. Among lower animals, the power to reason, is nearly, if not quite, non-existent, whereas in the highest order of animals (man), it is of a very high order. The way in which the brain works and the manner in which mind and body are linked together has been the study of philosophers and psychologists for many decades. Within recent years some scientists have attempted to create machines which duplicate the actions of the human brain. The piece of apparatus described in the following article is one such machine. Like the human brain, it can receive messages and send instructions; it possesses a memory and it can apparently reason. It is left to the reader to decide how justifiably it can be called a brain.

The problem which the apparatus is set to play a game of "noughts and crosses," in which the brain of the apparatus is pitted against a human brain. In order to carry out its purpose, the apparatus must possess a means of perceiving the actions of its opponent; it must possess a memory and a selective mechanism to determine the correct answering play; and it must have a method of indicating its decision. Some of these processes are carried out mechanically and some electrically in the instrument to be described.

Analysis of the Game of "Noughts and Crosses"

In the game of "noughts and crosses," the object is to be the first to obtain a row of three noughts or three crosses, either horizontally, vertically or diagonally. One player uses noughts and the other crosses, and each takes it in turn to play. The first player has a choice of nine squares in which to place his mark, leaving his opponent eight vacant squares. Thus the first square can be filled in any one of

![Fig. 1](image-url)"Method of numbering the "noughts and crosses" figure. (b)-(k) The plays necessitated by each of the nine possible initial plays of the brain's opponent.

![Fig. 2](image-url)"Two views of completed instrument showing the relative positions of the units.

![Fig. 3](image-url)"Plan and side elevation, and details of the perception unit."
nine different ways and the second square in any one of eight ways. There are, therefore, seventy-two ways of filling the first two squares. By applying this method to the whole game, and including arrangements where three “O”’s or three “X”’s appear in a row, it will be found that there are 9x8x7x6x5x4x3x2x1=362,880 ways of filling the squares. This is rather a large number of arrangements to deal with, and so some means of cutting them down must be employed. The machine’s opponent must be allowed complete freedom of choice and, therefore, his moves cannot be cut down, but we can cut down the moves of the machine itself. Thus, whatever square is filled by the opponent, the machine must be limited to one choice. In this way the number of arrangements is cut from 9x8... to 9x1 = 9.

This is rather a large number, but now within the capabilities of the machine.

Of course, the squares alter in importance during the play, but this need not be considered at this point. In his initial move the live player places a nought in any of the squares, 1, 2, 3, 4, 6, 7, 8, 9, the machine’s best answering play is to fill square 5. If, however, square 5 is the initial play, the machine must fill one of the squares, 1, 3, 7 or 9. Since the machine has only one choice, it is predetermined that in the instance square 1 is filled. The ensuing play depends on the opponent’s initial choice of square (the machine cannot initiate a game). The methods of determining the ensuing play will not be gone into here, but the result of such a determination are given in a series of diagrams in Fig. 1(b)-(k).

The mechanical brain’s answering play in each case will now be considered. For convenience, the squares of the “noughts and crosses” figure have been numbered from 1-9 as in Fig. (a).

The most important square of the figure is number 5, for a nought or a cross placed on it stops the opponent from completing four out of the possible eight rows of three. Next in order of importance are the squares 1, 3, 7 and 9, for a sign placed in any of these squares blocks three rows. Last in importance come the squares 2, 4, 6 and 8, for these squares only block two rows each.

The perception unit, which receives information from the machine’s opponent, (b) the memory unit, which analyses the information and controls; (c) the indicating unit, which shows both the squares selected by the opponent and the machine’s answering play. Fig. 2 gives two views of the machine and indicates the relative positions of these parts.

The machine consists of three major parts
the holes in the back of the box should correspond with the holes in the front of the indicating unit; these holes being used to bolt the units together. Finally, the holes for the balls should be of ample size to allow the balls to pass freely, but not too large, otherwise the balls might miss the switch rods.

The machine’s opponent selects his play by dropping a steel ball through the corresponding hole of the perception unit. The ball, after passing through the hole, drops a short distance on to two short inclined parallel rods (Fig. 4(a)). It runs down the rods until it is brought to rest by an earthing bar. There are three earthing bars running across the box. Fig. 4(b) gives views of the earthing bar arrangement. It will be noticed that the three bars are carried in a frame which is pivoted at one end. The frame is held in a horizontal position by means of a rubber band. When the game is ended the reset button is pressed, thus pushing the frame downwards, allowing the balls to fall to the floor of the box and thence to the channel. Looking at the instrument from the front, the rods of the ball railways are connected as follows: in the left-hand rod in each case is connected to the side-contact of the “0” bulb of the corresponding square of the indicating unit. The right-hand rod of each switch position is connected to the corresponding moving contact of the memory unit (see Fig. 6). Thus the right-hand rod of switch position 2 will be connected to terminal 2A of the memory unit and hence to moving contact number 2. The measurements of the various internal arrangements of the perception unit will depend on those chosen for the box itself. The following points should be noted however. The size of the steel balls determines the distance apart of the switch rods. Half-inch steel balls are of a convenient size and the measurements shown in Fig. 4(a) should then be used. The distance between the centre of one railway and the next should be equal to the distance between centres of the holes in the top of the box. The angle of inclination of the railways should be large enough to ensure a positive contact between the balls and the earthing strip, but not so great that the balls “jump” the strip. Care should be taken that the wooden strips carrying the railways are sufficiently far from the holes for the balls to drop cleanly on to the railways. If dies are not available for threading the rods, threaded rods should be purchased and the unwanted portion of the thread filed away before bending.

The Memory Unit

The memory unit consists of a ten-position switch with nine switch wafers. To construct the switch, nine pieces of three-ply wood 2 in. square and two pieces of 1 in. hardwood 2 in. square are required. The squares of plywood are drilled as shown in Fig. 5(a), while Fig. 5(b) shows how the hardwood is drilled. This operation must be carried out accurately, and the reader is advised to make templates for the job and check against them repeatedly.

Through the holes in each plywood “wafer,” numbered 1-9, are inserted 2 in. rods .

**Fig. 8.—Diagram of memory unit connections.**

**LIST OF MATERIALS REQUIRED**

- 18—M.S. lamp holders.
- 18—2.5-volt lamps.
- 5—1 in. steel balls.
- 7 din. 6 B.A. round headed brass screws with nuts.
- 1 ft. (approx.) 1 in. plastic knitting needle (1 ft.).
- 2 ft. 11 in. plastic knitting needle (1 ft.).
- 3 din. 6 B.A. brass rods.
- 3—1 in. dia. M.S. rods 9 in. long.
- 12 ft. (approx.) 1 in. brass rod.
- 2—Brass angle pieces.
- 1 ft. brass strip 3 in. x 6 in. 2 pieces glass 1 ft. square.
- 10 bushes 1 in. bore.
- 4—ft. lengths of 2 B.A. screwed rod.
- Red and green cellophane.
- Quantity of wood 1 in. thick.
- Doors of plywood.

绝缘的电线被焊在图7(b)的末端。这些电线被焊在终端条A (Fig. 6), 而从那里到对应编号的右手端的感知单元。每个wafer现在焊接在图8中，从终端条B (Fig. 6）。在Fig. 8中，数字在圆圈中代表接触点，而这些数字是被焊在相应的运动接触点上的。它将被发现更容易连接电线到末端条上所有的螺丝。焊接提供了更有效的方法。将电线焊在接触处。}

Connections are taken from terminal strip B to the side-contacts of the correspondingly numbered “X” bulbs of the indicating unit.

*(To be concluded)*
The search for an inexpensive alternative to commercial products led the writer to construct his own press tools for making small three-pole armature laminations. These tools have so far produced sufficient for about half a dozen armatures and seem good for plenty more yet. The raw material used is soft iron from cut-up cocoa tins, etc.; this is about 0.12-15 mls in thickness, so about 35-40 laminations are required for an armature stack 1 lin. thick plus a fibre one at each end to protect the winding insulation.

While construction of the tools may be a bit outside the scope of the modeller who is restricted to working on the kitchen table, there is nothing fundamentally difficult and the chief requisite is accuracy in marking out and drilling certain holes to size, and truly the chief requisite is accuracy in marking out. There is nothing fundamentally difficult and the chief requisite is accuracy in marking out and drilling certain holes to size, so that the first tin or so is absolutely central and square, then drill from the other end somewhat larger, say, about 3/16in., forming a stepped diameter hole.

Pin F should be threaded 8 BA for 3/16in., and this is best done before cutting off. Finish the other end off square.

Pin K is a plain length of 3/16in. silver steel about 1/2in. long, finished square on both end faces.

The three round pieces require hardening; heat to a bright red and quench in water, then brighten up with emery cloth and temper by heating in a tin lid over a flame to a light straw colour, and quenching again in water.

The Punch

The punch, E, should now be cut. It is a 3/32in. pitch circle (see Fig. 3). Having marked this circle step out the radius around its circumference; it should go exactly six times. Alternate marks give centres for 3/16in. holes at 120 deg. spacing. After all pilot holes have been drilled carefully open them out to final sizes. In the case of the first tin holes proceed in two or three steps, pop mark is needed for dividers to scribe the 3/32in. pitch circle (see Fig. 3). Having marked this circle step out the radius around its circumference; it should go exactly six times. Alternate marks give centres for 3/16in. holes at 120 deg. spacing. After all pilot holes have been drilled carefully open them out to final sizes. In the case of the first tin holes proceed in two or three steps, pop mark is needed for dividers to scribe the 3/32in. pitch circle (see Fig. 3).

While construction of the tools may be a bit outside the scope of the modeller who is restricted to working on the kitchen table, there is nothing fundamentally difficult and the chief requisite is accuracy in marking out and drilling certain holes to size, and truly square. Though possession of a lathe is not essential it is certainly an asset for jobs like this, and if the intending constructor is not so equipped it may be well worth while enlisting the aid of a fellow modeller possessing one. The materials required are small in number, and most of them can, no doubt, be requisitioned from the scrap box. Furthermore, mild steel strip is in rather short supply at the moment, and though alternatives are permissible for certain parts, some must be capable of being hardened.

Laminations are produced in two stages. The first tool, detailed in Fig. 1, yields tin discs with a 3/32in. central hole; these are placed in the tool shown in Fig. 2, and three 3/16in. holes at 120 deg. spacing are pressed out so that three poles are left (see Fig. 4 and b).

**Constructing the Tools**

The diagrams are self-explanatory, but one or two details require amplification.

The base plate D is used for both tools and all holes in both tools should be accurately dimensioned from the centre punch pin F to ensure symmetry. It is suggested that D should be drilled first with all holes drill size 51, then each of the other plates may be clamped to it in turn and D used as a drill guide plate for locating the other holes; it will be necessary to mark out plates L and M before drilling as a centre.

**Simple Press Tools for Punching Out Armature Laminations from Thin Tinned Iron Sheet**

By J. H. BLOOR

The Punch

The punch, E, should now be cut. It is a 3/32in. pitch circle (see Fig. 3). Having marked this circle step out the radius around its circumference; it should go exactly six times. Alternate marks give centres for 3/16in. holes at 120 deg. spacing. After all pilot holes have been drilled carefully open them out to final sizes. In the case of the first tin holes proceed in two or three steps, pop mark is needed for dividers to scribe the 3/32in. pitch circle (see Fig. 3). Having marked this circle step out the radius around its circumference; it should go exactly six times. Alternate marks give centres for 3/16in. holes at 120 deg. spacing. After all pilot holes have been drilled carefully open them out to final sizes. In the case of the first tin holes proceed in two or three steps, pop mark is needed for dividers to scribe the 3/32in. pitch circle (see Fig. 3). Having marked this circle step out the radius around its circumference; it should go exactly six times.

**Making ARMATURE LAMINATIONS**

Fig. 3.—Marking out for plates L and M.

Fig. 4.—Detail of a blank, and a finished lamination.

Fig. 2.—Details of the tool for punching the winding slots in the disc blanks.

Fig. 1.—Details of the punching tool for forming disc blanks.
NEWNES PRACTICAL MECHANICS

June, 1953

Back to First Principles

5.—Friction in its Useful Function
By W. J. WESTON

O f course friction has its use. We could not
not walk, we could not drive a car
along the road unless friction were
present to give a grip. The emergence of
friction as a benefit, instead of in the usual
aspect of a nuisance, is clearly seen when it
prevents overhauling in a machine, prevents
the weight from taking charge upon a relaxa-
tion of the effort. Perhaps the most interesting
instance of this is Weston's differential pulley;
the ingenuity of its devisors has "turned a
bane to antidote."

The Problem: In the diagram (Fig. 5) of a
differential pulley the radii of the upper
sheaves are 10 centimetres and 9.5 centi-
metres. What is the velocity ratio and what
(efficiency being 40 per cent.) is the mechanical
advantage?

The Comment: The essence of the differen-
tial pulley is that the chain round the larger
of the upper sheaves is unwound while being
wound round the smaller. The lessening of the
loop holding the movable pulley is, therefore,
for every complete revolution of the larger
pulley, merely the difference between the
winding and unwinding; and the pulley
closed in the loop rises half this difference.
The device may be thus compared—why does the
distance over which the force acts, and the
distance over which the resistance is overcome
is, therefore, very small; and the corre-
sponding mechanical advantage very great.
The Answer: Distance through which force
acts in one revolution of large sheave—
\[ 2 \times 15 \times \pi \times 10 = 20\pi \text{ metres.} \]

Distance through which weight rises in that
revolution—\[ 2 \times 15 \times \pi \times 9.5 = 15 \pi \text{ metres.} \]

Velocity ratio is \( \frac{15 \pi}{20\pi} = \frac{3}{4} \).

Force of friction reduces the 40 to
\[ \frac{40}{100} = 0.4 \text{ to } 16. \]

Mechanical advantage \( \frac{16}{0.4} = 40 \).

The Problem: If the fixed pulleys of a
Weston differential block have 10 and 11
teeth, and the effect of friction in the machine
is to increase the effort by an amount which is
a fixed proportion of the load, find that pro-
portion when the efficiency is 40.

The Comment: In order that friction may
operate to at least the desirable extent,
the grooves through which the endless chain of
a Weston differential goes have projections and
recesses. This desirable extent is such as will
reduce the efficiency to below 50 per cent.;
otherwise any relaxation of the force will
result in a slipping back of the weight. The
efficiency, it must be noted, is the ratio of the
effort when friction is neglected to the effort
when friction is considered—as, of course, it
must be in practice.
The Answer: The ratio of Effort to Load,
friction being neglected, is 1 : 22.

Friction being considered the Effort in
relation to the same Load is 5 : 22 (efficiency
being 40 per cent.).

The Problem: A man weighing 150 lb. sits
in a seat weighing 14 lb. (Fig. 2), which
is suspended from a smooth pulley supported
by two parallel portions of a rope which is
coiled in opposite directions round the two
drums of a differential wheel and axle of
radius 15 in. and 12 in., respectively. He raises
himself by pulling one side of the rope. Which
side is it? Show that to raise himself he
must exert a pull exceeding 16 lb. weight.
Restringing a Tennis Racket

How to Renew Your Tennis Racket Strings at Home

ALTHOUGH the restringing of a tennis racket, completely or in part, is a task which calls for the exercise of a certain amount of acquired skill, the task, once the necessary knack has been mastered, is not a difficult one. It is, indeed, an operation which is well within the practical capabilities of the average handyman, and only a minimum number of tools is required.

The amateur who takes up this interesting spare-time occupation needs merely a small work-bench fitted with an efficient vice, into which the racket under treatment can be held in the manner shown in Fig. 1. In order to obviate the risk of injury to the handle of the racket by undue pressure in the vice it is advisable to line the jaws of the latter with hollowed-out blocks of wood exactly conforming to the curvature of the racket handle. Such "liners" for the vice will also allow a better grip to be obtained on the racket.

For the purpose of racket restringing we require, in addition to the necessary gut, a pair of scissors, a pair of blunt-nosed pliers, and a "pricking" awl having a fine point, whose function it is to prevent the slipping back of any tensioned string by being thrust into the hole through which the string passes. A "setting-off" awl will be required. This implement is merely a pair of thin, sharp-pointed metal pieces fitted into a metal tube. Such "liners" for the vice will also allow a better grip to be obtained on the racket.

Practise on Cheap Rackets

Before embarking upon the restringing of a really good quality tennis racket, the beginner would be well advised to practise upon a junior racket, or even upon a child's toy racket, and in place of gut to use ordinary strong string or very thin cord. A short practice along these lines, following out the instructions given in this article, will sufficiently acquaint him with the precise procedure of the restringing operation. With this knowledge and experience will readily come the necessary confidence for tackling a full-size sports racket.

The gut for tennis rackets is obtainable in several grades and colours, the "extra-high tension" gut being the best. This quality of gut, which is expensive, is by no means necessary for average restringing work, for which purpose any average grade of gut will be quite satisfactory.

Tennis racket gut is usually supplied by sports outfitters or by gut manufacturers in 21 ft. lengths for the "mains," as the vertical strings of the racket are called in the trade, in various thicknesses. Good quality rackets usually have several crosswise lengths of gut put in at each end. These gut strings are professionally known as the "treplings," and their purpose is merely to fill up the space at the top of the racket which would otherwise have to be left vacant. "Treblings" gut is available in 18 ft. lengths and in several colours.

The "Mains" String

In order to thread the "mains" strings, the 21 ft. length of "mains" gut is threaded through the central hole in the neck or "throat" of the racket, as shown in Fig. 4, so that exactly one-half of the length of gut is made available on each side of the racket. One-half of the racket is then carefully threaded, following the method indicated in the diagram, Fig. 4. In this diagram the arrow heads indicate the direction of threading the "mains" strings on one-half of the racket, those on the opposite half are similarly threaded. Now comes the highly important task of tensioning the "mains" strings.

To effect this we must bring into service an implement known to racket makers and repairers as a "billiard." A professional racket "billiard" is illustrated at Fig. 3. It comprises merely a metal rod, which is capable of being screwed in or out of a short metal tube. To each end of the implement curved metal pieces are fitted. When the "billiard" is inserted into the racket, its projecting pieces press against the upper and lower ends of the racket, and by screwing up the implement it is possible to put a longitudinal tension on the racket frame and thus prevent it from being distorted during the tensioning of the strings.

Whilst a properly designed "billiard" is greatly advantageous for all serious work, a good substitute for this implement can be made from a strip of springy steel inserted into the racket frame in the manner indicated at Fig. 3(b).

The "Crossings" String

When the racket is fully tensioned, the "crossings" are then threaded in as shown at Fig. 3(c). These are the crosswise lengths of gut put in at each end of the racket. In threading the "crossings" gut the implement is inserted in the manner shown in Fig. 3(b). When the gut is threaded, the racket is then tensioned as indicated at Fig. 3(c).

The "Stop" String

In threading the "stop" string, the implement is inserted as shown in Fig. 3(d), and then tensioned as indicated at Fig. 3(e).

The "Doubles" String

The "doubles" gut, which is put into the racket as shown at Fig. 3(f), is not put in while the racket is flatly laid on the surface, as threads of gut are then liable to get caught in the vice. The racket is first held in the vice with the strings set up, and the implement is inserted in the manner indicated at Fig. 3(f), after which the implement is withdrawn, and then the "doubles" gut is threaded into the racket as shown in Fig. 3(f).

The "Mains" String

In order to thread the "mains" strings, the 21 ft. length of "mains" gut is threaded through the central hole in the neck or "throat" of the racket, as shown in Fig. 4, so that exactly one-half of the length of gut is made available on each side of the racket. One-half of the racket is then carefully threaded, following the method indicated in the diagram, Fig. 4. In this diagram the arrow heads indicate the direction of threading the "mains" strings.
Using the "Billiard"

The "billiard," or its substitute, is inserted into the racket frame, as illustrated, and the "mains" strings are each separately tensioned by pulling tightly upon them with the blunt-nosed pliers.

In tensioning these strings begin at the centre of the racket and work outwards in the order in which the strings were first threaded. In order to get the strings adequately and equally tensioned it will be found necessary to perform the tensioning operation about half a dozen times. When, however, the strings have been satisfactorily tensioned, pull the threaded ends of gut on opposite sides of the racket as tightly as possible and then cut them off short with the scissors.

If, during the tensioning of the gut, there is any tendency of the string to slip back, this can be prevented by "stopping" each string as the tensioning task proceeds. "Stopping" is a very simple operation. All it consists of is merely driving a fine pointed awl into the hole in the racket frame through which the tensioned string passes. The pressure of the awl blade against the string in its hole will prevent the string slipping back.

Having threaded and tensioned the "mains" strings of the racket, we have now to weave the "crossings." This is a rather easier task. The method of weaving the "crossings" is clearly shown in Fig. 5. Although in this diagram the loops of the "crossings" are shown on the outer side of the racket frame, these loops should be pulled tight as the work proceeds, and any slipping back of the loops being prevented by means of a stopping awl thrust into the hole through which the gut passes.

Crossings

The "crossings" are, of course, threaded over the one "mains" string and under the next one, and so forth. For squaring up the woven pattern of the strings, the "setting-off" awl will be required, this being used merely to press the various strings up or down or to the right or left.

Finally, the "treblings" are put in. These cross strings, which, as we have already seen, are those which occupy the extreme ends of the racket, need not be woven under tension. From the "trebling" gut, the necessary lengths required for the three or four rows of these strings at each end of the racket will have to be cut.

Note that the "trebling" gut is not merely woven in and out across the "mains" strings, it is taken right round each "mains" string, the two double "mains" strings near the centre of the racket being counted as one string for this purpose. Many racket repairers fill up the holes in the racket frame with a hard wax made by melting together resin and beeswax or any other similar natural wax, this mixture tending to keep the dirt out of the holes in the frame.

A racket which has been satisfactorily restrung should have all its strings lying in one plane, so that the entire network of strings presents a perfectly flat surface.

Note particularly that after the "billiard" or stretching implement has been inserted in the racket frame for the tensioning of the "mains" strings, it should not be withdrawn until at least half of the "crossings" have been woven and tensioned.

Replacing Broken Strings

Rackets which have merely one or two strings broken need not, of course, be completely restrung for ordinary use. A new string may readily be inserted in the following manner, no knots being utilised in the process.

Remove the broken string and bring its ends to the outside of the racket frame. Now restore the tension to the strings on each side of the broken string, maintaining the tension by means of a stopping awl thrust into the holes in the racket frame. Take now a length of gut slightly longer than the length of the new string. Pass its free end through the hole in the frame next to the vacant hole, wedging it by means of an awl. Then thread the gut through the adjoining vacant hole in the racket frame and, after tensioning the string, wedge it by pulling it through the adjoining hole.

Model Railway Exhibition

THE Model Railway Club held its annual exhibition in the Central Hall, Westminster, from April 7th-11th inclusive. As in previous years, the show was well attended and proved a great attraction for enthusiasts of all ages.

A scale model of a contractor's locomotive of 1893, constructed by Mr. P. J. Dupen.
Making A Wimshurst Machine

Made from Simple Materials, this Unit is Hand-driven and Generates 40,000 Volts

A WIMSHURST machine, as shown in Figs. 1 and 2, is simply a mechanical device for rotating in opposite directions two sets of conductors—in this case slips of tin-foil glued to 8in. gramophone records—with appropriate apparatus for collecting the electric charges induced on them. The essential parts of the machine must be perfectly insulated, for which reason they are usually mounted on glass pillars. In this model, vulcanite or some such composition is used, but it must be remembered that dry wood is no insulator to high potential static electricity.

The vulcanite posts are the tubes of 6in. wireless lead-in tubes. The brass rods and terminals, which are first removed, come in for use in other parts of the machine. The base is a block of tin, oak and the posts are mounted on it. This is done by boring holes slightly larger in diameter than the posts half-way through the wood. Some flowers of sulphur are then melted in a tin over a gas jet, and the liquid poured into one of the holes. The post is stuck in, squared up, and held until the sulphur cools. Posts mounted in this way are surprisingly firm (Fig. 3).

To strengthen the middle posts, which carry the bearings of the plate spindles, a hole is drilled through each about half-way up, and a brass rod from a lead-in tube pushed through and bent into a semi-circle. The two ends, which are threaded, are then bolted down to the base in the manner shown.

The Bearings and Collecting Combs

The bearings can be attached to the tops of the posts by tight-fitting screws, which will cut their own threads in the vulcanite. The collecting combs can be made from lengths of brass rod bent into a U, having...
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a convenient number of small holes drilled through each arm and gramophone needles, broken off to a suitable length, soldered or cemented in. In the model shown, ordinary metal cement was found to be very effective. The ends of the rod should be carefully rounded, as it is essential in electrostatic machines to have all metal parts smooth and polished and to avoid all sharp corners. As, however, electric charges are carried on the surface, it does not matter whether the parts are hollow or solid.

The combs are then mounted so that the plates can revolve between them without quite touching them. The clearance may be as much as a fifth of an inch without any serious loss of electrical charge.

Eight strips of tin-foil—silver paper—does well—will have a distance of equal distances on one side only of each gramophone record, and a wheel with a setscrew is bolted to the centre to facilitate attachment to the spindles. The records are then mounted to rotate back to back, the foils facing the points of the combs.

To keep the records apart, a ball bearing is slipped in between the spindles, a device which also makes for smooth running, since the spindles rotate in opposite directions.

On the tops of the brass knobs to which the combs are attached, the terminals from a lead-in tube are soldered. Two of the brass rods can then be bent into semi-circles and screwed in to form the conductor arms. These terminate in two brass balls (between which the sparks are produced) at the top of the machine. It is as well to use smooth rods to avoid the sharp edges occurring inevitably if they are threaded throughout their length. The brass rods are 45 cm long, and they are attached by filing them with metal cement, and then pushing the rods in. Alternatively, large, bright ball bearings could be soldered on.

All parts of the machine so far described are thoroughly insulated from the base by the vulcanite posts, except the spindles bearing the records, the rest of the apparatus—the simple system of pulleys and gears, and the earthing brushes—needs no insulation; in fact, it is better if they are earthed.

The Gears and Pulleys

The gears and pulleys must be chosen so that the two plates rotate at the same rate. The brushes are made from short tufts of wire taken from a piece of "flex" electric lighting wire. One brush is soldered to each end of a piece of brass wire about 7 in. long, and the wire mounted on the spindle bearing, as shown in Fig. 4. This assures its being well insulated. The two arms of wire are bent so as to make an angle of 45 deg. with the vertical, and the brushes adjusted so that they earth a foil on the opposite edges of the plates simultaneously. The brushes on the other plate are set at right-angles to these, and earth their foils at the same time.

If the whole instrument is brightly polished and perfectly dry, on turning the handle slowly a sizzling sound will be heard. This is due to internal discharges in the machine, visible as a blue glow with sparks formed in the dark. On turning a little faster the gloom, in length, will jump between the brass knobs at the top of the machine.

If you give the handle a vigorous turn at the first attempt, see that the brass knobs are not touching and then rub a vulcanite rod briskly on your sleeve to electrify it, then hold it to one of the combs while turning the handle and the machine will soon charge up and function normally. Sparks produced in this way will be a centimetre spark in dry air is 30,000.

Condensers

An enhanced effect can be produced by connecting a couple of condensers to the terminals. These are capable of accumulating the charges of electricity until they are full, and then discharging them suddenly in a violent blue spark. This should not account for anything but a part of the body a severe shock will be felt.

The type of condenser usually employed is the Leyden jar, shown in Fig. 5, and it is quite easy to make one from a jam jar. Wash and dry the jar thoroughly and line it with tinfoil. The easiest way to do this is to coat the jar with rubber cement, then line it with tinfoil. The clearance may be about three-quarters of the way up inside with tinfoil. The easiest way to do this is to cut up several strips of silver paper and stick them in, one at a time, so that they overlap one another. Then the outer side of the jar is coated to the same level in the same way. The cork, or vulcanite stopper, carries a short brass rod with a ball on its upper end. The lower end must make some sort of metallic contact with the inner coat of foil, the simplest way being by means of a short chain.

When two of these jars have been made connect the brass rods or balls with two terminals, or the comb bearers of the machine, and either earth their outer coats or connect them together by standing both jars on the same strip of metal. The machine will now produce the large sparks at about one second interval, using the lengths, of the sparking and the interval depending on the size of the Leyden jars used.

The Principle of the Wimshurst Machine

In Fig. 6, A is an insulated conductor charged with positive electricity. If an uncharged conductor, B, is brought near it a strange thing happens. Its neutrality is destroyed and a negative charge is found to be induced on the side nearest A, while its opposite side acquires a positive charge! If it is now moved away again its two charges flow together and neutralise each other and everything is restored to its original condition. But suppose that while near A the positive side of B is earthed by touching it with a finger. The positive charge disappears and when it is removed from the vicinity of A, B is found to be negatively charged.

The important thing is that, though B has been given an electrical charge, A has not lost any of its original positive charge. It looks like something for nothing, through the new electrical energy has really come from the work done in removing the two balls, which very slightly attracted one another.

It will be noticed in working the Wimshurst machine that it is quite hard to turn the handle when it is functioning well; this is due to the electrical attraction between the various parts of the machine. The extra energy that you have to employ to overcome this is the source of the electricity the machine produces.

In the diagram (Fig. 7) the two plates are represented by concentric circles for the sake of simplicity, the back plate with its brushes being shaded. The black lines are the foils. Imagine the foil A to have a positive charge. Then, C, D, E, F, G, is pushed slowly along on the side away from A by the brush, and it will jump to B, acquire a negative charge, and travel round to comb F1, which collects it up. Before it gets to F1, however, a postive charge in foil B1, where it is earthed by a brush, and B1 moves round to give its charge to comb E. Thus there is a continual multiplication of charges, positive ones always moving towards the combs E, B1 and the negative ones to F, F1.

The Electroscope

A useful little instrument for testing charges is the electroscope shown in Fig. 8. The cork top of a glass jar carries a brass rod and ball, as in the case of the Leyden jar. But the lower end of the rod supports two strips of metal foil, which hang close together. Gold leaf is the best substance to use, though very thin silver or aluminium paper will serve, provided the leaves are long enough to hang down straight by their own weight. If a charged conductor is brought near to B, the leaves repel each other and fly apart. Charges can easily be carried from one place to another on a metal ball held by an insulating handle, as shown in Fig. 6. The vulcanite handle is taken from a wireless lead-in tube and the brass rod cemented in with salpeter. A good round brass door-knob can be mounted in a glass ink-well (the old-fashioned, solid, square type) and used for the same purpose.
Putting Noise to Work

The Various Properties of Noise and Their Significance in Everyday Life

By Prof. A. M. LOW

MOST people look upon noise as a nasty racket and nothing else. It is more than that. Noise can break glasses, make you sick and wear you out, but if its waves are in the right place, it becomes sound. It can fasten metals together, make chocolate, mix oil with water and wash clothes to perfection at a cost of less than one farthing an hour. Sound is now an important new tool for industry.

Noise is mainly the result of alternate periods of compression and rarefaction in the atmosphere. It makes air warmer. It is quite easy to measure the rise in temperature of a room as the result of a distant rifle shot, and what is more, a man addressing an audience in London can be heard over the radio in Australia before his voice reaches the end of a long lecture hall in England.

Reflection

Reflection is another property of noise. Thunder has its rattling sound because the waves of noise bounce off clouds, houses and trees. An echo is only reflected sound. Try putting your loudspeaker in a corner so that the walls act like the sides of a trumpet. These reflected waves are very complicated and easily distorted by a very loud radio set. Worse still, music can be partly absorbed and turned into heat, leaving the rest to be reflected inaccurately.

There are some buildings in London where high notes are almost entirely lost because the wrong material has been used to decorate the walls. Even in an ordinary room rearrangement of curtains or books on the wall can affect music. Too much volume from your loudspeaker invariably ruins the sound, quite apart from its unfortunate effect upon the neighbours.

All this is very fine, but noise can be an extremely serious thing to human beings. No one can get used to it. When we say "I used to live in the country," we are talking nonsense. The truth is we can only resist the attack of noise by putting out energy which ought to be better spent. Noise can be heard everywhere, not merely by the ears, and it is most lucky for us that civilisation has reduced our sensitivity. Birds listen for worms many inches down in the earth, and if this is tested by putting worms in a box with a glass side they can be seen to stop wriggling as soon as a bird's foot lands on the grass. Terrible if with the brain of a human being you had the ears of a bird, for sitting on the greenest grass would prove a distressing experience, with nasty rattlings underneath you all the time! Noise from your loudspeaker invariably ruins the sound, quite apart from its unfortunate effect upon the neighbours.

Photographing Noise

I have been photographing noise since 1910, not by film recording, but audiometrically. Everyone laughed in those days when London was rattling like a series of bumpy, in 1927 it is just one large crash, and it has made us more nervous in many ways. Wave shapes are interesting, for one can have the staccato yells of Hitler and compare them with the wave form of someone more gentle. That "pure" sound, which some of us rave looks rather like a snake that has swallowed a series of buns, and it is usually sounds unbearably boring. It is the little "twiddles" in the wave which gives a noise its attractive character. Many years ago the B.B.C. broadcast a joke about a riot
Making a Chronograph

**Constructional Details of an Interesting Instrument for the Home or Workshop**

By L. R. C. HAWARD

The chronograph is an instrument for measuring the frequency and duration of an activity and producing a permanent graphic record of the event in terms of a square wave-form. The instrument is widely used in industry and scientific research, particularly in the fields of medicine and psychology. In the home or workshop it can be used in a large variety of ways, both for profit and pleasure, and some suggestions will be detailed later.

The **General Description**

The chronograph consists of a firm base on which is mounted the three major components: the drive, the feed, and the pen battery. The drive consists of an electric motor which operates, through a system of reduction gears, the paper feed. The two characteristics of the base are that it should be absolutely rigid, in order to preserve the correct alignment of the components, and that it should be heavy enough to damp down any vibrations which would otherwise be transmitted inadvertently to the pens. For size, 18in. by 6in. by 1in. will be found very convenient.

The **Feed**

This is in two parts, the driving roller and the spool support. The plan view in Fig. 2 shows the approximate position of these two items. The spool spindle should be 6.5in. above the surface of the base (see Fig. 2a) so that one-foot diameter roll of paper can be accommodated. Paper in various widths can be obtained, the one inch variety being the most economical. The support consists of two brackets screwed to the base about 1.5in. apart, and the spool spindle is 3in. diameter rolls. The paper is secured by a collar and grub-screw outside each bracket, two loose collars and washers being placed between the paper roll and the brackets. If you intend to use the smaller diameter rolls there will be a tendency for the roll to rotate too freely; in this case it is advisable to make two 1in. dia. metal discs, one being placed on each side of the roll and made tight by pressing the collars against them and securing to the spindle with the grub-screws. It will be found now that the friction of the unwinding paper against the inside of these discs is sufficient to stop an excess of paper unwinding.

The driving roller is mounted at the other end of the baseboard, and consists of a solid cylinder about 1.5in. in diameter and about half-inch longer than the width paper being used. The cylinder is keyed on to a spindle. The writer used a cotton reel, which he fixed to the spindle, as shown in Fig. 4. The driving roller passes through two brackets at a height sufficient to give the roller a half-inch clearance above the base. Two rubber rider wheels (tap washers are eminently suitable) are mounted on two radius arms, which bring the riders against the driving roller, where they are kept in place by the tension of the two springs shown in Fig. 3. The

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**Fig. 1.—General view of the completed chronograph.**

**Fig. 2.—Plan of the chronograph.**

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riders should be prevented from moving along the spindle by the use of fixed collars, and the rubber edges should be roughened with a file so that a non-slip grip is kept on the paper, which will pass between the riders and the roller.

The Pen Battery

A three-pen battery is usual, but there is no limit to the number of pens used provided the paper is wide enough to take it. The widest roll of paper obtainable at present for this purpose is 12 in., and so in practice 12 pens are the maximum employed in one instrument. The battery of pens is mounted on a platform between the paper roll and the driving roller. The platform should be about 1.5 in. by 1 in. per pen, that is, 1.5 in. by 3 in. for three pens and so on. The platform is supported by two upright brackets, between which it is allowed to swivel. These brackets also form part of the drive assembly, so that they should not be secured to the base until the requisite holes have been bored. Using the commercial metal strips which already have a series of holes bored, these can be immediately erected.

The pens pass within a sixteenth of an inch of the paper, that is, 0.005 in. The pens are held in position by two small strips of brass fixed to an insulated base (Fig. 7). The strips should be no more than 0.15 in. thick, as shown in Fig. 9. This is perhaps the most useful purpose for which the chronograph can be put by the mechanic or handyman. A spring contact can now be fitted to the pen and the inside of the V should be lightly filed, as the wing-nut illustrated, is necessary. Careful insulation is also a necessity.

The Drive

Any type of motor will do; the writer uses a 24-volt electric motor from a camera-gun. A drive should be taken to the pulley wheel mounted between the pen battery brackets, and a further drive taken to the driving roller. A sprocket and chain drive is the most efficient provided only one pen speed is required, but where a range of speeds is required a belt drive of heavy elastic is adequate. The method enables different sizes of pulley wheels to be brought into use with a very rapid adjustment (see Fig. 8).

Timing the Record

There are three basic methods of timing the record. In the first place, the operator times the paper speed independently, so that for a constant speed record a given length of paper represents a given time. Secondly, a built-in timer may be incorporated, consisting of a cam driven by the motor, and arranged to close the contact of one pen circuit, say, every second. The result would be a series of blips with one second intervals on the record itself, beside which the frequency of the other two traces could be directly compared. Thirdly, an external timer could be used, such as a metronome, the arm of which closes a circuit on every beat.

Method of Use

Fill the pens with ink with a fountain-pen filler, using different colours if desired. A drop of glycerine in the ink will help to provide a smooth and continuous flow. Lower the pens into contact with the paper, and switch on the motor. As the paper commences to move the ink will flow from the pens, but should any pen fail to startmarking the paper, slide a pin or similar sharp object through the reservoir and on to the paper; once the flow has been artificially started it will be found to continue until the ink is expended. If the ink flow presents any difficulty at the first trial, the underside of the paper should be examined for any foreign matters. There are three basic methods of timing the record.

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lines, the smaller will be the last fraction, and consequently the error of estimation will be smaller, too. This method can be used accurately on any type of rotating or reciprocating mechanism, provided the plasticine "cam" has no appreciable effect on the moving component (see Fig. 11).

For timing small mechanisms, such as a clock or watch movement, the reaction time method must be adopted. In this method, a mark is placed on the circumference of the moving part, and another mark placed on an adjacent stationary component. These marks should be made as fine as possible commensurate with legibility. The contact is now held in the hand and pressed every time the piece rotates and the marks are brought into alignment. You will see that this introduces the error of the human equation, as it is sometimes called. Because of the distance between the eye and the hand which the nervous impulse has to travel, and because of the time taken by the brain to sort things out, a period of time will have elapsed between the synchronisation of the two marks and the closure of the contact, a period of about 1/5 second. However, this time-lag remains surprisingly constant, and the gross effects will be cancelled out pro-

provided the record is long enough. If possible, at least 10 "blips" should be recorded to ensure the error has been averaged out.

Measuring Reaction Time

This brings us to the question of the time-lag and how it can be measured. At modern speeds the reaction time of the individual is fast becoming as important as the machine he is controlling, and the time is not far distant when the performance of the machine will be limited by its operator, and not by its inventor's abilities. This is especially true in high-speed aircraft. At modern jet speeds a pilot seeing an object in front of him will move at least 200 feet before even starting to move a finger. Where a complex action is required, the reaction time is considerably longer. Even in a fast car you will travel nearly 10 yards before starting to brake!

Measuring your own reaction times is quite a simple matter, but you will need a friend to help you. Sit at a table facing each other and both holding a switch contact before you connected to two separate sets of terminals. In the friend's circuit incorporate a bulb, and set the pulley ratios so that the paper is travelling at a fast speed. Hold your finger ready on the contact, and directly your friend closes his contact and the lamp lights up, press down on yours. Release both contacts and repeat this a number of times. The record will look like Fig. 12, and your reaction time is the distance between the two marker lines, that is, the difference in position of the two waves. This is your simple reaction time: to find out how you are likely to behave when the grey matter has to think a bit, tell your friend to close his contact, and at the same time say a letter of the alphabet. Giving A the number 1 ; B, 2 ; C, 3 ; and so on, you are to press your contact as soon as you hear the letter, but only if the number is an even one. Compare your performance with the former one, and also with your reaction time when you are given the numbers direct instead of the letters.

A Psychological Study

By having the chronograph moving slowly, and concealing the contact in the palm of the hand, it is possible to record the thousand and one repetitive acts which make up human behaviour : the blink rate of your friends, the number of times they say "I said to him, I said" and so on. You can also get them to measure their own oscillation rate. This is a rather intriguing little phenomenon which occurs when we look at an ambiguous reversible figure, three of which are shown in Fig. 13. Look at the white vase: if you study it for long enough you will see it can also be two black faces looking at each other, silhouetted against a lighted window, as it were. If you continue looking at this for a while, you will see it fluctuate from one form to the other quite involuntary. In the same way, the black cross on the white ground becomes a white cross on a black ground, and the transparent cube takes on two different positions. Cut out the figures and stick them on separate pieces of card, and, taking them one at a time, press the spring contact every time a reversal takes place. You must adopt a really passive attitude to the diagram, however, and not try to concentrate on one particular aspect of it. Rates of reversal vary considerably from individual to individual, usually lying in the range 5-40 oscillations per minute. Fig. 14 shows the record obtained from a patient in a mental hospital where this particular phenomenon is of diagnostic value. The upper line is the patient's oscillation rate, the centre is the metronomic time-scale in one second intervals, and the lower one indicates the point at which the measuring should start. This enables the experimental subject to become accustomed to the task, the opera-

Fig. 9.—Enlarged views of pen tip.

Fig. 10.—Details of spring contacts.

The incorrect (a) and correct method (b) of ruling the record with 3-second intervals the record shown again at 40 rpm.

Fig. 11.—Examples of timing graphs produced by the chronograph.

By incorporating a number of pulleys and sprockets a range of paper speeds can be obtained.

Fig. 8.—Details of belt and chain drives.

This enables the experimental subject to become accustomed to the task, the opera-

Fig. 12 and 14.—Graphs recording reaction time and stability.

Note that once stability has been established (A), one figure (b) remains predominant.
Washout Due to Flexure

The loss of tip incidence which results from wing flexure has another very important effect on the handling qualities of swept wing aircraft. Let us take the case of a pull out from a high-speed dive. The pilot pulls the stick back so as to raise the nose of the aircraft and increase the incidence of the wing. He expects that, if he then holds the stick fixed, the aircraft will pull out at a normal acceleration; that is, in a flight path with a constant radius of curvature. But let us see what happens. After he has pulled the stick back, it takes a moment before the aircraft attitude can change and the lift build up on the wing. When this happens the wings bend slightly upwards and, as we have seen, shed lift at the tips. On a swept wing aircraft the tips are well behind the wing aircraft and increase the incidence of the wing. He expects that, if he then holds the stick, the aircraft will pull out at a normal acceleration. As we shall have occasion to refer to this effect again, I shall call it "washout due to flexure," the term "washout" being in common usage to describe a reduction in incidence of the tip of a wing as compared with the root. Some washout is often built in a straight wing to improve the stalling behaviour.

The Aero-isoclinic Wing

If we return to the model of the swept-back wing and apply the load farther forward, it is obvious that we will produce a nose-up twist which will counteract the washout due to flexure and, if we choose precisely the right point at which to apply the load, we can bend the wing with no change of incidence along the span. This is shown in Fig. 10c, which appeared in the May issue.

One way of doing this is to place the torsion box well back in the wing so that the air loads acting at about the quarter chord line have a considerable moment arm about the torsion box. Even so, the torsional stiffness of the wing may have to be less than usual so as to get the right relation-

All wing air liner projected in 1945.

"The Shape of Wings to Come" was first presented as a paper at the British Association Conference in Belfast, September, 1952, and is reprinted here from the book by David Keith-Lucas, B.A., M.I.Mech.E., F.R.Ae.S., Chief Designer at Short Brothers, Rochester.

Another solution is for rotating wing tip controls because, if used as elevators as well as ailerons, they offer a means of overcoming the washout by the simple expedient of increasing the washout as the wing incidence increases. They can also be expected to provide excellent control at high mach numbers.

This solution of the aero-elastic problems has been advocated by G. T. R. Hill, who calls it an "aero-isoclinic" wing to indicate that the incidence or inclination to the airflow remains constant along the span in spite of flexural distortion. Fig. 11 shows possible appearance of such an aircraft with rotating wing tip controls.

The Crescent Wing

Another solution to the problem is to crank the wing tips forward from the rest of the wing so that the load on the tips is forward of the axis of the wing.

This is the "crescent wing" which was pioneered by Arado in Germany, and has since been developed by Handley Page in England and is shown in diagrammatic form in Fig. 12.

It is quite an attractive solution because it also lessens the tendency to tip stalling by reducing the sweepback over the critical tip portion.

There is necessarily some weight penalty on the structure due to the crank but it need not be much, particularly as the crank is fairly near the tip.

Another slight disadvantage is that the tips have to be very thin in order to make up for the loss of sweep.

The aero-isoclinic wing and the crescent wing enable the designer to use higher aspect ratios than would otherwise be possible, and they show to the greatest advantage when the design conditions are such as to demand high aspect ratios.

Forward Sweep

The tendency to tip stalling of sweptback wings is a problem which the designer of
every swept wing aircraft has to face and do something about. One possible solution is to sweep the wings forward instead of back and so get the stall to start at the wing root. It would then be accompanied by the same unstable nose-up pitching moment which we get with sweepback wings, but would be free from the loss of aileron control and sudden wing drop which occurs when the tips stall first.

It sounds quite an easy solution and has certain other advantages, including the opportunity for a long tail arm without a long fuselage. The objection is again that of aeroelasticity. Flexure of a sweptforward wing produces an increase in incidence at the tips exactly the same way as flexure of a sweepback wing causes a decrease in incidence. It is easily visualised by thinking of our model of the sweptback wing and imagining it to be flying in the opposite direction. What was a decrease in incidence is now an increase.

At first sight it would appear that the increase in incidence forward of the centre of gravity would have the same effect on stability as a decrease in incidence aft. In fact, it is much more pernicious because the process tends to be self-energising; an increase in lift causes an increase in incidence which causes a further increase in lift, which causes a further increase in incidence, etc., etc., and at some speed the wing will fail by having its 'neck wrung', which is the phenomenon known as "wing divergence." Now, on a sweepback wing there is usually no danger of wing divergence because of the washout due to flexure. It is only when we try to correct the washout by using a
correction being only an increase in stability. It is perhaps surprising that no designer has yet, at least so my knowledge, tried this variant of the crescent wing. Taken a bit further the idea leads to an M wing, which has certainly been tried by nature if not by man, as Fig. 14 showing a gannet in flight bears witness. But we must remember that the gannet is not designed for transonic speeds, so the reason for the sweep is not the same even though the aero-elastic problems aspect ratio has the property of reducing the effects of compressibility and of making the tendency to tip-stalling less severe; moreover, there is room in the wing to house the engines, fuel and undercarriage. Also, the cut-outs, which are necessary to allow the undercarriage to retract, are not nearly so serious as on a narrow wing. On the Boeing B47, with its very slender wing, it is interesting to see that the undercarriage is housed, tandem fashion, in the fuselage and the engines are slung externally on struts below the wing. How much neater to tuck everything tidily away inside the wing and keep the fuselage as small as possible! But, in spite of that and for all its virtues, the delta wing is not the answer to all our troubles. Strut-mounted engines may look untidy, but they are the favourites of the maintenance engineers. The crews of combat aircraft may also be partial to them on the grounds that the consequences of an engine fire are less serious.

Engines buried in a delta wing may present a beautifully clean installation, but the jet pipes and/or the intake ducts are undesirably long, especially when the aircraft is large, and there must be some weight penalty and loss of efficiency as a result (Fig. 16).

But what is more important is that when altitude requirements demand a wide span, the wing area of a delta becomes unnecessarily large and it has to be paid for in the most precious of aeronautical currency, namely drag and weight. The weight-saving on the basic structure can easily be nullified by the weight of the skin sheeting to cover so large an area plus the weight of the large chordwise ribs and most serious of all, the weight of fuel burnt in overcoming the skin friction drag of the additional wing area.
The very first locomotive stamp was issued in 1860, when the British colony of New Brunswick (in 1867 incorporated in the Dominion of Canada) issued the 1 cent and 12 cents stamps showing a locomotive and a steamer. The former, with its towering tunnel and heterogeneity of gadgets, is as the main motif. Those which I here describe, numbering fewer than 20 in all, are the main ones worth collecting. Of some of the designs there are sets of many values, but for the purpose of making a study an unused specimen of unused denomination will suffice.

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The very first locomotive stamp was issued in 1860, when the British colony of New Brunswick (in 1867 incorporated in the Dominion of Canada) issued the 1 cent and 12 cents stamps showing a locomotive and a steamer. The former, with its towering tunnel and heterogeneity of gadgets, is as the main motif. Those which I here describe, numbering fewer than 20 in all, are the main ones worth collecting. Of some of the designs there are sets of many values, but for the purpose of making a study an unused specimen of unused denomination will suffice.
THE camera is designed to take standard plates and the magazine built to take up to eight at a time, each plate being held in a thin metal sheath which can be of either tinplate or brass of about No. 24 or 26 s.w.g.

The camera body is a rectangular box made of plywood, glued and pinned together with fine panel pins and with triangular strips of wood, on the inside, covering all joints; it is shown in longitudinal section and part sectional plan in Fig. a and in cross-section in Fig. 2. In this latter view are figured the only major internal measurements it is possible to give, and these are for vertical height and width. The length of the box must, to some extent, be governed by the focus of the two lenses which are fitted, but this focus cannot be much shorter than 5 in.; about 4 in. will be the very minimum, and this only by placing the numbered lugs for engagement with the plate-changing trigger—details of which are shown in Fig. 3—on one side of the longitudinal centre-line of the camera, so as to clear the radially movable vane which separates the two pictures and prevents overlapping of the images projected by the lenses. It also renders dead sharp the inner edges of the pictures. This vane—see particularly the plan view in Fig. 1—must be pivoted on the centre line, although its bearings for pivots could be, say, 1 in. nearer to the front end of the box, i.e., the lens panel.

Focal Length

The question of the best focus to adopt for the lenses of stereoscopic cameras has been discussed in a handbook on "Photographic Lenses," published by R. & J. Beck, Ltd., of London, the well-known makers of optical apparatus, and the general conclusion is that 5 in. is the best for all-round work, and the focus of my own pair was of that length. Actually, two standard 4-in.-plate lenses will be suitable for this camera, but they must be alike, both of 5-in. focus and perfectly matched in every other way in the optical formation, angle of view and particularly in the diaphragm or stop aperture values. There is no rack and pinion; the focus is fixed for infinity, but I have taken portrait groups at distances of down to about 20 ft., and a locomotive, at speed, was dead sharp at about 500 ft. from the camera, full aperture being used in both cases.

Plate Carriers and Release

A few moments' study of the upper drawing in Fig. 1 will show that, although sixteen plate carriers are drawn, only eight are intended to be contained in the camera. Those which are shown in the horizontal position are the same as those which are vertical, each of the former having been, supposedly, one at a time, dropped after exposure. After each plate is exposed the trigger on the top is moved over to the left or to the right in order to release it, and at the same time the partitioning vane is turned to one side or the other; it does not matter which. The turning of the vane may be made the means of lowering the plate slowly and without shock. Whether it is used for this purpose or not it is obvious that it must be moved out of the path of the falling plate.

When all plates are exposed, the back
of the camera is opened in the dark room and the whole plate-holding gear, with the ramps on which they were first supported, can be slid out at the back, the plates pushed out of their thin metal sheaths or carriers and developed.

In reloading, the ramps and their base board are passed back into the camera, the release trigger is pushed over to the right and No. 1 carrier is put in first, then No. 2, and so on to No. 8. All the odd numbers will go to the right and even numbers to the left as in Fig. 3. In this perspective sketch it will be seen that the lugs on the carriers—which lugs are formed on the ends of straps soldered across the backs of the carriers—are shaped for the odd numbers, the opposite way to those having even numbers. This is a definite object in this, and the purpose served is to render it possible to give, by feel, which are the odd and even numbers when loading up, in total darkness, with panchromatic plates. In such cases, strict numerical order does not matter, but the odds, known by the shape of the lugs, must be put in alternately with the evens, and the first one in should be always an odd number.

The several parts of the trigger or plate release and their assembly are shown on the right in Fig. 5. The main item is a single plate, A, to the upper end of which two angles, B, B, are screwed, and to the lower end two other angles, B', B', are soldered. Between these parts, on them, thin brass plates, C, are placed, both shaped as shown. These, together with pieces of either suede leather or velvet (L), glued to the wood of the camera top, inside and out, serve to make the slot in which plate A moves, light-tight. The leathers or velvets are fixed, and plates C slide upon them.

The upper face of the slideable base of the ramp on the part, where No. 1 plate carrier will fall, is covered with a piece of soft, thin felt or cloth, to reduce the shock to the first plate dropped. This is indicated in Fig. 4, upper drawing.

In my own camera, the brass ramp on which unexposed plates are shown resting, was not made sloping, as in the drawing, but horizontal. With the present arrangement of making gravity assist in the forward movement of all the plates, a less powerful spiral spring will be needed; but this spring must be strong enough to keep the carrier lugs well up to the trigger.

Covering the Case

The whole of the inside metal and wooden parts must be painted over with dead black lacquer so as to present no light or bright surfaces for reflection. This lacquer may be made by mixing vegetable black with a thin spirit solution of flake shellac or a ready prepared optical black may be used. Externally, the best finish to give to the camera will be to cover it with a leather-grained material, such as bookbinders' cloth. Obviously all the outside metal fittings must be put on after the covering is completed and these metal parts can be either lacquered, polished and gold lacquered, or nickel- or chromium-plated.

The Shutter

The power for driving the shutter is provided by a long, light spiral spring of fine

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steel wire and the duration of exposure, from approximately one second to one-hundredth of a second. The exposure is made by a series of holes in a tubular extension of a cylinder, which cylinder is fitted with an airlight piston, the rod of which is attached to an arm carried by a long lever arm. The piston is set for an exposure of approximately one second to one-hundredth of a second exposure is made. The piston, the rod of which is attached to an arm carried by a long lever arm, is anchored on a long lever arm. With this lever over to the left, looking at the front of the camera as shown in Fig. 5, it will be seen that in the shutter that the friction will hold it in the full open position, where it is placed by opening and closing the shutter by hand.

Time Exposures

For making exposures of longer duration than the pneumatic cylinder and piston allows the spring arm is moved to the upper quadrant; that is to say to a vertical position and the spring then becomes inoperative, except for the fact that the spring tension will produce such upward pull on the shutter that the friction will hold it in the full open position, when it is placed by opening and closing the shutter by hand.

Fig. 5.—Full lens apertures and shutter travels.

To make such hand movements one or other of the pawls must still be pulled out of engagement and the same hand, which by a finger in the right hand, pulls the pawl, when the pawl down, can move the shutter until the arrow point marked on the lug coincides with the fixed arrow on the shutter frame. Obviously it is thus possible to make time exposures of any duration.

It is released by pulling down the right-hand ring, cord and catch, which on this is done and exposure made, the lug to which the piston rod is secured will have passed over to the left and the lug become engaged with the left-hand pawl. To reset for the next exposure, the shutter itself is not touched, but the long spring release lever is turned over to the right-hand side so that when the left-hand pawl is pulled out of engagement with the shutter lug the second exposure is made.

LOCOMOTIVE STAMPS

(Continued from page 377)

The most valuable stamp, however, in the locomotive range, and certainly the most weird-looking from the point of view is a stamp, which was issued for use on letters passing between the capital, Lima, and the towns of Galloso and Chorrillos. It was issued in long horizontal strips instead of in sheets, and is imperforated. The design and inscriptions are embossed in white on a solid ground of red. The arms of the country occupy the lower part of the central space and above is a steam-engine and tender, both having six wheels.

Before the end of the century other examples came from Nicaragua (1890), Salvador (the 3 cent of the second issue of 1890) and Honduras (1897). These show engines of a primitive kind, the huge bell-topped funnel being a marked feature. The United States came to the fore again in 1901 with a stamp illustrating a train with the caption "Fast Express." This is the first time a locomotive is shown, based more or less on present locomotive lines. It was one of a set of six values issued in conjunction with the Pan-American Exhibition held at Buffalo, each value of each of the series was designed to represent the march of progress. Perhaps the most interesting is the 4 cent which depicts one of the earliest types of automobile.

In 1928 a special set of stamps was issued by Ecuador to mark the 25th anniversary of its first railway. The set consists mostly of triangular stamps bearing portraits of great men and famous cities, but the lowest value is rectangular and shows one of the contemporary engines. Four years later Nicaragua and the U.S. produced on the Zelaya issue of 1912 an engine of the ancient Peruvian class, and this is thought the more convenient for looking through the eyepiece. If on the side, then the most suitable, as it is most suitable for the eye, right or left.

Another thing is a series of stamps to cover the lenses, as a safeguard against accidental and unintentional opening of the shutter. One of these captures is shown in Fig. 1 and it is to take these that the tubular rings are provided on the outside of the shutter case.

Items of Interest

Cans by the Million

With a floor area of 62,000 sq. ft. and standing 139 ft. 11 in. high, Northern Ireland factory of the Metal Box Co., Ltd., produces more than 230 million cans a year. About 230 workers are employed, and into the cans produced in 1952 went 40,000 tons of fruit and vegetables.

Atomic Submarine

The American Atomic Energy Commis- sion's Schenectady office recently released information relating to the construction of an atomic-powered submarine. The prototype is land-based and experiments with it are to be performed inside a 22 ft. diameter metal sphere. The concrete causeway which is to form the foundations on which the sphere will rest has already been completed; it is 37 ft. in diameter and 42 ft. deep. Helping to support the sphere in the saucer will be a ring of steel columns set in concrete.

This giant steel ball has been designed in order to give additional protection to operat- ing personnel above that given by the pressure of the water. The volume of the sphere will be 5,494 cu. ft. and will be made of welded steel plates, www.americanradiohistory.com
CATALYTIC CRACKING

The Story Behind the First Fluid Catalytic Cracking Plant in Britain

It is somehow symbolic that a revolutionised process like catalytic cracking should be controlled by a young man. And Ted Jeffers, who bears the imposing title of Cracking and Light Ends Divisional Supervisor at the Esso Refinery at Fawley, is still only twenty-six.

After taking his degree in chemical engineering in 1947, he joined Esso Petroleum Company and went to work in the Technical Service Department of the old refinery at Fawley. For decades of his progress and abilities were quietly watched and noted down, until one day he was called in by the Refinery Superintendent and told that he had been chosen to go to America in advanced technical training in new refining techniques. For by 1950, the great new refinery under construction at Fawley was nearing completion, and many of the units being built had never existed in England before.

In the United States, Jeffers studied the design and theory of the Fawley cat-cracker and watched the operation of existing units at various refineries throughout the country. After four months' intensive training he returned to England, arriving back on Christmas Eve, 1950. At Fawley, the cat-cracker construction was still under construction. Jeffers's first task was to prepare a training programme for the men who would ultimately operate it with him. This man had a basic knowledge of refining from their work in the old refinery, but they had to be introduced to new instruments and new techniques. For the unit is a highly technical mechanism which needs constant watching and a deep understanding.

All the molecules of petroleum contain the same elements—atoms of hydrogen and carbon, of carbon. The molecules in crude oil, however, contain varying numbers of hydrogen and carbon atoms, which result in widely differing patterns. Some of the molecules contain a large number of atoms. Those with many carbon atoms make up the thicker and heavier components of petroleum, such as asphalt. Others with relatively few atoms make up the lighter and more volatile components, like petrol.

Distillation

The first step in refining is distillation, which roughly separates the molecules in crude oil according to their size and weight. The process can be thought of as taking a barrel of gravel containing stones of many different sizes and running it through a series of sieves to sift out the small ones, the next larger, and so on, up to the very largest of all. As applied to a barrel of crude oil, this process "sifts out" such things as gas, petrol, kerosene, heating oil, lubricating oils, heavy fuel oils and bitumen.

But while distillation can separate crude oil into its fractions, it cannot get more of a particular fraction out of the crude than it is naturally there. This process is known as cracking.

Earlier we compared distillation to sifting out stones of different sizes from a barrel of gravel. Cracking is comparable to crushing some of the larger stones in order to get more small ones. Cracking amounts literally to breaking big molecules into little ones, and has made it possible to produce more than twice as much petrol from a barrel of crude oil as can be made by simple distillation.

The type of cracking which was first invented (and which is still used) employs only heat and pressure, and is called thermal cracking. A later development was catalytic cracking.

The Catalyst

A catalyst is a substance that causes other substances to change chemically without being changed itself. No one knows precisely why it works—only that it does. You can try it yourself by holding a lighted match to a lump of sugar. The sugar will begin to melt, but it will not catch fire. If you put the sugar in some cigarette ash, though, and then hold a match to it, it will burn. Now the ash itself would not burn, nor would the sugar by itself, but when combined the ash acts as a catalyst and changes the sugar's reaction to flame.

Fluid Catalytic Cracking

The fluid catalytic cracking process, which was developed in Esso Laboratories, revolutionised catalytic cracking, for it enables the process to run continuously for months on end. Thermal crackers require overhaulS about once a month, whereas fluid crackers have been on stream for periods up to a year or more; and these longer periods between overhauls mean lower maintenance costs and a cheaper product.

Fluid catalyst cracking, therefore, is now the leading cracking process. But at the time the Standard Oil Development Company began its experiments with catalytic cracking thirteen years ago, fixed-bed or stationary catalytic cracking was the accepted method.

Initial tests carried out in Esso Laboratories were literally on a half-pint scale. A number of small units were set up consisting of catalyst containers through which oil vapours could be passed and from which the cracked petrol could be withdrawn. Hundreds of catalysts and dozens of oil stocks were tested with results so favourable that it appeared desirable to step up operations and to begin thinking how to overcome the difficulties inherent in the fixed-bed type of operation.

The size of the organisation concerned with the development of this process soon grew from a few technical men to a very large team of more than a hundred chemists, chemical engineers and mechanical engineers, who worked together with several

A general view of the Esso Refinery at Fawley.
hundreds of operators, analysts and mechanics. Work was then proceeding on the designs of a large fixed-bed plant, and in order to miss no chances, it was decided that part of the organisation should work on alternative techniques which offered the promise of being better than the fixed-bed type of plant. Experiments with these entirely different methods were also begun on a very small scale, but it soon became apparent that the use of powdered catalyst would enable the plant to be more easily built and operated. The laboratory tests with powdered catalyst were soon being scrutinised by all the chemists and engineers involved, and a three thousand five hundred gallon-a-day pilot plant using powdered catalyst was built. In its operation, catalyst from the hopper was forced by a screw conveyor into a vapourised oil stream, and the mixture of catalyst and oil vapour was sent through a heated coil where the cracking took place.

Again after several months of intensive effort, the engineering details of the process were worked out on this pilot plant and plans for a four hundred and fifty thousand gallon-a-day commercial plant began to go on to the drafting boards. Just as the construction of the four hundred and fifty thousand gallon-a-day unit was about to begin, there came one of these moments which gladden the hearts of research workers. By tying together all the work on powdered catalyst, it became clear that if the proper amount of gas (either oil vapours or air or steam) were mixed with the catalyst, it became fluidised and could be handled like water or oil. Further, it became evident that this “fluid” composed of catalyst and vapour could be made heavier or lighter as desired, simply by changing the amount of vapour added to the catalyst and by controlling the speed at which the new fluid moved. This technique of changing the density of the fluid could be used through a system of stand-pipes to generate any desired pressure at any particular point in the system, and by proper manipulation could circulate the catalyst through the units without moving parts.

Here was a really revolutionary idea. It was recognised at once that by the time these new principles were put into operation, although the cracker’s exterior shows no operation were bound to result. Again the three thousand five hundred gallon-a-day pilot plant was completely rebuilt to put these new principles into effect. The engineering factors were established in a relatively short operation of the pilot plant, and development immediately followed the building of the four hundred and fifty thousand gallon-a-day unit.

Despite the risk involved, the first large unit proved completely successful and development was hurried on to its goal, the designing and constructing of large commercial units. The extent of engineering work needed to design a commercial plant may be judged from the fact that one of the first of these plants took one hundred and twenty-five thousand man-hours of engineering work alone. Contributions to the development work have also been made by many other oil companies; and the patents which cover the fluid process have since been made available to the entire industry.

The fluid process grew in a remarkably short time from the laboratory to the first commercial plant, which went into operation in May, 1942, at Eso’s Baton Rouge Refinery. The first commercial unit was over a hundred times larger than the previous pilot plants. In spite of the growth in size, however, the development of the process has been marked by a continuous simplification. In the number of its plants, the fluid process leads the other catalytic cracking processes by substantial margins.

Fawley Construction

Construction of the vast cat-cracker at Fawley began in April, 1950, when thirty thousand cubic feet of concrete were poured to form its foundation, and it was completed and on stream two months ahead of schedule towards the end of 1951. Although the cracker’s exterior shows no movement, a veritable storm takes place inside its huge vessels. Vast quantities of vapourised oil, air and powdered catalyst circulate at high temperatures through miles of pipes and reactors.

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grains of catalyst become coated with carbon removed from the oil. The catalyst is then inactive. By being whisked into a regenerator where the carbon is burned off, however, the catalyst is reactivated and thus can be used over and over again. The regenerator liberates heat equivalent to fifteen hours of coal every hour, and this is used to raise the temperature of the oil to the cracking temperature. Any surplus heat is used for steam raising. Although its intake is approximately a million gallons a day, the instrumentation of the unit is so skilfully designed as to be largely self-controlling and only twelve men are needed to supervise the running of the plant. But once the cat-cracker is in operation, it runs continuously night and day for many months on end, and so there are four shifts of these twelve men, three on eight hours of duty each day and one shift off-duty.

The Stillman's Work

As an example of their jobs, let us take the stillman. On arriving at work, he takes over his duties from the previous shiftman, the stillman. On arriving at work, he takes off-duty. Ted Jeffers, the supervisor, and Leonard Keel, his assistant, he checks the operation of the air blowers and gas compressors. This inspection is carried out once an hour throughout the whole shift. In between times, a close watch is kept on the dials in the control room, which record on the operations taking place in the various parts of the unit. If one of the instruments registers anything unusual, an immediate check is made. First the stillman checks the particular section of the plant where the upset has taken place; he checks all flows, temperatures and pressures relevant to this section of the plant and modifies any of these if he feels it is advisable. If, for example, an instrument is obviously giving trouble or a pump is not running as it should be, then he will call in the necessary mechanical personnel to remedy the defect. If, however, the upset is something that he cannot analyse himself, then wherever necessary he will call in the unit supervisor who can bring in any further assistance that is required.

The Supervisor's Job

When Ted Jeffers arrives in the morning he first checks the plant, then issues operational instructions and prepares a list of required maintenance for the engineer. Next he collects the details of the previous day's operations, including log sheets, laboratory reports and instrument charts, and prepares a summary of them, which is presented at the daily process meeting with the process superintendent, Dr. Pearce. At this meeting, the complete refinery operations for the previous twenty-four hours are analysed and discussed and any alterations for the present twenty-four hours are announced. Such variations may be designed to meet a change in the demand for the finished products.

His other duties are the general supervision of the running of the cat-cracker, the training of new staff, and planning the future operation of the unit. (The annual shut-down is not decided by him, for it is planned well in advance to fit in with the refinery's other operations.) Then, just before going home in the evening, he puts down in the general instructions book all details of the unit's operations during the day.

The feed stock for the cat-cracker is a heavy gas oil, which normally forms part of the fuel oil used for bunkering ships and of which there is a surplus after normal distillation. By subjecting this gas oil to catalytic cracking, however, 65 per cent. of it is transformed into far more valuable and far more necessary high-octane petrol, while the remainder emerges as gas oil, which is not re-processed, but is used as a blend stock in the manufacture of industrial and marine fuel oils.

Reprinted from "The Esso Magazine," by courtesy of The Esso Petroleum Company, Ltd.

An Automatic Draught Excluder

Lifts a Rubber Strip Over the Carpet

By J. L. BROWN

As will be seen from the sketches, the opening of the door releases a spring which lifts the draught excluder away from the floor. When the door is closed a screw positioned in the door jamb acts on a cam to which a lever is attached. This lever is connected by a rod to the hinged draught excluder and imparts to it a downward movement, bringing it into contact with the floor as the door finally closes.

The actual draught excluder is formed of a light aluminium hinge running the full width of the door, a rubber strip forming the seal, being attached to the lower leaf of the hinge. A light 22 S.W.G. spring is positioned round the hinge pin, the two ends being braced against the top and lower halves of the hinge respectively; this keeps the draught excluder in a raised position when the door is opened. A 3/32 in. rod is silver soldered to a plate which is in turn riveted to the lower half of the hinge so that the end of the rod projects past the edge of the door sufficiently to engage in the elongated hole on the end of the lever.

The Cam Plate

This is cut to the thickness of the door, drilled and countersunk as shown in Fig. 2, so that it may be screwed to the edge of the door. This cam plate and the cam and hinges are of steel peg silver soldered to a plate which is then riveted to the cam plate. The cam and cam plate are formed from 20 S.W.G. mild steel.

The Lever

The lever is also cut from 20 S.W.G. mild steel and the dimensions are given in Fig. 3; it hinges on a steel peg silver soldered to the cam plate. Both this peg and the one on which the cam hinges are lightly peened when their respective parts have been fitted. The device may, of course, have to be made to operate in a way on which the door opens.

The actual draught excluder is formed of a light aluminium hinge running the full width of the door, a rubber strip forming the seal, being attached to the lower leaf of the hinge. A light 22 S.W.G. spring is positioned round the hinge pin, the two ends being braced against the top and lower halves of the hinge respectively; this keeps the draught excluder in a raised position when the door is opened. A 3/32 in. rod is silver soldered to a plate which is in turn riveted to the lower half of the hinge so that the end of the rod projects past the edge of the door sufficiently to engage in the elongated hole on the end of the lever.
LETTERS TO THE EDITOR

The Editor does not necessarily agree with the views of his correspondents.

Petrol Pump for Lighters

SIR,-I have a suggestion which would, I think, improve the design of the lighter fuel pump described by Mr. L. Wingo in the March issue.

Lighter fuel is very volatile and highly inflammable, therefore it would be dangerous to have Mr. Wingo’s pump anywhere in the house. The reason is this: when a lighter has just been filled there is liquid on top of the plunger up to the level of the spout, therefore, until the pump is used again the fuel will be evaporating through the spout. Also when the pump is used again the fuel will not be up to the level of the spout, and so it will not deliver the required amount of fuel.

If the rod were shortened so that in the rest position the plunger closed the end of the delivery tube, the whole thing would be sealed, so no evaporation could take place.

The pump would still operate in exactly the same way, because the tube below the plunger would always be full of liquid, so that when the plunger is depressed an inch, an “inch” of fuel would be transferred to the top of the plunger and expelled when the plunger was released. —CHRISTOPHER Fox (Welling-

grove in the March issue.

A Hearth Coal-box

SIR,—I enclose a sketch of a simple but efficient hearth coal-box.

The container itself consists merely of a discarded potato crisp tin; a biscuit tin would also suffice, the lid being discarded. The idea is that the box, which is located on the stand by four angle pieces, can be lifted out, carried to the coal pile and filled, thus dispensing with a bucket. Likewise, it can be taken direct to the fire when the latter requires remaking.

I have not shown too much detail on the sketch as the making of the stand can be left to the builder’s own choice of shape, etc. The tin sizes are apparently of standard dimensions and the sketch shows how I fitted mine on the stand. Alternative leg shapes could be bent quite easily, the whole job being extremely simple.

With regard to finish, I painted the box a bronze colour, and the stand and handles black.—D. McCREDY (Harborne).

Time-lag in the Cinema

SIR,—The time-lag between the picture seen and the sound heard at the back of a cinema is quite a normal thing, and it is difficult to see how it can be avoided. What surprises me is that the manager and visiting engineer at the cinema did not point out the reason to your correspondent, for all terrestrial purposes light travels instantaneously but sound travels at the comparatively slow pace of round about 1,100ft per second, so that at the back of a cinema 140ft long the sound is heard about one-eighth of a second after the appropriate picture has been seen. Such a lag can quite easily be observed but is rarely noticed by the average cinemagoer for two main reasons, the principal one is that this time-lag is normal in everyday life, a speaker on a public platform may be 140ft away and this same time-lag must occur, but is never noticed unless the listener concentrates on it. The other reason is that producers avoid or keep as short as they possibly can shots which would make this time-lag apparent.

The sound for a given “frame” on a film is eight frames in front, this allows for a minimum of loop in the projector. If a careless projectionist threads the film with a loop the film takes too long to get from the projector “gate” to the sound “head,” thus increasing the time-lag; I have known this lag to be increased in the projector by as much as 50 per cent. without anyone complaining, so that it would appear to pass quite unnoticed by the majority of persons.

Extension speakers at the back of a cinema would be just horrible. If a cinema fitted with hearing aids (mislabeled deaf aids) is available to your correspondent he should visit it and experiment with one of the aids, the plugs for these instruments being usually on the back seats which shows up the effect to the greatest extent. The sound is produced in the ear-piece of the aid at the same time as it is produced in the loud speakers behind the screen, but, of course, it takes time to travel down the hall to the observer in the rear seat; the sound from the aid is heard by (say) the right ear and that from the screen by the left ear, and the result has to be heard to be believed.

Experiments are now being conducted in St. Paul’s Cathedral on sound reinforcement by loudspeakers fitted in different parts of the auditorium, but a time-lag has been artificially introduced into the loudspeaker circuits so that each speaker produces the sound at the same time as the air-borne sound reaches the same position.

The artificial time-lag is very interesting; it consists of a rotating disc on which the sound is magnetically recorded, the reproducing head is at a suitable distance around the disc from the recording head so that the time taken for a given recorded sound to (Continued on page 389)
**GAMAGES**

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- WATER OR OIL PUMPS—Rolls-Royce built, cap. approx. 2,000 gals., P.H. inlet and outlet, flanged, splined shaft, 1½ H.P. required. Many uses, 45½.

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Did you know? A Showroom is being allotted to the display of this material which can be inspected at your leisure.

MAIL ORDER SUPPLY CO., THE RADIO CENTRE, 33, Tottenham Court Road, London, W.I.
LETTERS TO THE EDITOR

(Continued from page 380)

travel from the recorder to the reproducer is the time-lag; the record is wiped out before the disc rotates back to the recording head. — "DERBAN" (Barking).

Conservation of Energy

SIR,—The work done by a magnetic field in moving an iron object from one place to another is the same as the work done on the magnetic field by moving the object back to where it came from. Thus, in Mr. Bailey's hypothetical experiment, the energy is stored in the field by the work done in pulling the weight off the magnet and replacing it on the platform. If the weights are not removed, the magnet will pick up where it came from.

Dr. D. E. F. (London). 1

Cistern Fault

SIR,—May I offer my experience to augment your answer to the above query, which seems to have nothing to do with the recording equipment of the cistern, but is a continuation of the flush pipe into the stand pipe inside the cistern.

When the cistern is full, a force equal to the weight of the water in the cistern, overflows, as would certainly occur if the valve was defective in seating or the bell was dropped. If air is unable to enter the flush pipe after the flush, the water will still in the cistern, and so the water still in the cistern is displaced by the bell dropping down and displacing the stand pipe inside the cistern.

The weights are not removed, the magnet will pick up where it came from. — R. A. FAITHORNE (Farnborough).

Modern Pumps. Edited by E. Molloy. 240 pages, 150 illustrations, 42 x 6 in. Published by George Newnes Ltd., Tower House, Southampton Street, Strand, W.C.2.

THIS is a survey of modern pumping equipment, a subject of great and growing importance to-day. Pumps exist in great varieties and of widely different capacities. Pumping applies not only to liquids but to solids, and this book deals with the subject in two parts: the first dealing with principles and layouts, construction and operation, and the second covering three main types of pumps, installation, maintenance and repair; whilst the second half deals with special applications for particular duties and their choice. The contents include: Principles of Pumping; Reciprocating Pumps; Centrifugal Pumps; Rotary Pumps; Installation, Maintenance and Repair; Boiler Feeding and Feed Pumps; Pumps for the Mining Industry; Oil Pumps; Well and Borehole Pumps; Pumps for Special Applications. The book is fully indexed.—F. J. C.

Successful Conjuring for Amateurs, by Norman Hunter. Edited by F. J. C. Camm. 384 pages, and impression. 18 x 11 in. Published by C. Arthur Pearson Ltd., 29 Southampton Street, Strand, W.C.2.

THE first edition of this book went out of print within a few weeks. It is the book which the conjurors unsuccessfully tried to ban. The publishers, however, undaunted by threats have embarked upon a second edition, and no doubt large numbers will be sold to conjurors themselves before this can be said of such subjects as conjurer's equipment, tricks with flowers, magic wands, cards, chemical balls, chemical magic, cookery, levitation, lamps and candles, knots, watches, pictures, trays and plates, dice and cubes, conjuring with colours, tricks with hats, paper, rings, cigarettes. There are nearly 400 illustrations.

The book the conjurers tried to ban.
Photographic, Optical and Scientific Instruments

We have received a new catalogue of the products of Messrs. Charles Frank, 67-73, Saltmarket, Glasgow, C.1., and a wide range of items is listed.

Many types of binoculars are included, ranging from the lightweight for holiday use to the bulk-mounting binoculars, weighing, with mounting pillar, 1.34 lb. There is a section covering many kinds of rangefinder, sextant and navigational compass, and a long and comprehensive list of lenses and prisms is included. Several pages are devoted to second-hand astronomical and terrestrial telescopes and also available in a wide range of both new and second-hand microscopes. Details are given of a comprehensive stock of ex-Government and second-hand theodolites, levels and other surveying instruments and accessories and examples are shown of the varying types and sizes of drawing instruments which are for sale. Many items are offered “on approval” if desired, and all goods carry a guarantee of satisfaction or refund of payment.

Low Melting-point Solder

A new Multicore tape solder, which melts with a real tin lead solder, without the use of Low Melting-point Solder desired, and all goods carry a guarantee of satisfaction or refund of payment.

Many items are offered “on approval” if desired, and all goods carry a guarantee of satisfaction or refund of payment.

A NEW Multicore tape solder, which melts with a match, will shortly be available, and this will mean that small components can be joined, models constructed and repairs made on toys and other household articles with a real tin lead solder, without the use of a soldering iron.

This solder contains cores of Ersin extra active non-corrosive flux and thus no extra flux is required. It is of the same high quality as the well-known Ersin Multicore solder which is sold in cartons and on reels.

The price of a card of this new product is 1/- and full directions for its use are given on each card. The maker’s address is Multicore Solders, Ltd., Multicore Works, Marylands Avenue, Hemel Hempstead, Herts.

S. and B. “Dermic” Oller

DESIGNED for the controlled and accurate lubrication of any small or intricate working parts, the “Dermic” oller can also be used as a grease or flux gun. It can be loaded with any oil up to XL consistency. Similar in size and action to a hypodermic syringe, it is particularly useful for clock and watch lubrication. The oil is fed down a needle tube and if the cleaning wire is inserted into it, the flow of oil will be restricted, the wire acting as a stylus, feeding the minutest drop of oil required for watch pivots, etc.

S. and B. “Dermic” oller

When using as a grease or flux gun the needle is dispensed with as the bore is too small to force it through; soldering fluid, however, may be fed through the needle. The “Dermic” is also very efficient for injecting fluid into wormholes in woodwork. Spare needle tubes are available; standard 9d. each, and extra long 1½/- each, and a packet of six spare leather washers costs 6½/-.


Steam Traction Engine Preservation Association Publications

TWO small booklets entitled “Burrell Two Seven O Four” and “Doble” E24 “Essent to Norfolk by Steam Car” have been written, edited and published by A. T. Phoenix, who is founder of the Steam Traction Engine Preservation Association, Thetford, England. The first of these is a collection of humorous short stories dealing with the now almost extinct steam engine fraternity. The second is an account of a journey by the American-built Doble steam car, with an authentic description of the car, some humorous incidents and photographs taken en route. The price of these books is 1s. 9d. each, or 2s. post free from the address given.

Electronic and Radio Equipment

MESSRS. CLYDESDALE SUPPLY CO., LTD., have sent us their two latest catalogues, one containing a list of ex-service items and the other being a supplementary list of radio and television components. These two books will shortly be produced as one. Both catalogues are arranged alphabetically and include a vast diversity of equipment with widely different applications in the fields of electronic, radio and television. The items listed range from small things such as control knobs and resistors at a few pence each to complete ex-R.A.F. transmitter and receiver units costing several pounds and including such items as television practice kits, electric motors, plugs and sockets, switches, capacitors, gramophone pick-ups, wireless books, loudspeakers and many other components too numerous to mention. The price of the ex-service catalogue, and its radio and television supplement is 1s. 6d., and it may be obtained from Clydesdale Supply Co., Ltd., 2, Bridge Street, Glasgow, C.5.

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By F. J. Gamm

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STRAWBERRY HILL, LONDON, S.W.1.

Club Reports

Ramsgate and District Model Club

A memorial service will be held at the above club’s premises from September 21st to 26th inclusive, from 6 p.m. to 10 p.m. daily and from 3 p.m. to 10 p.m. on the Saturday.

Guests are invited from local patrons, modellers, etc., on special days, leaving Tuesday and Friday evenings open to anyone who would care to come and see the club, and to view the demonstration of its activities including a display of members’ models.

On the Saturday it is hoped that any club or society interested will pay us a mass visit, and secretaries of some that are interested are asked to contact the club first so that arrangements can be made to make their visit pleasurable.

During the past year the Ramsgate Model Club has made good progress. Membership has increased and several promising juniors are “coming along.”

During the summer months the workshop is open on Friday evenings only from 7 p.m. to 9 p.m. Visitors are always cordially welcomed at the club in Princes Street, off Queen Street, Ramsgate.—Hon. Sec., E. CHURCH, 14, St. Mildred’s Avenue, Ramsgate.

Port Talbot, Neath and District Society of Model Engineers

THERE was a good attendance at the fifth annual general meeting of the above society which was held in the Club Room, Melyn Works, Neath, on Friday, April 10th, 1953. The balance-sheet for the year ended revealed a very satisfactory credit balance on the year’s working. Thanks were accorded to the Auditors, Mr. E. J. Williams and Mr. J. V. Roberts, and the following Officers for 1952-3 were elected. Chairman, Mr. J. Thomas; Vice-Chairman, Mr. A. Hiscock; Treasurer, Mr. D. H. Jennings; Secretary, Mr. D. Elwyn Evans; Committee, Mr. S. Morse, H. Tugdlay, E. J. Williams.

The third annual dinner was held at the Castle Hotel, Neath, on Thursday, March 19th, 1953. A good number of members and their womenfolk were present, and we were honoured by the presence of our President, Major J. L. M. Bevan, and Mr. A. R. Harris, Hon. Solicitor, and a very enjoyable evening was spent.—Hon. Sec., D. Elwyn Evans, Bronchwyn, 6, Beechwood Avenue, Neath, Glam. Tel. 726.

Birmingham Society of Model Engineers, Ltd.

A T the A.G.M. of the above society, held on Monday Night, Mr. J. E. Guy was elected hon. secretary in place of Mr. R. Phillips who resigned. The following dates have been fixed as part of our summer programme:

June 6th—Public Day.
June 13th—14th—West Midland Federation Rally.
June 15th—Social Day.
July 4th—Public Day.
July 19th—Visit from St. Mellans and " O " Gauge Day.
August 1st—Public Day.
August 15th-16th—Loco trials.
September 5th-6th—National Rally.

The National Rally has been fixed for early September, therefore will all clubs please make a note of these dates, as this annual event is a rally of live steamers on quite a large scale.—Hon. Sec., J. E. Guy, 21, Penwood Road, Bordesley Green East, Birmingham, 9.

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SALES AND WANTS

The pre-paid charge for small advertisements is 4d. per word, with box number 1/6 extra (minimum order 6/). Advertisements, together with remittance, should be sent to the Advertisement Director, PRACTICAL MECHANICS, Tower House, Southampton Street, London, W.C.2, for insertion in the next available issue.

SITUATIONS VACANT

The equipment of present owner’s three steam driven A.B.C. presses is for sale. Full details from the Ministry of Labour or a scheduled agent. 3/6; 10/-; or a woman aged 19-17. Write or phone Home of Businessman, 15, Valentine Avenue, N.W.15.

SKEILL INSPECTORS wanted by a large firm in the motor trade of S.E. London for experience in general machine work. Must have technical qualifications. Apply to T. C. for decisions. Apply No. 105, 6/9 PRACTICAL MECHANICS.

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HOUSE SERVICE METERS, credit and prepayment; available from stock. Universal Electrical, 221, City Road, London, E.1.

COMPRESSORS for sale, 3 C.F.M., 100-lb. pressure; including piping, driving wheel and receiver, 10/-; 2, 1/2 H.P., Heavy Duty Motors, 3/-; carriage forward, 6/-; London, E.C.2. Phone: Baudouin 7589.

PERIODICALS of various descriptions, 2/-; post 8d. per copy. W. R. Weir (Engineer) Ltd., 3, Sepulchre Avenue, Bristol, 4.

STAMP OF APPROVAL, 2/-; post 8d each. Inquiry to: The Stationary Engineer, 75, High Street, Huddersfield.

THE BOOKSELLER, 3/-; post 8d. per copy. Weekly. A. H. Whyman, 55, Oak Road, Harold Wood, Essex.

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June, 1953

NEWNES PRACTICAL MECHANICS

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Turbentine will mix with and thin out Japan gold size, but when it has become perfectly dry and hard it cannot be redissolved with turpentine. If the specimen is to be immersed in methylated or similar spirits, dry water, then Canada balsam may be used as a cement.

Cellulose acetate sheet is not permanent or rigid; it both darkens in colour and shrinks with the passage of time. The only way in which rings of this material could be fixed to the slide would be to immerse the whole slip of glass in a cellulose solution —celluloid dissolved in amyl acetate—let it dry off and then block the rings down with a celluloid cement. The cover glass would have to be similarly treated. Alternatively, for use for a limited time only, the acetate sheet could be used for both bottom sheet and cover, using no glass at all. Cementing difficulties would then disappear. If there is to be no cover glass, and the fluid, say, oil of cedar wood, is to serve for oil immersion, then I suggest cementing with glue.

In any case, you would be well advised to abandon the acetate material entirely and purchase rings of glass from dealers in microscopic materials.

Ice-box Insulator

WISHING to make an ice-box, suitable for use in a trailer caravan, I should be pleased of your advice as to the best insulator to use.—D. S. Marshall (Brighton, 7).

We suggest that you use any of the following:—Celluloid, Slab Cork, Fibre Glass, Stulbat, Slag Wool, Celotex.

The thermal conductivity of each of these substances is about 0.05 B.T.U.s per sq. ft. per inch thickness per deg. F. temperature difference.

Namely, thin thickness will provide greater efficiency than thicker, but in view of the space difficulty which must necessarily be present in a caravan, you will probably be satisfied with results from the use of thin.

Greenhouse Heating

AT present I have fitted into my 8ft. x 6ft. greenhouse 140 ft. 2in. galvanized conduit pipe with a return of tin. copper pipe. This is heated with a small (6in. x 4in. x 4in.) boiler which has clamped to its side a smoothing iron element (300 watts). Sufficient heat is given out on account of the comparatively low thermal conductivity of the boiler shell and/or because the element is not maintaining close and tight contact with a smooth and clean surface on the boiler. As a result the heat generated in the element is not being transmitted to the boiler but is causing the element to operate at an excessive temperature. Better results would be obtained by using an immersion heater in the boiler.

However, we consider that more efficient results would be obtained by using tubular heaters. These could conveniently be in 2ft. lengths each of 70 watts loading, the various sections being connected in parallel. For use on a 230-volt supply each 70-watt element could consist of 40ft. of 38 s.w.g. nickel-chrome resistance wire wound on a strip of asbestos.

Repairing Prismatic Compass

I HAVE an old filled-Prismatic compass (Barkers Patent, Pat. No. 2965F, 1910). I recently stripped it down to the lens, and the lens is set in a case to remove air bubbles, and refilled it with masts. This had disastrous effects on the compass card, which ceased to exist. Could you tell me if I could get another card, also if I can get a suitable liquid to refill it? If I cannot repair mine, could you inform me where I could buy Prismatic compasses?—P. G. Adam (Rutland).

Your difficulty will be to obtain a compass card of the exact dimensions for your existing instrument, and you may have to make an extensive search. The following firms, however, are actual makers of mariners’ and prismatic compasses, or else are suppliers and retailers. From one of these sources you will probably (with a little luck) be able to obtain suitable replacement compasses. Henry Hughes and Son, Ltd., 59, Fenchurch Street, London, E.C.3.; Messrs. E. M. Vowell, 13, John Street, London, E.C.3.; Messrs. A. W. Gamage and Co., Ltd., Holborn, London, E.C.1.; Maritime Stores, Ltd., 8 and 10, Lancelot Hey, Liverpool; Messrs. James Morrison, Ltd., 1, Lower Street South, Sunderland; Messrs. J. J. Wilson and Son, 19, Hudson Road, Sunderland; Messrs. James Sangster, Ltd., 4, Broadway Street, Birmingham; Messrs. C. Baker, 244, High Holborn, London, W.C.1.; Messrs.
from a wet bowl or pail in which the shingle then take a scoop and scatter the shingle to begin with.

H. J. Meyer (W.7.)

Rhodamine Naphthalene sulphonated dyes
Ammon. acetate
Ambergris...
Alizarine compounds:
as above stated
dozens or minium foil.

substances on ground glass (E.17).

told that many interesting experiments can be carried out with them. We

use carbon tetrachloride without this liquid being inflammable.

Strictly speaking, any reasonably inert fluid can only suggest, in the present circumstances, one, for celluloid is not soluble in spirit. We

obviously unsuitable for your compass. This varnish is thick but, with care, it can be brushed out to a thin, glossy film.

Removing Stamp-pad Ink

I
can remove violet stamp-pad ink from white paper.—F. R. Bull (Macclesfield).

MOST of the two-solution ink-removers will remove violet stamp-pad ink from paper quite readily. You can make such an ink-remover in the following way:

I take up 1 teaspoonful of castor oil, of cold water.

Store this in a well-stoppered bottle and, unopened, in the dark. In another well-stoppered bottle, place 2 parts of glacial acetic acid and 4 parts of water. To remove the ink markings, rub or brush over them a quantity of the chloride of lime solution, avoiding wetting the paper so as far as possible. Then brush or rub over the same paper a little of the dilute acetic acid solution. The ink markings will quickly turn yellow, dis-colour and fade away. The process can be repeated until every trace of the ink markings has vanished. Whenever possible, it is always advisable finally to wash the paper in running water.

Information Sought

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

Mr. E. G. Skoines, of Exeter, writes: I would like to hear from an expert in making a paddle-driven pedal boat for a small child. I have one of the alloy aircraft tanks (the big ones used by the fighter 'planes extra range), which have been made into boats, canoes and motor-boats, but I would like to make a paddle-boat for river use. If you have in mind of a pedal boat, driven by change gear suitably " mud-guarded."

Mr. R. C. O'Dell, of Bedford, writes: Please furnish me with details of a pedal-driven "coasting", incorporating a figure mechanically. A propeller drives a shaft to which is attached a figure of a man. As the propeller rotates, the shaft causes the man's arms to work, and it appears that the man is working the propeller.
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A.G. and D.C. Motors A to 1 h.p. Write

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Battery-various contacts, 8/6


Brass Pistons and Cylinders11/6 in.x 3in.

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Powerful small Blower Motors, 24 v.


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Miniature 24 v. A.C./D.C. Motors, 1/6.

Multimeter Kits with calibrated M/C meter, readouts volts 3, 150, 300 and 600. MA. 0-60. Ohms 0-5,000, 8/6.

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Jin x Jin. spindle, 4,000 r.p.m., 40/6.

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36 resistances (1 to 1 Watt), 5-Bank Tesla 6-way

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