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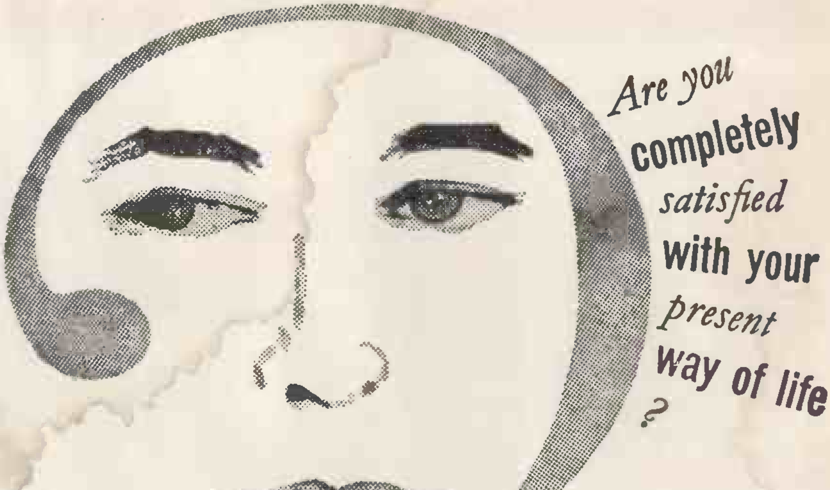

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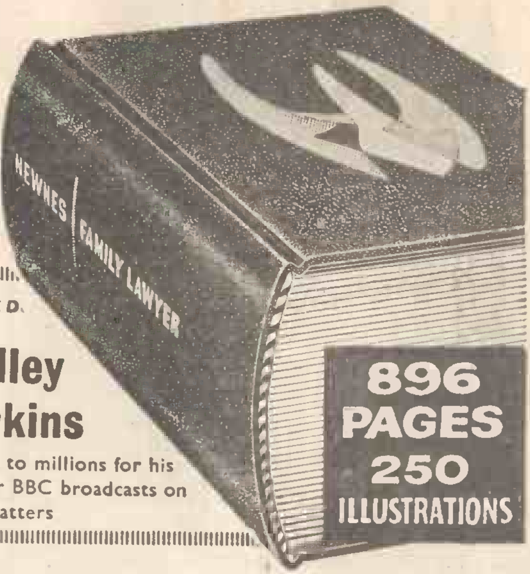

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TALKING POINT

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CONTENTS

Hovercraft in miniature

ILLUSTRATED on our cover is an air-cushion vehicle which, though made by a well-known firm of manufacturers of toys and furniture, is a good deal more than a toy: it is a hovering semi-scale model with characteristics calculated to interest not only youthful aeromodellers but anyone concerned with hovercraft.

Assembled from a kit or obtainable in finished form, the Mobo hovercraft is powered by a 0·8 c.c. model aero engine of the glow-plug-ignition type driving a three-bladed lift-fan in a shallow pylon amidships. The light-gauge but well stiffened moulded-plastics hull is a double-walled structure forming an annulus through which the peripheral jet emerges. For forward propulsion a proportion of the air is bled from the main supply and ejected through (a) triangular vents in the mountings of the twin rear fins and (b) six stub pipes projecting through the transom.

The little craft will operate over any reasonably smooth, dust-free surface or, ideally, over water. With the engine adjusted to optimum revolutions a hoverheight of approximately ⅛in. is obtained, with a forward speed of about 10 m.p.h. Course is controlled by adjusting the rudders, which are hinged to the fins by soft aluminium strips, this means the craft can travel in a circle. The main exit ducts provide slipstream effect over the rudders.

A table-top demonstration in the offices of this journal showed—more vividly than any words, drawing or even film—the true implication of the term "air-lubricated", for the lightest push with one finger would send the hovering vehicle drifting across the table.

Overall dimensions are: length 17in., beam 11in., height to top of fins 4in.; weight is 11·5oz. Retail prices are £2 2s. in kit form without engine or £7 5s. for the fully assembled and finished craft with engine. The kit has been designed for a variety of British and U.S. motors. Included, incidentally, is a neat fuel-dispenser by BP —who are well versed in fuelling rather larger craft of this type.

The manufacturers of the Mobo hovercraft are the Jetex Division of D. Sebel & Co. Ltd., West Street, Erith, Kent.

Reprinted from the "Air-Cushion Vehicles" Supplement to "Flight International."

The Hovercraft Kit

ALL scientific research does not begin and end in a laboratory. In many cases it entails physical hardships as well as hazardous pursuits, and one such instance concerns some of the scientists and technicians associated with Canada's interest in Oceanography.

This might almost be termed a companion piece to the article on Canada's new Institute of Oceanography, in Nova Scotia, which appeared in the May issue of PRACTICAL MECHANICS AND SCIENCE. It concerns frogmen—but frogmen with a difference, scientists, who are learning a new craft and are training to venture into the depths of arctic waters. By this method, oceanographers who go down to the sea in ships and pursue scientific studies in Canada's deep, and shoal, waters, are going to get a closer look at their element in the future. Following the lead of geologists, who last year made under-water sea-bed studies off the east coast of Canada, a group of oceanographers are practising skin-diving in preparation for future research in arctic seas.

OPERATION DEEP FREEZE

By our science correspondent

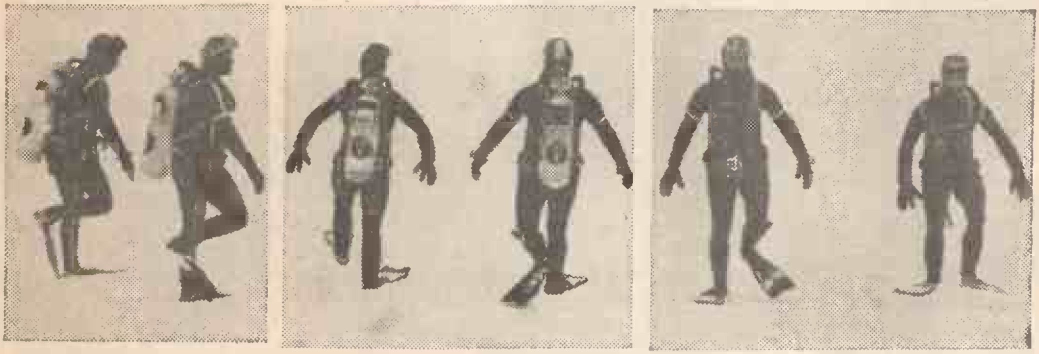
(*right*) A plank across the ice hole is used to anchor the life-line which these arctic skin-divers use for safety when working on the bed of a frozen lake.

(*left*) After skiing across the lake dragging their equipment on sleds, the oceanographers' first task is to saw a hole in the ice.

In sub-zero temperatures, half-a-dozen oceanographers, hydrographers, and technicians, leave their warm offices and laboratories, don special skin-diving suits and, pulling a sled or toboggan laden with scientific equipment, ski across a frozen, snow-covered lake to the spot where they intend to operate. First, with a special ice-saw, they cut a sizable hole in the ice, exchange their ski boots for flippers and don their self-contained under-water breathing apparatus. A plank placed across the hole in the ice acts as an anchor for the rope the skin divers use for safety when down in the depths testing their instruments and examining the lake bottom. Not exactly the type of job for a novice, but everybody has to learn to do their job properly, and scientists are dedicated people. Swimming deep in the freezing lake depths, they can observe under actual working conditions, the oceanographic instruments with which they will be working in northern research. Also they will accustom themselves to ice-cold water and adapt the technique of " scuba " (self-contained underwater breathing apparatus) diving to the needs of their profession.

In future seasons of research work the skills they learn will pay off in first-hand observations of physical-biological aspects of the ocean floor and the correct functioning of delicate underwater research instruments and cameras. This innovation in Canadian oceanography is, however, but a small part in a growing field of operations. In addition to research programmes to gain knowledge of sea areas on Atlantic and Pacific coasts and in the Arctic Archipelago, Canada is joining a dozen other nations in a scientific assault on the Northwestern Atlantic. In this operation, Canadian oceanographers are to be responsible for

(*right*) Winter work for these oceanographers used to be in the warm data analysis office at the Department of Mines and Technical Surveys.



Dressed in their foam diving suits, breathing apparatus and flippers these divers look curiously like penguins. Perhaps they wish they had a thick coat like a penguin —though their suits do keep out most of the cold.

processing and analysing all the research data obtained—a proud indication of Canada's international interest in the new science of the sea.

The surge of scientific interest in Canada's vast sea areas has been largely spurred by Dr. W. E. van Steenburgh, Director-General of Scientific Services, Department of Mines and Technical Surveys, and Dr. W. M. Cameron, Director of Marine Science's Branch in Ottawa. The data analysis chief, Charles Sauer, a master-mariner, turned geologist, turned oceanographer, is one of the small band learning the intricacies of ice-water scuba diving, as is his assistant, Blake Kelly, who has sailed in arctic seas as an oceanographic technician.

Though commonplace in warmer waters, skin-diving in arctic seas—where ordinarily a man lost overboard is given but minutes to live—calls for added precautions and a stricter diving drill. In icy salt-water seas (which can remain liquid below freezing temperatures because of their mineral content) the scuba-diving oceanographers and technicians expect to be able to stay under water for useful periods and keep reasonably warm in their single-skin outfits. These outfits contain thousands of pinhead-sized bubbles which act as insulation.

As the fascinating study of oceanography expands, it brings together men of widely varied interests, background and professions. Most of their work, despite close association with the unpredictable sea and the ice-breaking ships and research vessels which are their floating workshops and laboratories, consists of pure research and the evolved processes of scientific discovery. Though observations are made from wind-swept decks in stormy seas, or in the stillness of a flat calm, much more time must be spent in the laboratory to digest the information recorded. So, clad in these specially-made rubber space suits for exploring the *inner space* of vast water regions of the earth's surface, Canadian oceanographers swimming in the chilly depths will be as one with their subject and will gain an affinity with their later research work in office and laboratory that could hardly be gained by remote study alone.

LATHE GADGETS

Part 20

LATHE MODIFICATIONS

By L. C. MASON

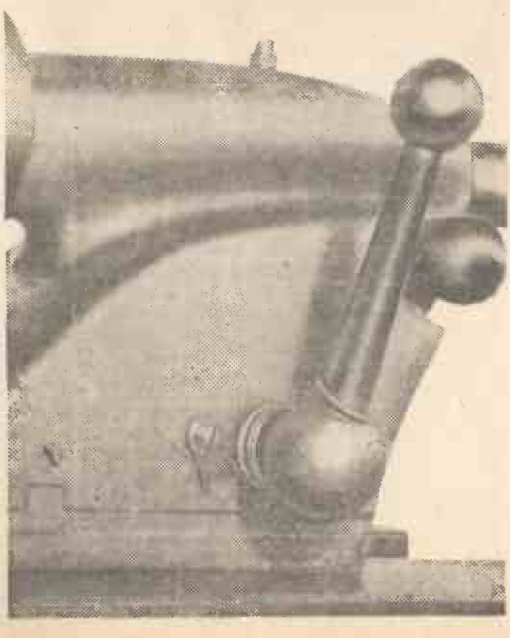
SO far, this series of articles has dealt entirely with accessories, for use with the ML7 or similar lathes, which can be fitted to the lathe by the normal attachment methods. There are, however, a number of slight modifications and additions to the ML7 itself which can make a deal of difference to the convenience of using it. It was thought that this series might well conclude with the mention of some of them. None of these modifications is such that the lathe cannot be quickly restored at any time to its original condition, apart from an odd small hole or two.

One slight modification has already been mentioned in the first of the pair of articles covering dividing (Sept., 1962 issue), and that was the conversion of the stud hole in the change wheel fixed cover plate into a slot. The front finger nut on the cover need not then be loosened more than a couple of turns to remove the cover, instead of having to take the nut right off. This modification has been made by the makers on recent ML7's and is worth while on older models.

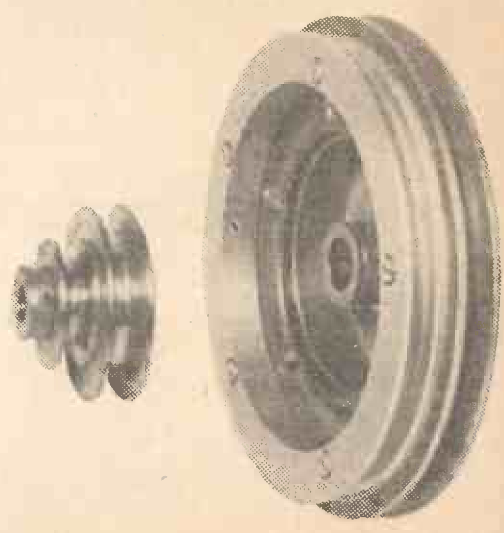
Another modification that helps to produce accurate work—particularly in cross-slide boring and milling jobs—is the provision of a cross-slide lock. This is merely a 2B.A. pinch screw in the edge of the cross-slide, positioned between two gib adjusting screws and on the same horizontal line. Its position should be chosen so that the pressure on the gib strip comes on the solid V-ways across the saddle, wherever the cross-slide may happen to be between its limits of travel. This applies to both standard and extra long slides, and can be seen in several earlier photos of various set-ups.

At the indicated spot, merely drill and tap for a 2B.A. by 1 in. Allen screw, which can be left permanently in place. In normal use the screw should not be run in far enough to nip the gib strip. To

Rear view of ML7 tailstock showing the clamp lever retaining spring described in the text.



The new small pulley and the modified countershaft pulley for the two-speed modification to the ML7 lathe.



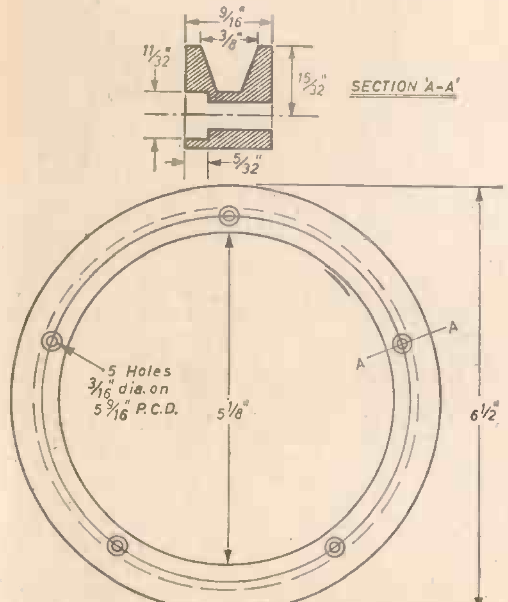
lock the slide, tighten it hard enough to hold the slide firmly by its pressure on the strip. It may be found that when the slide is fed right in, the head of the cap screw just fouls one side of the raised spot-facing for the saddle lock bolt. If this is so, a small clearance can be filed on the side of the bolt seating at the back of the saddle. Alternatively, an Allen grub screw can be used. The use of a cap screw is preferable on the whole, as it enables a stouter Allen key to be used for locking.

Incidentally, the lock screw is a worthwhile addition to the Myford vertical slide as well, fitted and used in precisely the same way. In the writer's vertical slide two tapped holes have been provided for the one screw, giving alternative positions for the screw to ensure that it can always be made to bear fairly on the shorter V-way.

Continuing to discuss locking movements, the rear lever which locks the tailstock to the bed by an eccentric clamp will be familiar. The most effective position for the lever to reach the end of its swing, and at which it exerts the most pressure, is when the clamp eccentric is not quite at "top dead centre." This gives a convenient lever position of about 11 o'clock when viewed from the front. The lever can then be operated by the fingers across the top of the tailstock, swinging it to about 2 o'clock to free the tailstock.

However, if the lever is not re-clamped but merely released in this position, in the writer's lathe at least, it promptly swings down to 6 o'clock, out of sight and reach and necessitating fishing round the back for it in order to re-clamp the tailstock. This became increasingly exasperating to the point where it was thought worth while spending a little time remedying this. Accordingly the lever was fitted with a weak spring, serving to keep it lightly at about the 1 o'clock position. The lever is

Details of the additional pulley ring which bolts to the countershaft motor-driven pulley.



now accessible and to hand at all times; a one-finger movement clockwise completely releases the tailstock or a slight push anti-clockwise clamps it.

The spring can be easily wound from 18 g. spring steel wire, round a ½in. drill shank. First bend a hook to engage the bottom of the lever next to the ball, then wind about three turns of spring, bringing out the end to leave about an inch of straight wire. Drill the tailstock body using a No. 40 drill, to a depth of half an inch, level with the eccentric spindle and ⅜in. or so from it. Tap the hole ⅛in. Whit. Provide a screw and washer, fit the spring, bend the straight tail into a loop round the screw and clamp it under the washer.

One minor disadvantage of the ML7 is the comparatively low top spindle speed—640 r.p.m. with the standard motor pulleys. For smaller diameter turning and drilling, twice this speed would be useful. The Myford handbook mentions a top speed of 830 r.p.m. if a 2½ in. motor pulley is used. The spindle speeds using this size motor pulley are roughly 50% up on the equivalent slower series, and it is quite a straightforward job to provide *both* ranges, giving a usefully increased top speed in a total range of twelve nicely spaced steps.

This is arranged by bolting a slightly smaller V-grooved pulley ring to the motor-driven pulley on the countershaft and providing a two-step pulley for the motor. There is very little latitude for varying the large pulley size, so any adjustment of sizes to equalise belt tension on both sets is best made on the motor pulley. This can be done quite quickly by trial and error.

The countershaft pulley ring should be turned up from a light alloy casting made from a wooden plain ring pattern. Any local foundry could produce this. It can be machined complete in a 6in. four-jaw, copying the proportions and angles of the groove in the existing pulley. When machined to the dimensions shown and drilled for the five 2B.A. holding bolts, strip the large pulley off the countershaft and mount it to run truly in a four-jaw chuck. Position the new pulley ring on the face and hold it in position with a piece of wood laid across it, backed up by pressure from an old centre in the tailstock. Rotate the mandrel by hand and adjust the position of the ring until it is concentric with the pulley. When correctly placed, clamp both pulleys together with a pair of toolmaker's clamps—avoiding the bolt holes. Remove from the chuck and spot through the bolt holes on to the face of the pulley. Remove the ring, drill the indicated spots and tap 2B.A. If the ring is being attached to the clutch countershaft pulley take care to avoid the makers' balancing holes already drilled in the face of the pulley. Bolt the ring in place and re-assemble the countershaft.

The motor pulley should be turned from a short length of 2½in. diameter mild steel shafting. Bore the piece, fit the set screw and then turn the small belt groove with the job mounted on a mandrel, copying the small pulley groove exactly. Turn the large diameter groove next, a trifle narrow at first, and then mount the pulley on the motor shaft and try the belt tension using this groove. It will probably be impossibly tight. Re-mount the pulley on the mandrel, widen the groove very slightly and try the tension again. Repeat if necessary, until the belt tension is the same on both sets of pulleys. If by this time the belt has sunk below the outer diameter of the pulley in the large groove, turn off any surplus from the outside that does not contribute to belt grip.

SMALL BLOWLAMP

makes a useful Workshop addition

BY JOHN WALLER

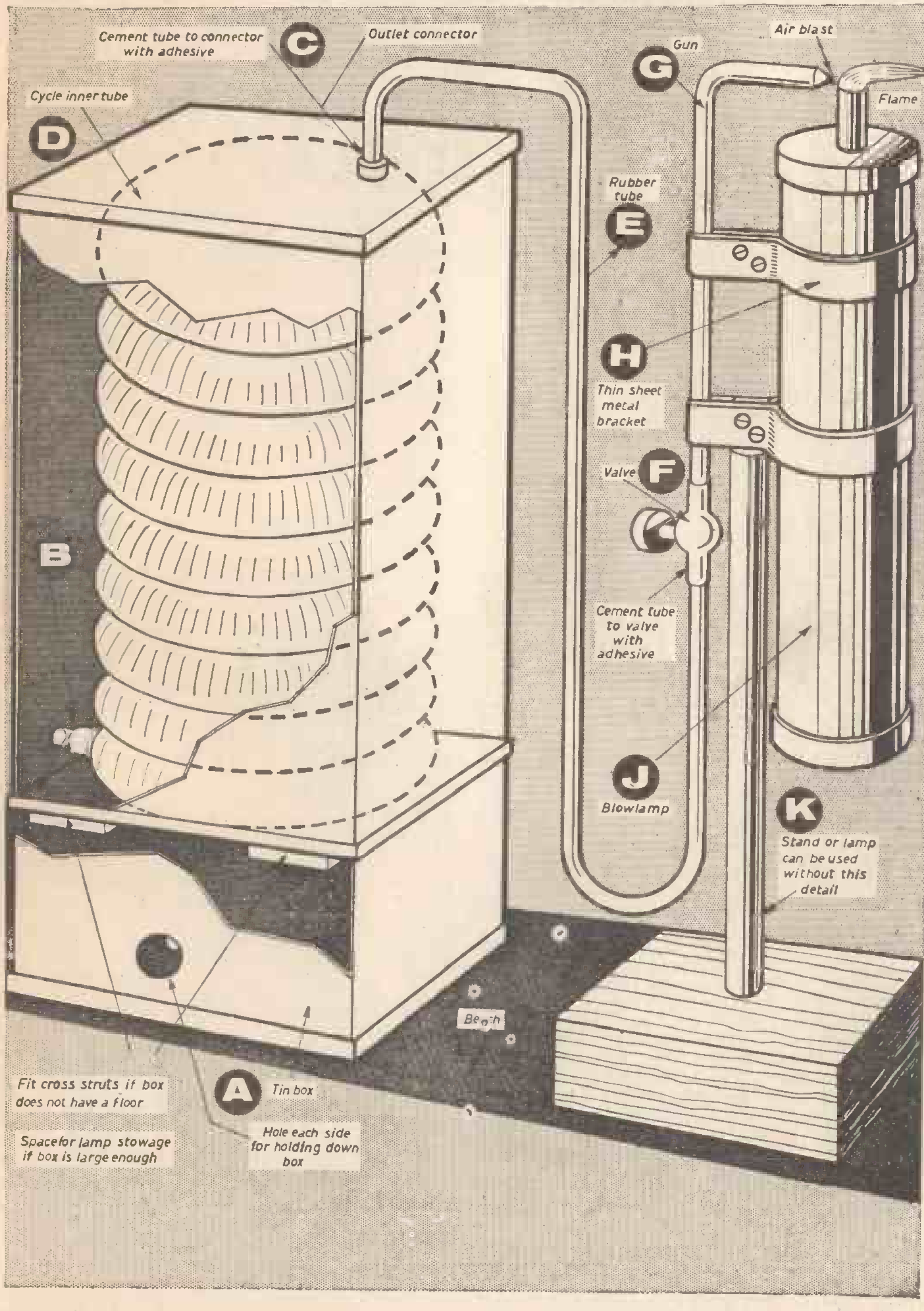
A SMALL mouth blowlamp is often a useful piece of equipment to possess when a soldering job or some similar melting operation is necessary, where the degree of heat required need not be high. However, the continual puffing of air can give rise to that high blood pressure feeling, so any gadget that overcomes the lung bursting technique is welcome. Much better control over the flame can also be obtained if a constant pressure is available. Manipulation of the parts is also easier as better concentration is possible.

The drawing illustrates a blowlamp of this type that will operate for several minutes, which is usually long enough for all but the most awkward jobs of soldering. Construction is simple and uses some of those odd items of material that are retained in the workshop for no other reason than that the owner believes they may become useful. A suitable metal box is required, an empty biscuit tin for the smaller version of this lamp, or perhaps an oil drum to hold a larger tyre if it is desired to have a longer pressure of air before recharging is essential. The provision of struts or a floor as shown is optional, but is useful for storage purposes when the lamp is not in use, as it can be stowed in this space. Having decided whether this is necessary, a hole should be made in the side of the tin or drum in an appropriate place to accommodate the valve connection " B " from the tyre. However, prior to inserting the tyre another connection to it is required, to allow the escape of air. This should be arranged to come at some convenient point at the top of the container. If difficulties are experienced in cementing the connector to the tyre, any garage will perform this task where equipment for vulcanising tyres is available.

Whether a stand for the lamp is desirable is another point the reader can decide for himself, but the time taken in making such an article is soon repaid as this overcomes the problem of finding somewhere to lay the lamp down every time an operation is completed or suspended for a time. A wood base is suitable and if made sufficiently large it will not fall over at the slightest touch. Drill a hole in the base and insert a dowel rod; a light smear of glue will hold this rigidly in position, particularly if the initial drilling is a close fit with the rod. Two thin metal clips or some similar arrangement should then be arranged to hold the lamp. One of these—the lower one—could be made to pivot if required.

A length of $\frac{3}{4}$in. diameter rubber hose cemented to the connector and valve completes the assembly. Make sure that the joint is absolutely air tight otherwise the air will soon leak away and continual pumping will be necessary which will be blamed on a faulty tyre or connector. Lap in the tap barrel with a little grinding paste before final assembly to ensure this part will turn off effectively without a suggestion of leakage.

Refinements such as brackets for holding down the box or drum to the bench or a handle to lift it from place to place, have obvious advantages and their addition depends on how much a user requires this equipment. A pair of holes punched through each side as shown on the drawing are useful for the former purpose. Finally, it is not suggested that a new tyre be used as an air container because most cycle shops and garages have a number of comparatively old items which are throw-away scrap and usually well patched. Though perhaps dangerous for road use they will serve a useful life inside this tin for several months before they require replacing with a similarly worn one. A cycle tube will give a reasonable length of " blow " before reinflation is required, but obviously a car type tube has several times the capacity, and as a fairly high pressure is possible with the tyre safely concealed inside the drum, a surprisingly long and strong blast is secured that makes mouth blowing an unwelcome task best regulated to the distant past. One final point. Do not forget to clean out the tin or drum thoroughly before inserting the tube because the presence of oil can soon rot the rubber.



Cut-away drawing of the air reservoir and the lamp on its stand. The cycle inner tube should be neatly coiled in the container as shown.

UNTIL a few years ago when the latest maritime warning technical systems were installed, Sable Island had enticed an estimated 500 ships to their doom. Thousands of sailors had perished in the roaring surf around its shores. Sable Island was not so named because sables are found there but because the word "sable" means sand in French. And sand is what this potent menace to Atlantic shipping consists of—soft, treacherous, shifting sand sprawling across the busy shipping lanes. Sand shrouded in clinging fog and lashed by 90-mile-an-hour gales. Sand that comprises the loneliest and most barren outpost off the east coast of North America, and has been responsible for more maritime disasters than any other land of equal area in any part of the world.

Sable Island is 170 miles east of Halifax, Nova Scotia. Known as The Graveyard of the Atlantic and owned by Canada, it has been shunned for centuries by sailors and fishermen. It is the visible portion of a treacherous sandbank which extends beyond it in hidden sand bars for more than a dozen miles under the sea—a deadly menace to shipping. The island itself, 24 miles long and an average of one mile in width, is shrinking daily as the insatiable tides eat away its shoreline. Lighthouses erected on either end eventually fall before the endless beating of the sea, and new ones must periodically be rebuilt further inland. The thunder of the sea when it strikes this long thin line of sand is nerve-shattering. The vibration of the whole mass under the mighty impact threatens to shake the island into oblivion. Death, grim and leering, is always on patrol, ready and eager to take advantage of any mistake or error in reckoning on the part of navigators. Mariners claim that some sinister quality is possessed by the sands of Sable Island which will confuse the best compass made if an unfortunate ship ventures too near. Many Nova Scotia fishermen keep a sealed flask of Sable's yellow, insidious sands among their marine mementos.

Twenty-one people live on this "dust-of-death" island, employees of Canada's Department of Transport, and their families. The men operate the latest weather-tracking devices, issue regular weather bulletins, and warn navigation of approaching storms. They are specialists in the use of life-saving apparatus and surf boats. They also man two lighthouses and the marine radio beacon which 24 hours a day warns ships to stay well clear of the hungry sands.

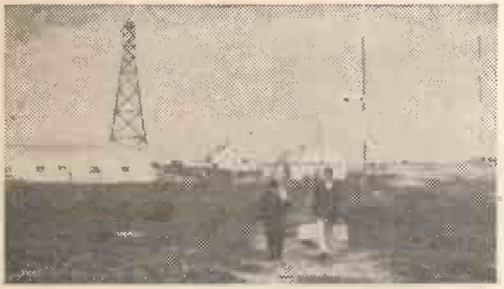
Some of the ponies have been domesticated, and are used to haul buckboards loaded with supplies. Main weather station is in background.

So effective have Sable's modern safety measures become during the past few years that the last ship to come to grief there was the "Manhasset" on July 18, 1947. No lives were lost, but the ghastly toll of ships and men preceding the "Manhasset" leaves no mystery about why Sable is referred to as a graveyard. Buried all around the island are the shattered, twisted and rusty skeletons of hundreds of wrecked ships.

They include the New England trawler "Gale" and the big Philadelphia steamer "Independence Hall", both wrecked on Sable in 1945. All the crew of the "Gale" were rescued, but ten sailors on the "Independence Hall" perished. Three of the bodies were washed up 18 miles from the wreck. Others were the S.S. "Lemberg" (1937), the "Labrador" (1926), the "Sylvia Mosher" (1926),

GRAVEYARD OF THE ATLANTIC

By Paul Brock



The main weather station at Sable Island. Twenty technicians are employed here, and work one-year shifts. Many bring their families.

Youngsters play near deserted lighthouse on Sable Island. Constantly shrinking, it is now half the size it was 200 years ago.

the "Sadie Knickle" (1926), the "Falmouth" (1925), the "Puritan" (1922), the "Esperanto" (1921), and the "Marshal Foch" (1921).

The list of known and recorded wrecks goes on and on, right back to the grim disaster which led to the establishment of the first life-saving shelter on Sable in 1801. In February of that year the British Army transport "Princess Amelia", with 200 men aboard, was swept on to the shores of Sable Island. Every man perished. A gunboat was sent to pick up hoped-for survivors. It, too, was wrecked and all hands lost. A party was then settled on the island to rescue shipwrecked people and save property from pirates and freebooters. A proclamation was issued forbidding any person, on pain of death, to reside on Sable Island without a Government licence. Most of today's residents live at the principal weather station near the centre of a valley which extends almost the whole length of the island. There are also five other out-stations where men keep watch.

Sable Island is rich in hair-raising legend, and old-timers pass on tales of the headless horsemen who accompany patrols on stormy nights. They talk of the ghostly shapes of lost ships rising out of the mists, and the eerie sounds of drowned sailors whispering in their sandy graves. In 1927 one man serving on the East Light had to be taken off the island, a nervous wreck. He kept seeing the ghostly shape of the doomed schooner "Sylvia Mosher". This vessel was lost with all 60 hands in August, 1926. Each time this unfortunate man saw the spectre of the schooner he said he could make out the figures of men leaping over the side to their deaths in the boiling surf.

The origin of the 300 wild ponies which roam the wreck-strewn sandbar is shrouded in mystery. One theory is that they are the sole survivors of a French settlement sent to colonize the island in the 15th century. Another, that they struggled ashore when the French frigate "L'Africaine" struck a sandbar and broke up with the loss of 40 lives in 1822. The ponies eat beach grass, wild peas and flowers. Despite this unusual diet, the animals grow tough and shaggy, and are greatly prized on the mainland. Every year a few are rounded up and shipped out, but the herd always remains roughly the same due to breeding.

Nothing much else exists on the island in the way of vegetation. No trees grow there, no crops. So loose is the sand that the surface is constantly altering. A conical hill once only a few feet high is now over 200ft, and is still growing with the tributes of the storms. Often, after a shrieking

GRAVEYARD OF THE ATLANTIC

Personnel on the island, like Bert Haley shown here, operate the latest weather-tracking devices and warn shipping of approaching storms.

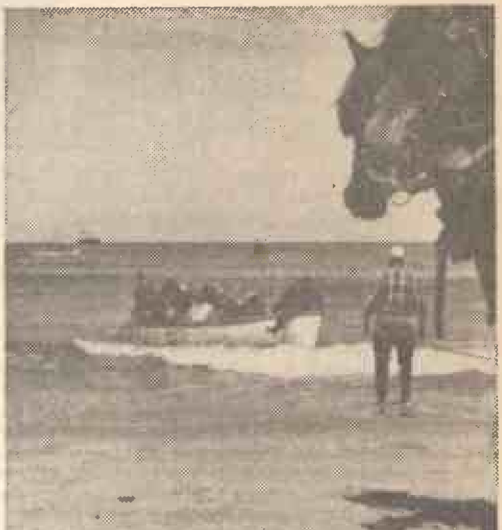
gale, the skeletons of shipwrecked mariners and the ribs and timbers of derelict vessels which have been buried for years, are exposed by the pitiless sea blast. Children of the inhabitants spend much of their time outdoors searching for, and finding, treasure in the form of Elizabethan coins, French trinkets and jewellery, rusty old cutlasses, muskets, cannon balls, and items of ships' stores. Once a large packet of English five-pound notes was found, said to be worth £1,700. Another time a patrolman picked up a human skull and a solitary seaboot. When he shook the seaboot several bleached skeleton toes fell out.

Though housing accommodation on the island is limited to two frame houses and a collection of aluminium huts, a generating plant helps ease the austere living conditions there. Residents have washing machines, refrigerators, radios and stoves. They contact relatives on the mainland by using a "ham" radio. Personnel serve on Sable for one year only, and are then relieved by other meteorological experts, radio operators, light-keepers and their families. For recreation they read, listen to the radio, and visit each other's living quarters. There are no cinemas, stores, cars, buses, or even bicycles on Sable. Anything heavy is transported by pony and cart. The island is the loneliest and most barren outpost off the east coast of North America.

Yet Sable was really the site of the very first European settlement in this continent. French explorer De La Roche landed 48 convicts from French prisons, plus 50 sheep, on its shores in 1598. He left them there and went on to explore Nova Scotia. The convicts built huts from wreckage swept up on the beach. They ate seal and mutton, and dressed themselves in sealskins. Twelve survived and were taken back to France in 1605. As the colonization of North America proceeded, Sable became a sort of paradise of villainy. It was not only the scene of countless wrecks, but also the chosen resort of wreckers who deliberately lured ships to their doom. Blood-thirsty pirates prowled around it in their ships, waiting for the island to do their murderous work for them.

Today a relief steamer calls from Halifax three times a year with stores, fuel, books and other reading matter. Because there is no harbour, this vessel stays at safe distance offshore while surf boats go out to it and load. If the weather is bad the relief ship cannot come near. In 1930 the vessel had to stand off the island for 17 days. Provisions ran short among the residents and they were reduced to eating ponies.

Surf boat loaded with supplies is brought ashore at Sable Island. Supply ship stands off in background, while the native ponies wait to move provisions and equipment.



Geologists fear that one of these days the terrific and continuous pounding of wind and waves will wipe out the visible part of Sable altogether. If that happens the dangerous sandbank will be left in utter darkness, all of it lurking just beneath the sea's surface. Even radar will be helpless against it. Such a catastrophe, mariners predict, could increase fivefold the grim toll of vessels and lives so far exacted by the Atlantic's grim graveyard of shipping.

Main spars
Rear spars
Front spars
Wing assembly
Lift struts

Main spars

Some sort of jig is necessary to build the front and rear main spars. Clean, heavy planks of wood, 17ft x 1ft wide, perhaps reinforced with a series of battens on the underside, are ideal. This expense can be avoided, however, by making use of a wooden floor instead, provided it is smooth and perfectly level. Mark out the rib datum line. (This may be done by means of a taut string between two nails, chalked and twanged) and carefully set out the positions of the outer faces of the spar flanges. Draw in the positions of all blocks.

Rear spars

Cut a number of blocks, about 4in. x 1in. or 1½in. slightly less than ¾in. thick and screw down at intervals of about 18in. along the line of the outer faces of the spar booms. Place a block, tangential externally, at each rib position over the tapered portion of the spar. Eccentric buttons may be located at the rib positions against the flange inside lines over the outer 4ft, in order to assist in getting the correct curvature over the tapered region. The same effect may be obtained with packing blocks of suitable dimensions between the flanges, again at the rib positions, to hold the flanges against the outer blocks. Steaming of these parts of the spar, or horizontal slitting, may be found desirable, but the degree of curvature is not large.

Place the two flanges in position in the jig and insert sheets of wax paper or polythene beneath them at the block positions to prevent glue from adhering to the jig. Make and fit all internal blocks, ensuring close fits, and also that the upper faces of the blocks and flanges are in the same plane. *i.e.* the blocks, etc., are of uniform thickness, and set the blocks with glue.

Scarf up the 16ft lengths of ⅛in. plywood (scarf length 1½in.) for the webs, mark out and carefully cut to size. Note: If this is made the first operation the web plates may be used as patterns for making the spar jigs, but care must be taken to avoid even

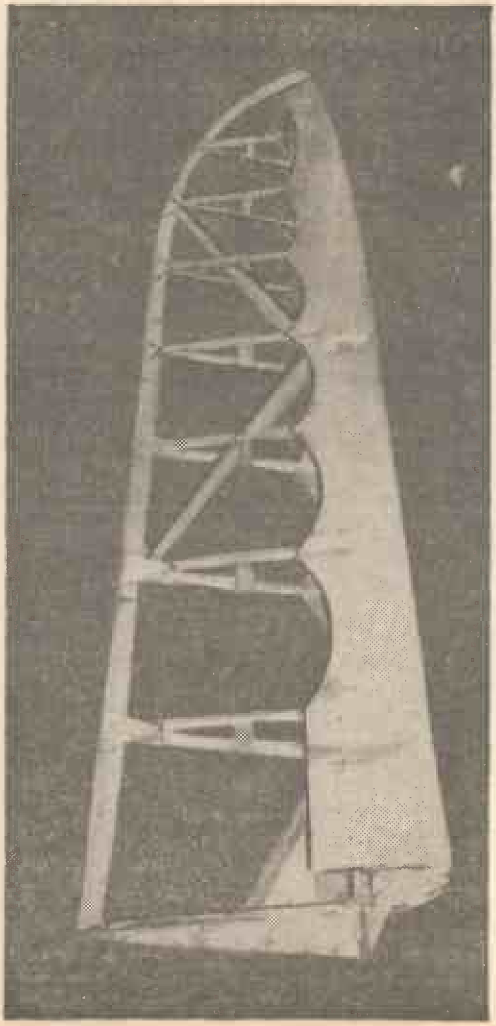


Fig. 37.—An aileron, complete apart from the fabric covering, by Mr. W. J. Sproat of Kircudbright.

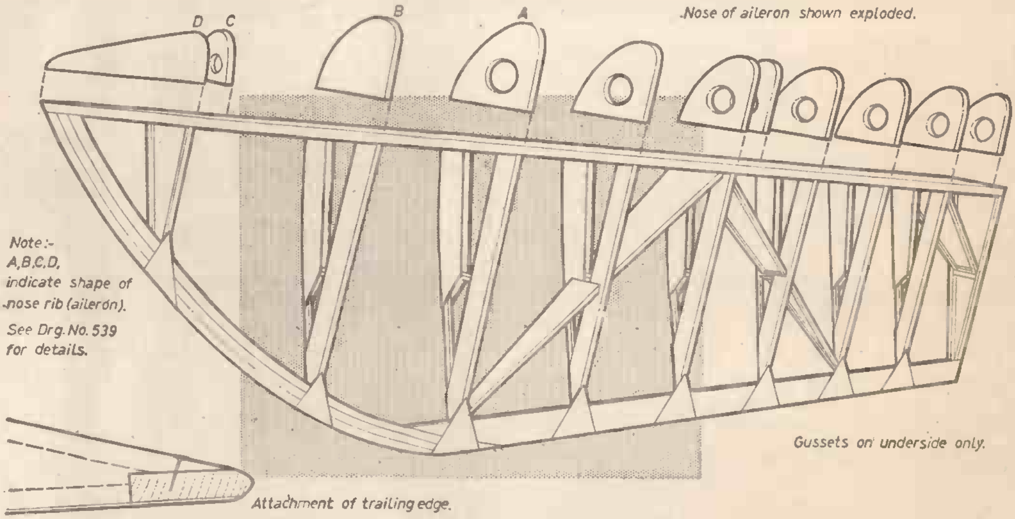


Fig. 36.—Starboard aileron construction and details of attachment of trailing edge to aileron and wing.

slight discrepancies in the webs from being incorporated in the spars. Glue the top faces of the flanges and blocks and the mating parts of the underside of the web plate and fix the web in position with ½in. x 20g. brass brads, at about 1in. pitch and staggered. The jig blocks over the tapered part of the spar should be repositioned for the second, handed, spar and likewise the inclined lift-strut attachment block will have to be reversed.

Front spars

The front spars are a little more complicated, owing to the double flanging of the 'I' section. The process outlined above may be repeated to join one pair of flanges to the ply web, but in this case it is preferable to employ ½in. staples and tacking strips in place of the brass brads. Note that the front portion of the port spar is similar to the rear part of the starboard spar and can be made in the same jig.

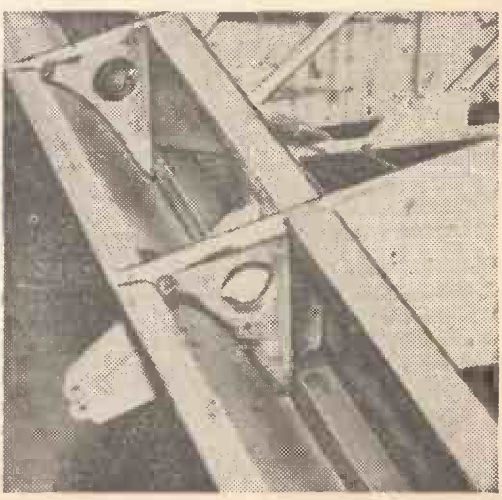
When the glue has set, the tacking strips and staples should be removed. Fix some additional jig blocks, 1½in. deep, externally to the flange outer curves of the tapered portion and one or two over the parallel portion and then insert the remaining pair of flanges and packing blocks. Glue all surfaces to be joined, carefully checking for proper alignment at all points, then apply vertical pressure while the glue sets. If a base board has been used for the jig, pressure may be applied by a number of G cramps, after first placing one or more lengths of stiff boarding on top of the spar. Failing this, the pressure may be obtained by means of heavy weights evenly distributed along the length of the spar, care being taken to avoid any tendency to twist the assembly.

Wing assembly

Each wing should be assembled on a pair of horizontal trestles set about 8ft apart. Thread the ribs on the main spars at the correct spacings, the rib positions having been first pencilled on the spar top flanges. Before adding the three wing-tip ribs, the aileron spar should be threaded into position, after which the drag struts should be made up and placed ready for fitting. If not already done, the positions of all fittings should be marked and the bolt holes drilled. Note that if the root-end fittings are attached at this stage, the wing attachment bolt holes must be used henceforth as the datum. Fit all drag bracing lugs and make up the 14g. wire bracings in accordance with the drawing. Place them *loosely* in position.

With the wing carefully aligned—spars parallel and root end datum at 90°—glue and fix the drag struts. When the glue is dry, gently tighten the drag wires by gradual and systematic adjustment of the wire strainers, the whole time checking the

Fig. 38.—The aileron shroud assembly which fairs the nose of the aileron into the wing. Also by Mr. W. J. Sproat.



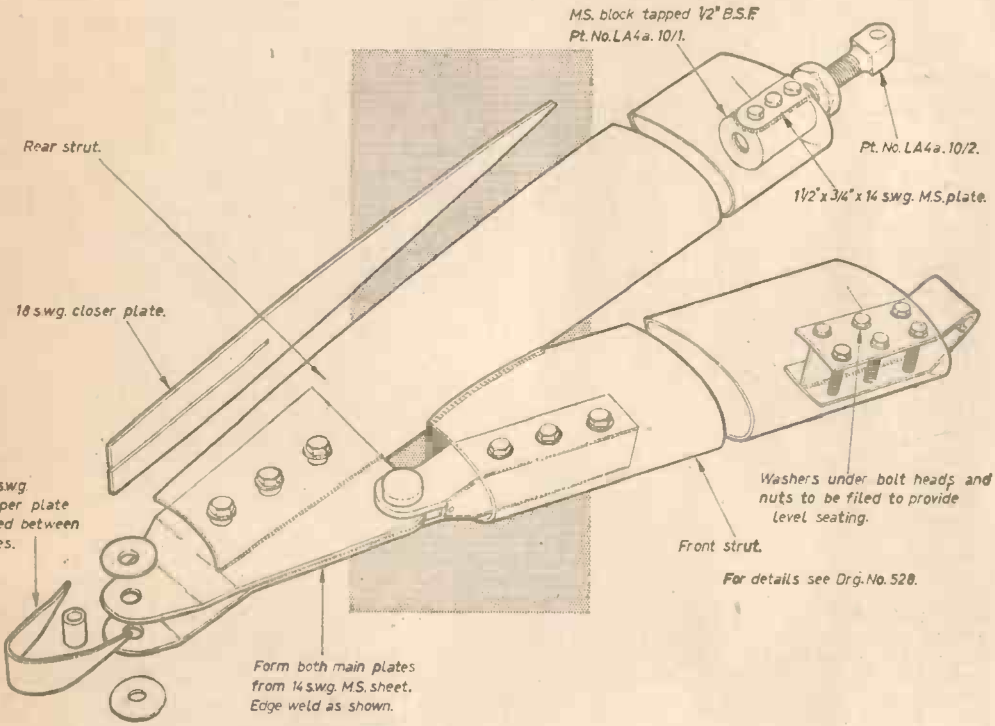


Fig. 39.—Details of the lift struts and fittings.

wing alignment by cross-trammelling. Check also, by eye, that the spars remain unbowed. The ribs may now be fixed with glue and brads, the underside of each rib being in close contact with the undersurface of the spars.

Connect lengths of cotton thread across the leading and trailing edges and recheck for alignment in plan and elevation. Slide the leading and trailing edge members into position, easing the slots in the ribs where necessary prior to fixing. Make up and fit the tip bends, profiling them after fitting, and fit the rib trailing edge gussets on the underface.

Pack along the top and bottom faces of the front spar between the ribs, with ribstock or similar material, to provide a smooth surface for the plywood nosing. The rear spar inboard of the ailerons, should not be treated in this way, or a transverse ridge will be formed in the fabric where it sags between the ribs. Similar packing is, however, necessary over the aileron spars.

Next prepare the wing to take the nosing plywood. Place a long straightedge, 5, 6ft in length, across the ribs, forward of and parallel to, the front spar. Keeping the straightedge parallel to the spar and leading edge, slide it from the spar over the leading edge and back to the spar underside, carefully noting any protruding or sagging rib flanges. Make any adjustments necessary, resorting to small amounts of planing or packing.

The wing is best supported in a vertical position, trailing-edge down, for ply skinning. Cut lengths of plywood which will join where necessary at rib locations and prepare the edges by feathering. It is possible to join up the whole length of 12ft and apply it in one piece, but it is probably better to work with three separate pieces, scarfing them at rib locations. A 50in. or 52in. sheet of plywood will just cover 4 rib spacings. The plywood may be pre-formed by pouring water over the outer face (cold water will generally suffice, but boiling water may be resorted to if desired) concentrating on the leading-edge line, and bending the ply over a radius, roughly equal to the wing-section leading-edge radius. Clamp the sheet to a plank, or fix with straps, and leave overnight.

Over the area of the first panel, apply glue to the rib flanges, the leading-edge member and the spar packing strips. Place the sheet of plywood in position and tack with 1/4in. x 20g. brass pins along the leading-edge. Initially, tacks at each rib position will suffice, the intermediate tacks at about 1in. centres being left until last. Tack or staple strips of plywood along each rib location, from the spar over the leading-edge, and back to the spar, and also fix the panel along the top and bottom spar faces with brass gimp pins. Straps running from the rear spar, forward over the leading-edge and back to the rear spar, placed close to each rib and tensioned, are useful in this operation, but as the strap pressure is mainly concentrated in the vicinity of the leading-edge, it is as well only to rely on them to hold the plywood in position; they may be applied before any tacking is done.

When the glue on the first panel has set, feather the edge along the outer rib by means of a plane or file, in readiness to scarf on the next panel. The corresponding edge of this second panel should be feathered before pre-forming. The panel can then be fixed in the same manner as the first.

Over the wing-tip portion the ply skinning should be carried out separately over the upper and lower surfaces; scarfing to the tip bend member.

Lift struts

Originally the pair of lift struts were welded together to form a single structure, which called for very careful handling during assembly and dismantling and, moreover, damage to one strut could result in the whole unit having to be discarded. These disadvantages have been overcome by the modified design (Oct., 1960) in which the front strut has a simple pin joint to the lower end fitting of the rear strut.

The upper end of the rear strut is supplied with an adjustable screw fitting, which permits adjustment of wing incidence. The cylindrical block, Pat. No. LA4a 10/1, is located by six $\frac{1}{4}$in. bolts, wire locked together. Cheese-head screws have been specified owing to the small space available, but hexagonal heads may be modified for the purpose. Small 14g. mild steel plates should be welded or brazed on the outer faces of the strut to increase the bearing area of the bolts and care should be taken to ensure that the bolts have 0·1in. long plain shanks to provide a good bearing surface. The threaded portions should penetrate nearly to the $\frac{1}{2}$in. threaded hole, but must not protrude into it.

The rear lift strut lower-end fitting comprises two 14g. plates, sandwiched and edge-welded over the upper 3in., but bent apart and fitted with a closure plate at the extremity to form a lug to mate with the fuselage fitting. Before assembly, the lower rear 12in. of the strut should be cut away as shown (this avoids fouling the fuselage when the wings are folded) and a slot $3\frac{5}{16}$in. x $\frac{11}{64}$in. wide, cut along the strut leading-edge.

Three transverse tubes, which pierce the fitting and are welded to the plates, locate under the holes in the strut tube. As shown on drawing No. 528 the spacer tubes, $\frac{5}{16}$in. i.d. x 20g., are 1 $\frac{3}{16}$in. long, as against the strut short outer axis of $1\frac{1}{4}$in. They do not come flush with the outside of the strut. It is better to make these spacer tubes $1\frac{1}{4}$in.—$1\frac{5}{16}$in. long, which not only makes a better job but facilitates location and welding. Furthermore the tubes may be $\frac{7}{16}$in. o.d. x 17g., which is an easier size to obtain. Adopting the tube length of $1\frac{5}{16}$in. does mean a little more springing of the lift strut end when making the insertion, but since this should be done prior to welding the closure strip along the trailing-edge, it should present no difficulty. It is obvious that great care is necessary when drilling the fitting and lift strut, and in welding the spacer tubes perpendicular to the fitting and parallel to each other. The drawing also shows three $\frac{5}{16}$in. bolts passing through the spacer tubes; strictly these are redundant and may be dispensed with, providing the welding is of a high order.

The fixed fitting on the upper end of the front strut is straightforward. The development of the main portion is a rectangle, from which the two 'wing' portions extend at an angle of approximately 15°, this angle to be checked from the aircraft. After inserting and welding the central web, the wing portions should be carefully hammered to a roughly circular arc, to be a good fit in the strut. The front lift strut lower-end fitting is also straightforward; a box fitting, located by three $\frac{1}{4}$in. bolts, either peened over, or fitted with lock nuts.

This series has necessarily omitted many aspects of construction. We hope however, that it has demonstrated that the home construction of a first-class ultra-light aircraft is within the capabilities of painstaking amateur craftsmen. A complete set of constructional drawings is available from Phoenix Aircraft Ltd., Cranleigh, Surrey, price £20. This firm also supplies a kit of materials and parts to complete the airframe, price £250, and completed aircraft at about £1,795: —[Editor.]

Fig. 40.—After all the hard work of constructing the Luton Major. What a thrill to know that this beautiful little aircraft is all one's own work!

PRACTICAL MECHANICS AND SCIENCE

Readers will be sorry to hear that *Practical Mechanics and Science* is ceasing publication with this issue. Some of them, we know, have taken it since the first issue appeared in October 1933. The present editor and his assistant take this opportunity to say farewell to all readers and contributors. Though *Practical Mechanics and Science* is ceasing to exist, we know that practical mechanics will always be found at their home work benches.

PRODUCING rocket liners for two of America's top-priority missiles—Polaris and Minuteman—America's prime deterrent against nuclear attack, calls for incredible precision. Two synthetic partners, rubber and glass fibre, are working hand-in-hand to replace steel as the envelope for these missiles. The reason: steel weighs more, and when you fire a missile into a ballistic path, every ounce is vital. The lighter the load, the farther the projectile travels. Secondly, during the firing of these missiles, the pressures caused by the solid-propellant combustible gases may be great enough to expand the case as much as two per cent in circumference. Rubber, with its ability to stretch as well as seal and insulate, solves this problem.

A 10-million-pound pressure curing press produces the moulded insulators which prevent the solid fuel in the missiles from burning through the fibre-glass filament cases. The press, which is electronically programmed, can be operated by one man, and the temperature controlled to within a couple of degrees. After the moulded insulators are cured and cooled, they are sent to an X-ray room, where they undergo microscopic examination. As many as 120 pictures may be taken of each liner to make certain it is free of flaws. A

Hundreds of man-hours ensure that each missile liner meets the rigid requirements for a successful launching.

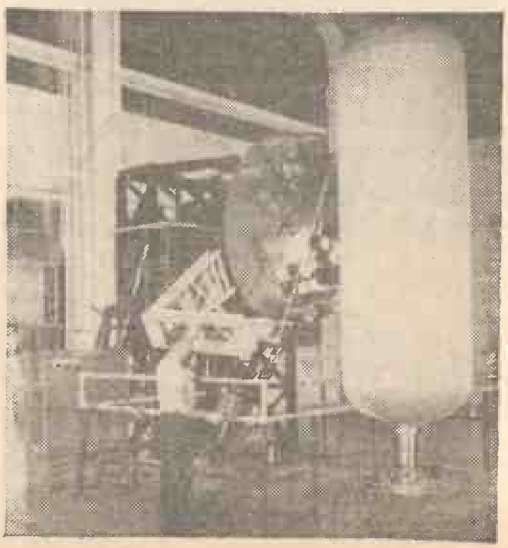
MAKING MISSILE ROCKET LINERS

machine winds myriad layers of fibre-glass filaments around the missile insulator, resulting in a resilient insulator and a strong, lightweight case. The fibre glass filaments are applied by a machine like a giant spinning wheel with a mind of its own, which winds the filaments around the missile insulator in a complicated pattern.

Because both missiles are storable for long periods, and require no last-minute fuelling or lengthy count-downs, U.S. defence officials claim they will constitute the backbone of that country's retaliatory striking force.

A 35-ton crane hoists a newly made missile liner from its mould after it has been cured in the huge 10-million pound pressure press which can be seen in the background.

Resin-impregnated fibre-glass filaments are wound under tension round a cylindrical rubber liner to give it the strength to withstand the tremendous pressures generated during firing.



Towards Perfect Slide Projection

Part 2

MOST people are interested in seeing a show of colour slides, for example of a particularly successful holiday, but that enthusiasm is not always shared by the projectionist. He must spend most of the time giving a descriptive commentary of the individual transparencies, as well as operating the machine.

A tape recording of the commentary is a greatly appreciated accompaniment to the slides, and is quite easily made and mated with the pictures. The recording can not only provide descriptive details, but also background sounds and suitable music.

The writer has found that the formula which suits his needs best is to have brief spoken commentaries of each slide, with occasional local noises and interviews immediately before and after some of the commentaries. For this, a very inexpensive portable battery-operated recorder is used. Location recording of brief talks with interesting people shown on the slides is thus quite possible, as is the taping of sounds. Since no mixer is available, the various tracks are not superimposed.

A few examples will show how useful this technique is. On a recent holiday at the coast a colour picture of an old fisherman was taken. Then, a brief recording of his voice was made in which he described the problems of present-day inshore fishing and told of the various types of catches made in the locality. On returning home, this recording was spliced into its correct order with the slides and no further commentary on the shot was needed.

Similarly, an evening picture showing the sea lapping up the beach and the breakers rolling in was accompanied by a recording made a little later with the microphone fairly near to the water's edge. The absence of synchronisation between the various noises and the photograph of the water is not apparent because the picture is still, but there is an illusion of movement.

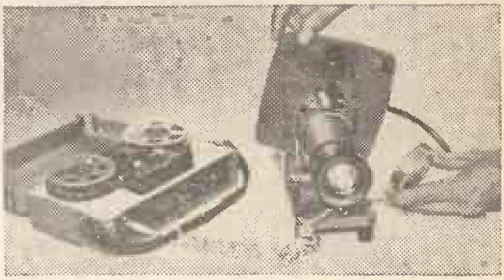
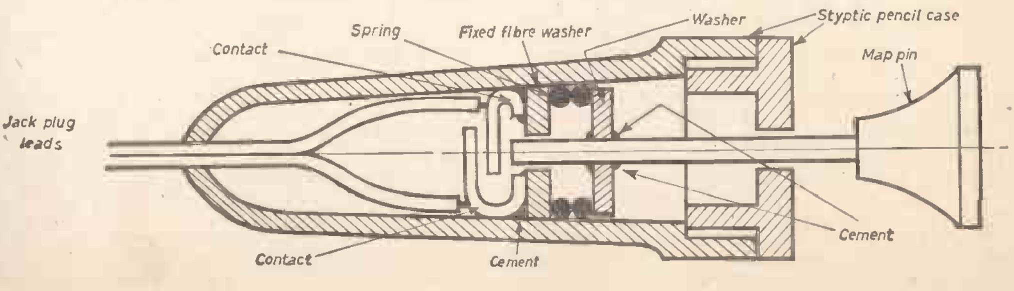


Fig. 2 (above).—Recording cueing sounds.

Fig. 1.—Details of the remote motor switch.



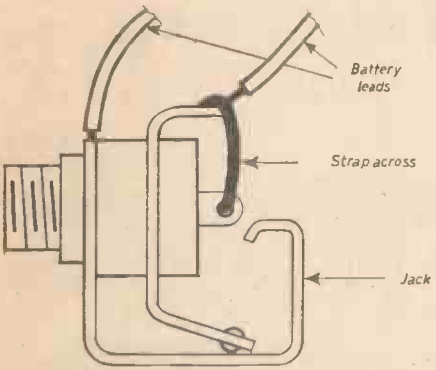


Fig. 3.—Wiring up the jack socket.

Fig. 4.—Soldering the socket to the motor wires.

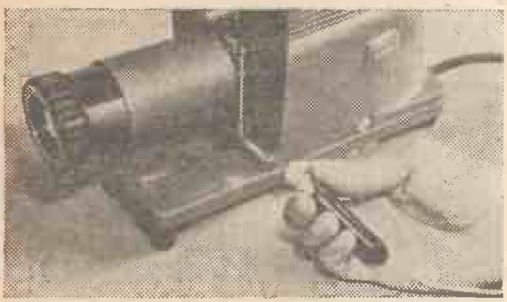


Fig. 5.—Using the remote motor switch.

When recording a commentary, it is most advisable to project the slide at the same time so that the description can be authentic in its nature (Fig. 1). Never try to fit the text too closely into the time for which you wish the picture to be projected. This makes synchronisation of sound and picture change a split-second, and virtually impossible, state to achieve. A commentary should ideally, take less than half of the desired projection time, so leaving the audience free to look at the photograph as well as to listen to the sound. Naturally, the slides should be edited into the required order in the first place, and the tape recording made accordingly. Any subsequent re-arrangement of the slides can be accommodated on the sound track by cutting and splicing the tape.

There are two principal methods of controlling the tape and slide relationship. The first is to have the recorder running continuously, even when there is no sound on the track. Since there must be some system of cue marks on the tape, which will enable the operator to change slides at the correct moment, some recognisable sound should be employed.

A satisfactory method is to run the tape while viewing the slide. Then, when sufficient viewing time has elapsed, switch the machine to "record" and operate the projector slide carrier near to the microphone (Fig. 2). The change noise will record and serve as a cue during future projection; when the slight click is heard, the slide must be changed. This method is suitable only for fairly short shows, when a portable recorder accommodating 3in. diameter spools is used, unless a change of tape can be tolerated part of the way through.

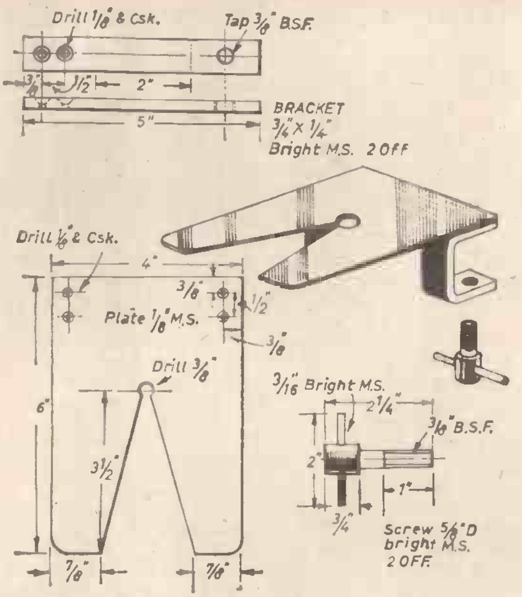
If the slight trouble of changing reels or tracks is to be avoided with a small capacity machine, all tape run which is not essential to the show must be avoided. Therefore, the tape recorder must be switched off immediately after each slide description has been played over, the required additional viewing time allowed and the recorder switched on again when the slide has been changed.

Unless the loudspeaker can be used remote from the tape deck, and this is not usual in a portable machine, the entire equipment should be placed near to the screen and operated with an extension switch on a wander-lead. Portable recorders usually have two separate battery circuits, one for the motor and one for the amplifier. It is quite simple to fit a remote switch into the motor circuit alone, leaving the amplifier running continuously. The desired tape economy is thus achieved.

Since the motor of a battery operated machine is usually of very low voltage, in the writer's case it is only 1½V, the remote switch may be quite light in construction. A home-made one, built into the case of a styptic pencil, is shown in Fig. 3. In this diagram, the contacts are shown arranged so that the switch is closed and the recorder runs only while the button is pressed, that is with the contacts 'making'. If preferred, the contacts can be arranged so that they are normally closed ('breaking'). A cut-out in the top one will enable the pin to pass clear through and push the bottom leaf away when the button is pressed.

The connection to the recorder should be made with a miniature jack and plug, as the former is self-shorting when the plug is withdrawn. The connection between the remote switch and the plug should be made with fairly heavy twin wire of low resistance, to avoid excessive voltage drop. The design of jack sockets varies considerably from one make to another, but most miniature types have three solder tags. This entails fitting a wire strap across two of the tags, as shown in Fig. 4, and breaking one of the battery leads to solder the socket between the cut ends. The deck of the machine can generally be raised sufficiently to permit the cutting of the lead and the soldering of the socket (Fig. 5). A hole must be drilled at a convenient place in the deck or case, in which the socket can be fitted.

When the jack plug is in position, and the recorder switch is on, the motor will run only when controlled by the remote switch. Withdrawing the plug enables the built-in contacts of the socket to close, thereby returning full control to the recorder switch in the normal way. This system should, of course, be employed only where low voltage circuits are concerned. Mains voltages require the use of fully insulated leads and switches.



No big project on hand? Then make these small workshop tools

Fretsaw table

A FRETSAW is a particularly valuable addition to any tool kit, but it should always be accompanied by a suitable fretsaw table. The type illustrated should prove invaluable to model makers, indeed to all amateurs who have to tackle a variety of practical work.

Commence by marking out and cutting the plate from 1/8in. mild steel. This should be quite flat for obvious reasons. Locate the hole centres with try-square, rule and odd leg calipers. Centre-pop and drill as indicated. Note that the four 1/8in. diameter holes should be countersunk so that the working top of the table will be quite flat (lightly countersink the underside too, so that the bracket will be drawn up close to it). The V should be marked to extend to the rear of the 3/8in. diameter hole and should be cut with a hacksaw—not a shearing machine, which may produce distortion. File the edges and round off the two outside corners; a 3/4in. radius will do.

The brackets should be formed from 3/4in. x 1/4in. bright mild steel. The rivet holes should be drilled and countersunk before bending; the gap of the bracket may be altered to suit individual requirements. Drill and tap the clamp screw holes 3/8in. B.S.F. The 1/8in. rivet holes should be countersunk both sides and a steel block will have to be used to support the underside during riveting.

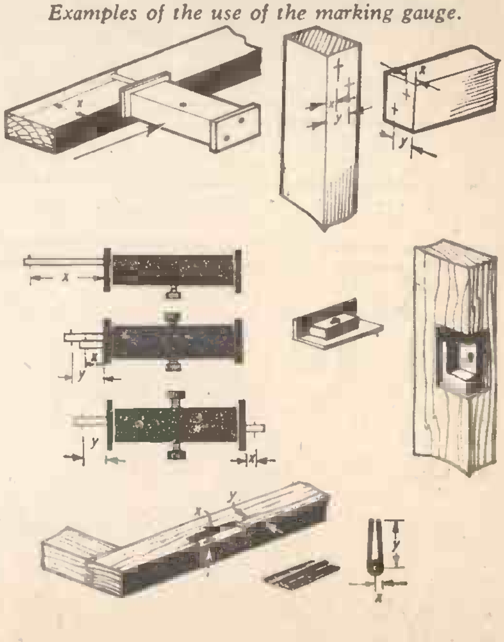
The clamp screw is quite simple; if a lathe is not available the screw can be made from a 3/8in. B.S.F. hexagon head bolt, drilled for a tommybar. For the lathe owner the screw should present no difficulty. The more ambitious constructor may fit a loose cup washer at the end of the screw (as in a G cramp) so that the underside of the work bench will not be marked. Two felt pads, secured with Bostik, inside the brackets will not only protect the bench top but will tend to dampen vibration in use.

says D. McGhee

A handy marking gauge

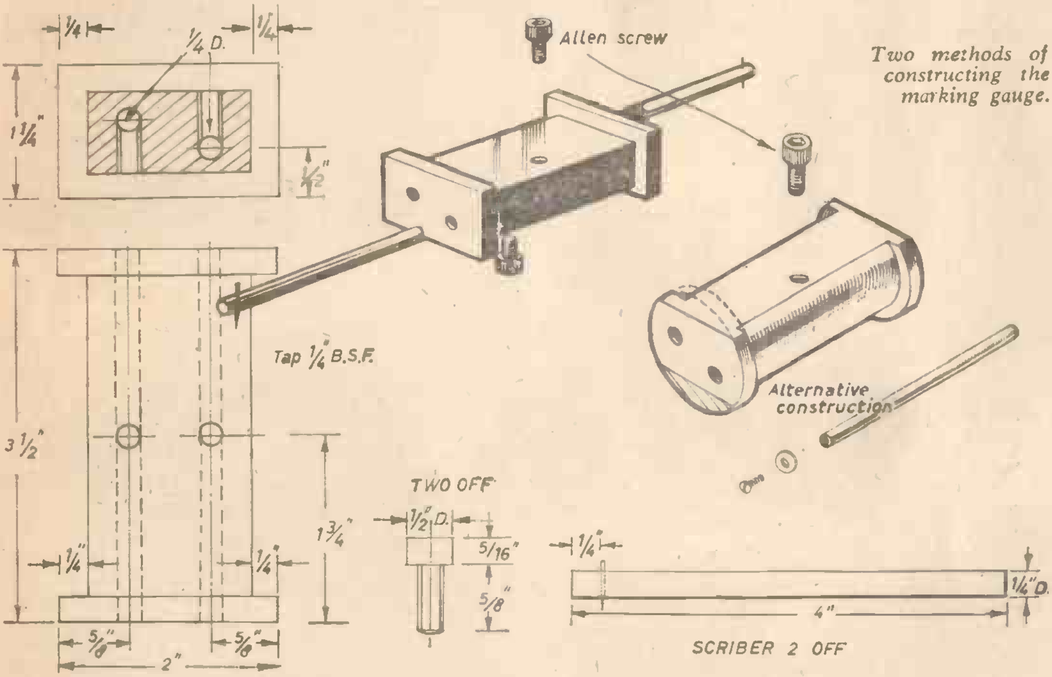
Although a conventional marking gauge is essential to every woodworker this handy little gauge will prove its worth on many occasions. Furthermore, it provides a fine shaping machine exercise for metalwork students. The body should be shaped, to the dimensions shown. The diagram also indicates the positions for the holes to accommodate the scribing bars and the holes for the locking screws. If possible, the former holes should be reamed 1/4in. The other holes are of course tapped 1/4in. B.S.F.

Examples of the use of the marking gauge.



The two scribing bars are 4in. lengths of ¼in. diameter bright mild steel. They should be drilled to take discarded gramophone needles—a tight fit is needed. Two locking screws should be turned from ½in. diameter bright mild steel and screw threaded ¼in. B.S.F.

An alternative construction is also illustrated. In this case the body should be turned and then two flats cut, close to the dimensions given previously. The needle scribers may be replaced with roller scribers made from washers with sharp edges, secured to the bars with round head machine screws.



Two methods of constructing the marking gauge.

The marking gauge is principally used to gauge widths and thicknesses of timber in the preliminary stages of work. This gauge can be used for this purpose within limits. The dowel joint is an apparently simple woodwork joint, but it can be quite ineffective unless the hole centres are accurately located. If these holes are slightly staggered as illustrated, then the timber is not unduly weakened. To ensure that the joint fits well, the gauge should be used from corresponding surfaces.

Fitting hinges and locks are other uses for this gauge. Two gauge settings are necessary here and if one scriber is reversed then the two settings can be quite independent. Note that these gauge settings should be obtained direct from the fitting.

A small router

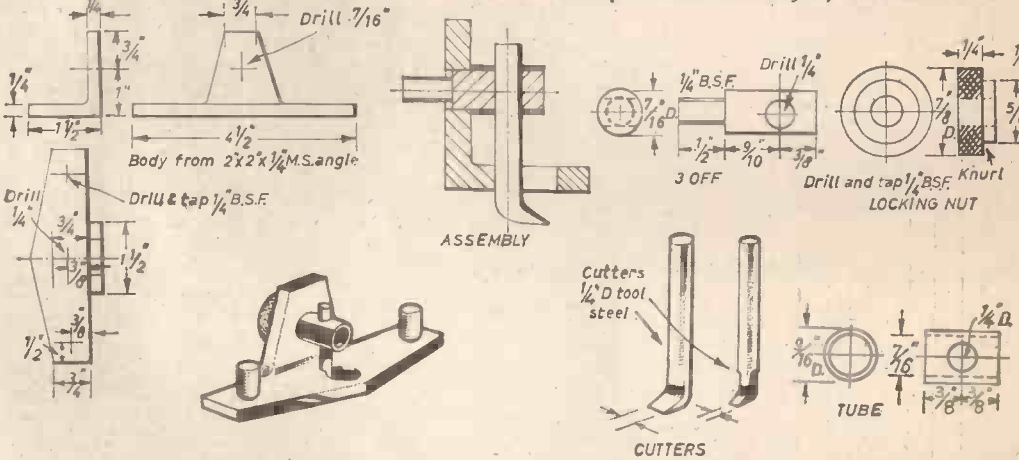
Mild steel angle is a medium which can be used profitably in the home or school workshop for a multitude of purposes. It is easily shaped and drilled and will frequently obviate a brazing operation for which many amateur workshops are not equipped. In this example it is used to make the body of a small router. This is a particularly handy item for the woodworker and is commonly used to ensure that a long housing joint has a uniform depth. Although the model shown has a maximum cutter width of only ¼in., it is still suitable for broader housings by multiple cutting. The body or stock should be shaped from a 4½in. length of 2in. x 2in. x ¼in. mild steel angle. The outer surfaces of the angle should be quite true and at right angles to each other as all holes are drilled relative to these surfaces. Mark the outline and centre pop all hole centres before cutting to shape. Remove most of the waste with a hacksaw and finish with a file. Slightly round off all sharp edges. Drill the two holes for the handles, ¼in. B.S.F. tapping size and lightly countersink on both sides. Two other holes, ¼in. diameter and ½in. diameter, should also be drilled in the sole of the router. Important—drill these holes in that particular sequence. The hole in the upright should be drilled 7/16in., or reamed to size if possible, to receive the clamping device. Paint the body black or grey, the sole being left bright of course.

The clamp is a rod and tube, each drilled radially, ¼in. diameter. This device is frequently used in surface gauges etc., and an explanation of its functioning will not be necessary to those familiar with workshop equipment. Note that 1/16 clearance shown in the sectioned drawing. This permits the rod to be pulled along the tube, thus firmly securing the cutter. The two items should be drilled together, then separated and the burrs removed to give easy action. The locking nut should be turned from ⅞in. diameter mild steel, to the dimensions shown, and should be knurled. The centre hole is of course drilled and tapped ¼in. B.S.F. A washer should be used in conjunction with the locking nut.

The handles should be turned to the same dimensions as the rod, except for the length of the screwed part, which need only be $\frac{5}{16}$in. long. These should be screwed into the body, lightly rivetted on the underside and filed flush with the sole.

The cutters should be made from $\frac{1}{4}$in. diameter tool steel. Naturally the steel should be annealed before bending to form the crank. The material will need to be bent while at red heat after which it should be allowed to cool very slowly so that further shaping can take place later. The edge may then be filed to shape, and the width of the cutter shaped as shown in the diagram.

The parts and assembly of the small router.



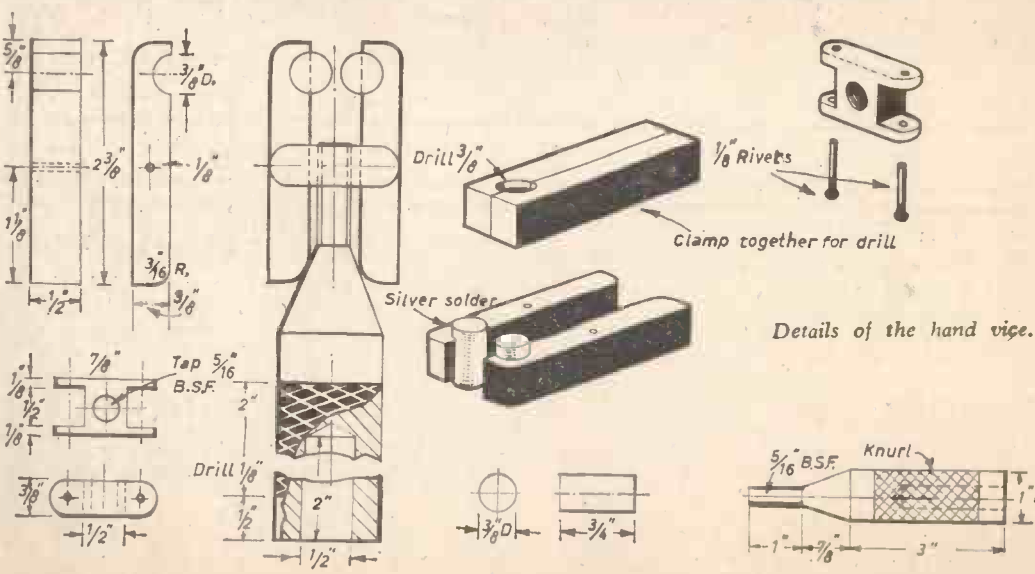
Finally, before obtaining a keen edge on the oilstone, the cutter must be hardened and tempered. A mild straw colour will indicate a suitable temperature for tempering. Maintain the cutting edge as for a firmer chisel, although certain timbers and projects may require a finer edge.

Hand vice

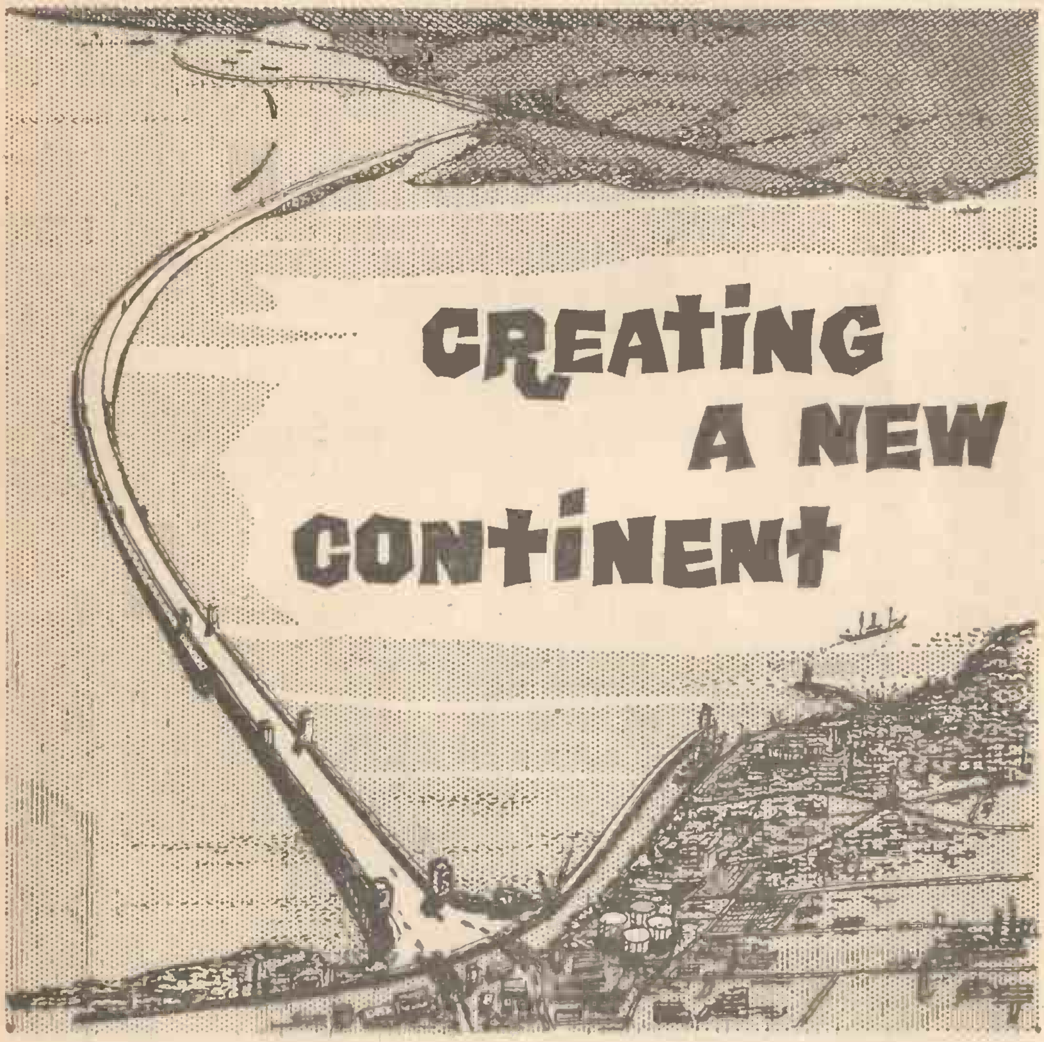
This hand vice works on a well known principle and will need no introduction to metalwork enthusiasts. Nevertheless it will provide a valuable exercise for the novice constructor, particularly the student in a school workshop.

Start with the handle. This incorporates many of the basic lathe operations. An alternative handle could be satisfactorily turned from a length of hexagon section steel to obviate the knurling operation. Face off each end of the rod, and reduce to length. Reduce one end to $\frac{5}{16}$in. diameter for 1in. and thread $\frac{5}{16}$in. B.S.F. The taper of the sloping shoulder should be calculated (from the tangent of the required angle) and the top-slide of the lathe set accordingly. Centre drill the other end and mount

(Continued on page 525)



Details of the hand vice.



CREATING A NEW CONTINENT

GERMAN engineers are busy with a gigantic project which has fascinated them ever since the resurgence of West Germany from the ruins of World War II. It is nothing less than the proposed abolition of the Mediterranean Sea and the bridging of the continents of Europe and Africa. This would be accomplished by lowering the water level of the Mediterranean 300 to 600 feet with the help of huge dams between the straits of Gibraltar and Gallipoli. The Gibraltar dam would unite the two continents. The idea was developed by German architect Hermann Soergel who called his project "Atlantropa." A film has been made of it, in which relief models and trick photography show the various stages, with a spoken commentary by Swiss writer John Knittel.

The Atlantic Ocean sweeps into the Mediterranean basin at the rate of 100,000 cubic yards of water every second, and Professor Soergel has shown that once the water supply from the Atlantic is cut off the Mediterranean will disappear at the rate of about 5 feet 2 inches a year by evaporation alone. But a dam across the Dardanelles, on the other side of the Mediterranean would be needed, too, since the flow there has been found to be about 10 per cent of that entering through the Straits of Gibraltar.

The project would create a new continent, since the artificial lowering of the Mediterranean would enable some 225,000 square miles of fertile land to be reclaimed from the sea.

It is not proposed to build the Atlantic dam across the Straits at the narrowest point, because of the great depth of the sea there; some 550 yards. Professor Soergel has suggested that the dam be built outward from Tarifa on the European side. Thence it could follow a line of submerged reefs and shallow places, with a greatest sea depth of about 350 feet. The dam would arch out into the ocean in a wide loop, be 500 yards thick at the

CREATING A NEW

bottom to withstand the enormous pressure of water and taper gradually to 50 yards at the top. It would be the greatest engineering enterprise ever undertaken by man. Soergel and his colleagues have pointed out, too, that no engineer would dare to provide flood gates to such a mighty barrier because they would seriously weaken the structure.

On the face of it the advantages of such a scheme are tremendous, since the draining of the Mediterranean Basin would provide a vast new land area on an overcrowded Europe. This new land alone would compensate for the losses sustained by the seaports that would become obsolete all round the Mediterranean coast. It is not proposed, however, to completely drain the entire sea basin, but to reclaim great tracts of land in a wide belt all around the coast. This would enable the linking of Italy, Sicily and Northern Africa.

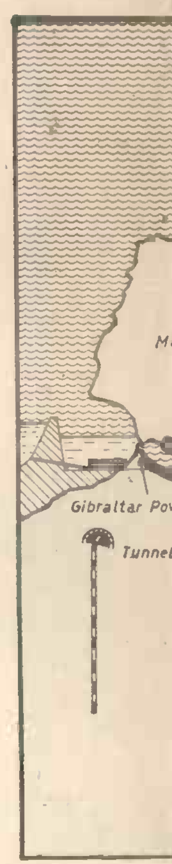
There are four big rivers which empty into the Mediterranean: the Ebro, Rhone, Po, and the Nile; and these alone supply a vast volume of water. But Professor Soergel has shown convincingly that the necessary changes at the mouths of these rivers and at the end of the Suez Canal could be effected without much difficulty.

One of the most significant advantages would be a change of climate favourable to Northern Europe—and especially to the British Isles—because the Gulf Stream would be rendered much more effective. At present the British Isles, Northern France, the Netherlands, Northern Germany, and even the Scandinavian countries, benefit tremendously from warmth brought to their shores by the Gulf Stream. But this warming current is seriously affected by a cold water current which flows out at great depths through the Straits of Gibraltar into the Atlantic.

Recent experiments have revealed that despite the vast inward flow of Atlantic water into the Mediterranean there is at the bottom this counter current of cold water, which not only cools the Gulf Stream but diverts its course and prevents it from reaching Europe directly. The Gulf Stream would probably flow directly into the English Channel and out to the North Sea if the Mediterranean ceased to send its cold bottom waters into the Atlantic.

Thus Soergel's mighty dams would not only change the map of Europe but greatly improve its climate. They would also have far-reaching effects on the African continent, as the bottled waters of the Atlantic surging against the dam would provide perpetual motive power. According to Soergel's calculations, this power would provide 160 million h.p. of electrical energy, sufficient within a few years, to bring industrial prosperity to the awakening giant known as the Dark Continent.

France, too, has her "dream project" involving the Mediterranean. General de Gaulle, always anxious to further the cause of his country in the field of international prestige,



has been considering a sch
link between the Atlantic a

A canal more than 300 m
waterway eight times long
times longer than the Suez
as the proposed project is
Atlantic seaboard at Le Ve
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Though the Canal of the
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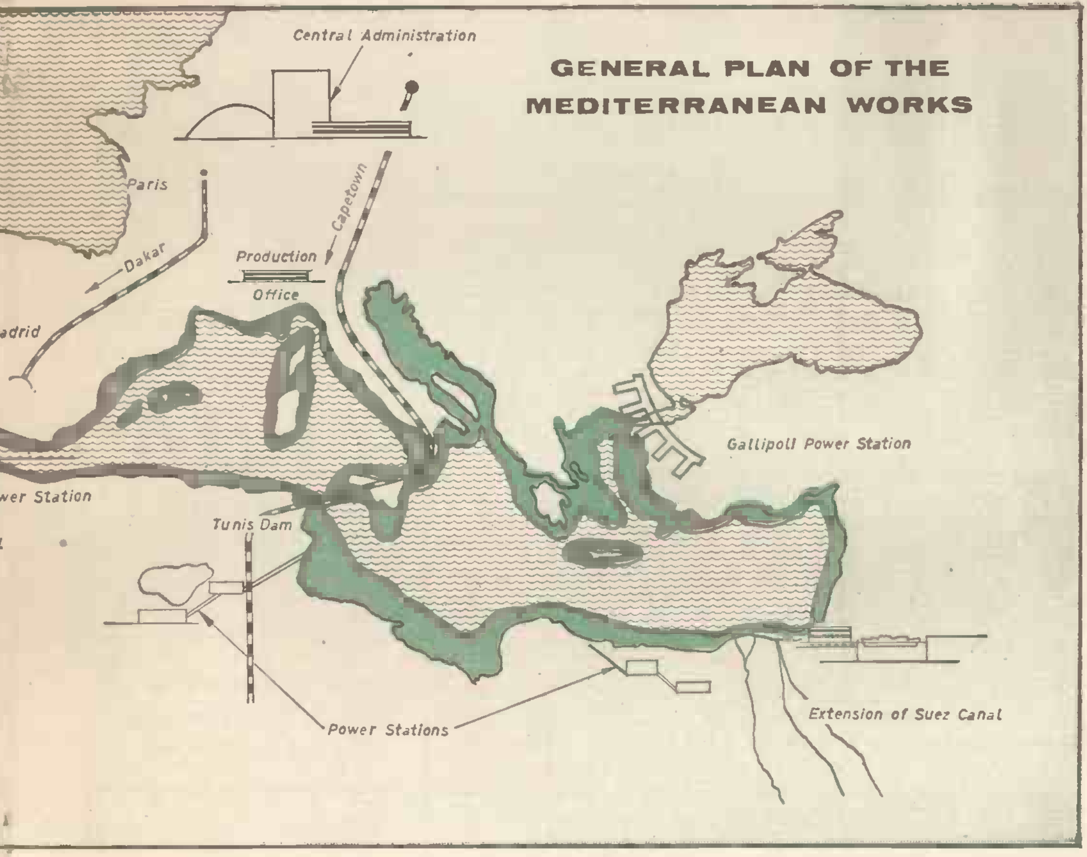
CONTINENT

by PAUL BROCK



...e which involves a new man-made ...nd the Mediterranean.

...miles in length is proposed—an artificial ...er than the Panama Canal, and three ... Canal. This Canal of the Two Seas, ...s called, would start inland from the ...rdon in the Gironde district, and reach ...a natural inlet into the Mediterranean, ...360 feet and a depth of 40 feet. These ... passage of the largest liners and

...e Two Seas presents problems bristling ...ers and geologists, all, the experts now claim, they are capable of solution. At some points the canal would reach a height of 350 feet above sea level, and thirteen mighty locks would be necessary to raise the world's largest ships. It is estimated that vessels could shorten their routes by at least 1,000 miles by cutting through the heart of Southern France instead of rounding the Spanish Peninsula and entering the Straits of Gibraltar. The canal would also enable NATO fleets to enter the Mediterranean quickly. Ships could pass through the greater part of its length in safety at a speed of ten knots.

Both these schemes would have far-reaching effects on the Mediterranean area. In fact, if Atlantropa comes into existence, present-day maps of the Mediterranean Sea will one day be as inaccurate as those of early map makers.

The Polygon Tool Box

by A. W. Neal

1 A variety of parts showing the varied shapes which can be produced directly on a lathe fitted with a polygon tool box.

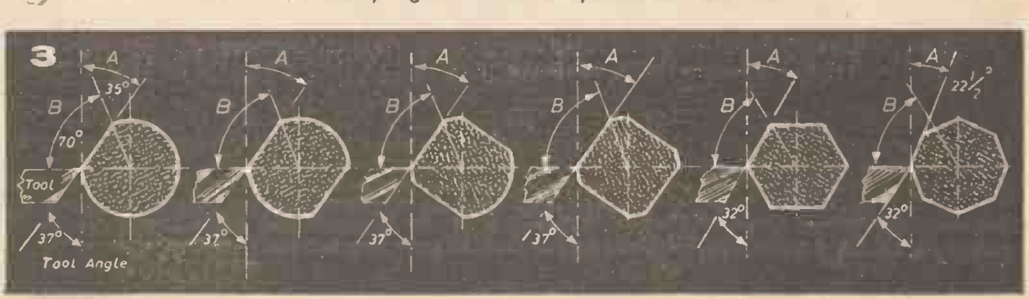
IT is perhaps not so very well known that metal parts like those shown in Fig. 1 may be produced by turning operations on capstan, turret and automatic lathes. To carry out these operations an attachment known as a polygon tool box is used, one form of which is shown in the photographs.

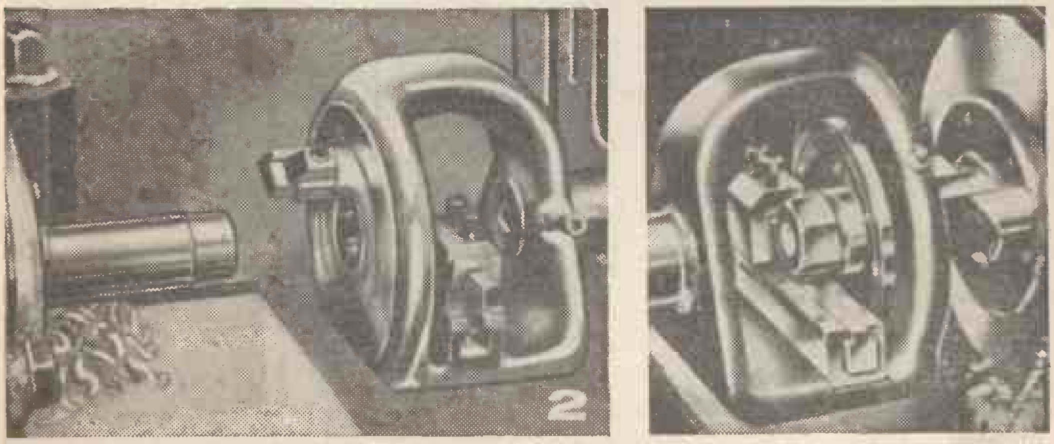
In this the box contains a holder for a tool which can slide transversely under the control of a rotary cam journalled in the body of the box and operated by a driver fitted to the nose of the lathe. On multi-spindle automatics it is driven from the rear by means of a coupling shaft connected to the rear gear box. Many lathes have a small hole tapped into the collet front plate into which a stud can be screwed to act as a driver for the box. This acts in the same way as a driver on a centre lathe driving a carrier. On capstan lathes, it revolves a spinner which carries the cam. It is necessary that the box speed should be synchronised with the spindle speed when mounted on multi-spindle automatic machines. The cam referred to is so formed that it will generate the shape required. An operating finger or cam-follower bears against the cam face and is kept there by spring pressure. As the cam revolves, it forces the tool slide inwards towards the centre of the work. The outward travel of the tool slide is accomplished by means of a return spring. When the box is brought up to the work in the lathe, the cam rotates to control the movement of the slide. The traverse of the machine is then engaged and the box travels along the work.

The recommended speed for these boxes is from 280 to 500 r.p.m. and the tool utilises the usual soluble oil or neat cutting oil coolant to lubricate the moving parts. The bearings are provided with grease nipples. The tool box is capable of producing any form in which the angle A in the diagram is not greater than 35°. Diagrams of such forms are shown in Fig. 3. The maximum length of flat which can be produced on any diameter of work is that which is included in the angle B. This angle is 70°. If the flat is required to be closer to the centre it will be correspondingly shorter and the extensions to the circumference will be curves as shown in Fig. 4. An exact square, as shown in Fig. 5 cannot be produced as its length is greater than that subtended by angle B and this increases angle A to more than 35°.

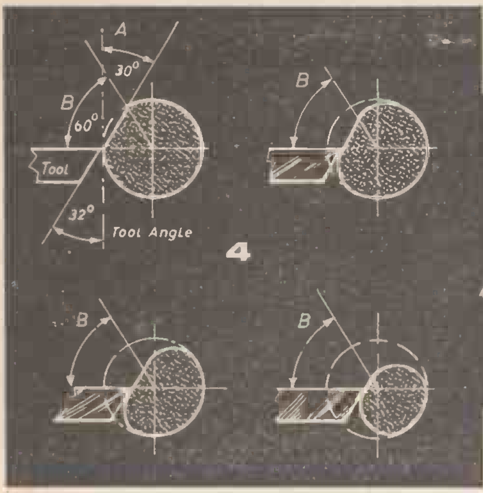
Fig. 6 shows a polygon tool box fitted to a 1½in. capstan lathe, boring out a hexagon. Fig. 7 shows another box on a $\frac{9}{16}$in six spindle "Acme Gridley" automatic machine, putting a square on the end of a small valve spindle.

3 The shapes that can be produced by this method are limited by the angle B that is subtended by the flat, and by angle A which must permit tool clearance.

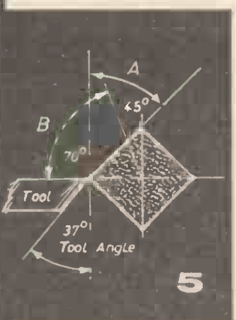




2 (*left*) Round stock to be turned to a hexagon about to enter the box. (*right*) The finished hexagon from the other side. Note the driving stud in the collet.



4 How the distance of the flat from the centre determines its length.

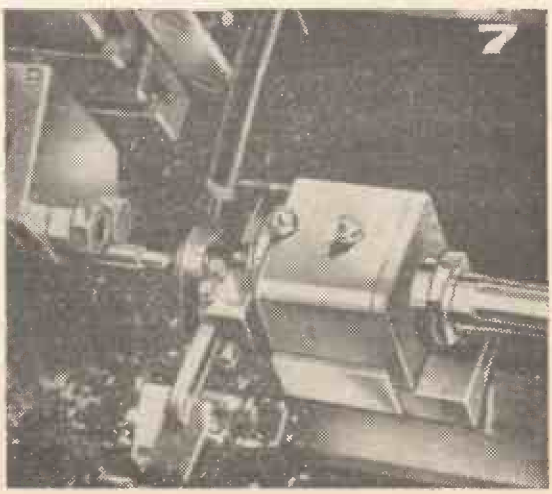


5 A perfect square such as that shown, cannot be produced as angle A exceeds the tool angle and the length of the side exceeds that allowed by angle B.

6 A polygon tool box being used to bore a hexagonal socket in the end of a round bar.

7 Another type of polygon tool box fitted to a six spindle automatic lathe.

6



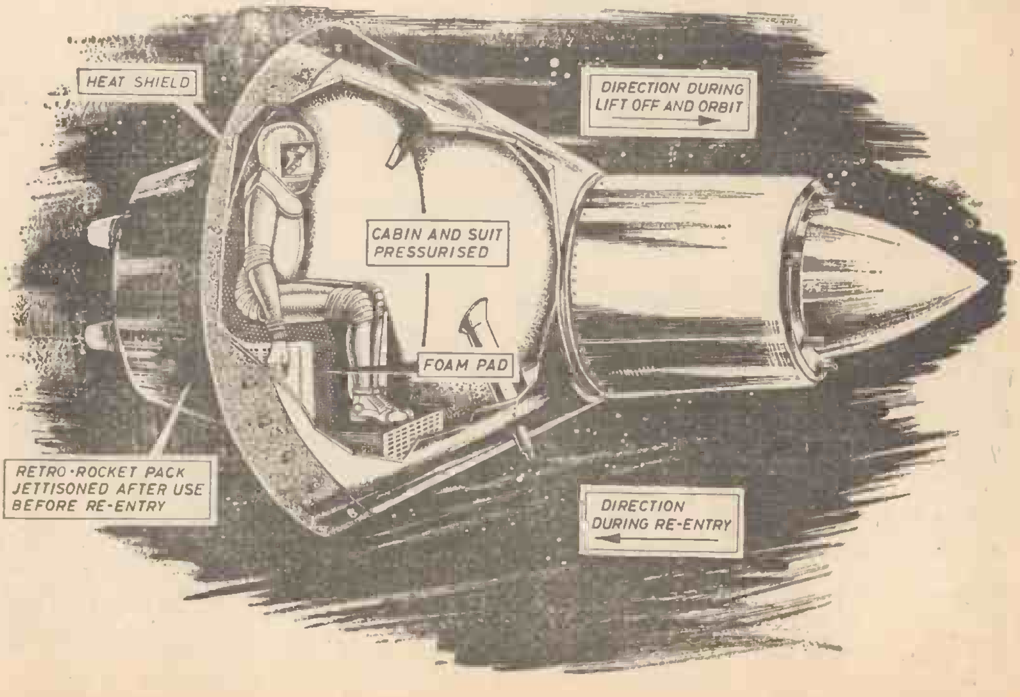
7

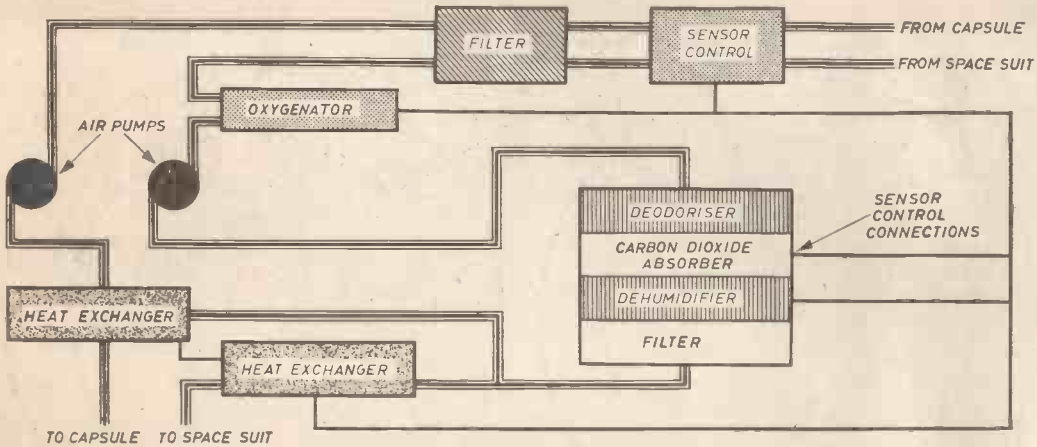
HAZARDS OF SPACEFLIGHT

By B. C. Macdonald

THE man in space can only survive if he can take with him substantially the same environment as that which exists on earth. This means that the spacecraft must carry complex and vital equipment to provide an artificial atmosphere. In high-flying jet aircraft the cabins are pressurised using air from outside, but there is no air in space. The small amount of air which the astronaut takes with him in his capsule must last until he returns to earth. This means that oxygen must be added at exactly the same rate at which it is being used. The exhaled breath contains carbon dioxide and this must be absorbed, as its continued accumulation would cause the occupant to suffocate, in spite of the oxygen. Monitors are provided to continually check the composition of the air and to speed up or slow down the rejuvenation process according to the requirements of the astronaut. For additional safety the equipment is duplicated. In addition the air must be maintained at a suitable temperature and degree of humidity. It must also be purified to prevent the accumulation of body and other odours, which would very quickly contaminate such a small quantity of air.

It is not enough that the man in space should survive, he must remain alert and normal in spite of the severe psychological strain to which he is subjected. First, there is a considerable risk that the rocket might explode before or after lift off, and although provision is made to meet such a contingency as we shall see later, the risk cannot be eliminated. There is the effect of being alone in a confined space and there is the powerful effect of the inertia forces developed during acceleration. Finally there must be some doubt about the success of the return journey. Therefore the astronaut must

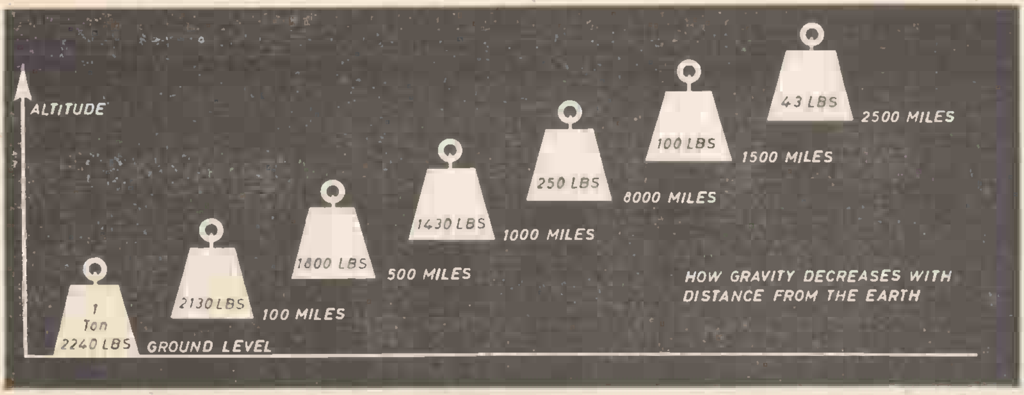


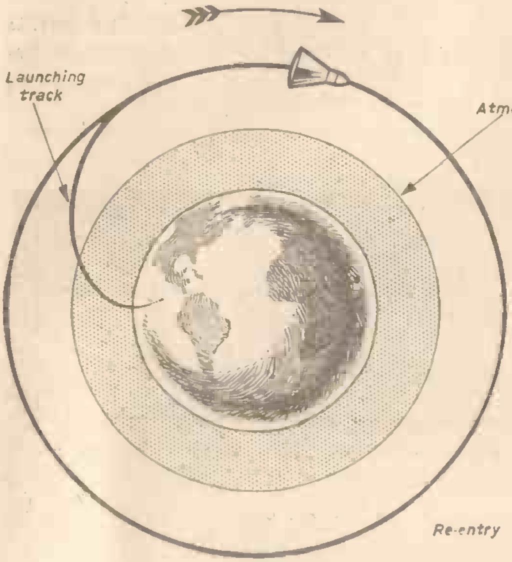


Space vehicle life support system.

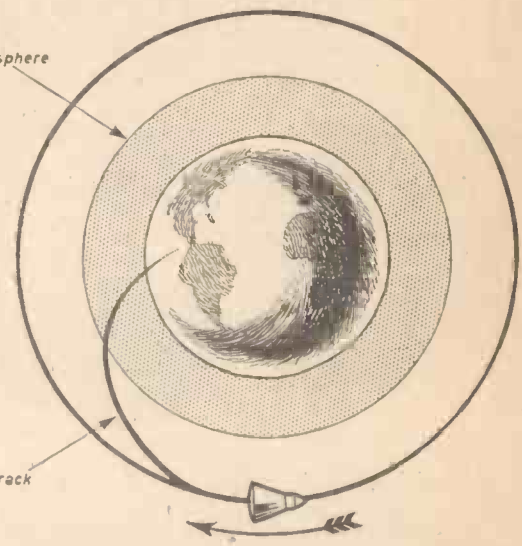
be an extremely fit man of exceptional emotional and mental stability. He also has to be an aircraft pilot of considerable experience, because the qualities he has acquired in this way are similar to those he will require during his mission in space. So far no man has made more than one journey into space, therefore to each astronaut the journey is a new experience. As far as possible he must be acclimatised to the conditions he will experience in flight, and this requires long and arduous training.

In a successful firing to place a capsule in orbit, the rocket motors operate for only a few minutes. In this short space of time the velocity increases from zero to 18,000 miles an hour. This rapid acceleration subjects the rocket structure, mechanism, instruments, and the astronaut, to forces of 5g to 6g, that is to say, all weight is increased five to six times its normal value during the acceleration period. If the astronaut was in a normal sitting posture during lift off he would become unconscious in seconds, because his blood would move into the lower part of his body, and therefore away from his brain, due to the great temporary increase in weight which would overcome the pumping action of the heart. To avoid this effect the astronout lies on his back during the acceleration period. Even so he is partially incapacitated while it lasts. It would be extremely difficult for him to move or to lift his arms. In one of the pictures released by the Russians, of Yuri Gagarin in his space capsule just prior to his flight, he is shown holding switches in his hands, presumably those controlling the ejection equipment. The man on top of the rocket is virtually sitting on top of a powerful bomb and however great the care taken in design, testing and preparation, disaster may occur before or after take off. To meet such a contingency the capsule is provided with a small independent solid fuel rocket which can carry it clear of the main lift rocket, even when the latter is still on the ground. At lift off the main rocket contains many tons of propellant of great energy potential, and if a serious failure occurred without warning, the astronaut would be engulfed in the explosion before he had time to eject. To prevent this happening "sensing" devices monitor the operation of all vital components such as the fuel pumps, to give instant warning of a malfunction developing. Such for instance, as fuel accumulating in the combustion chamber due to delayed ignition, which would cause an explosion. The warning interval would be small, but should be long enough to enable the capsule to get clear of danger. Ejection can be initiated either by the astronaut or by ground control.





Capsule in orbit.



Capsule turned round and Retro-Rockets fired.

When the space vehicle is in orbit there is the danger that it might be pierced by a strike from a small meteor thus causing depressurisation of the cabin. In such an eventuality the space suit which the astronaut wears will retain sufficient pressure to allow him to survive. The silvered surface of the suit also serves to reflect heat from the walls of the cabin, particularly during the re-entry period.

Should an emergency arise when the vehicle was in orbit, that required an immediate landing, this could be very difficult unless the point for firing the retro rockets in the planned descent was approaching and near. To descend at a point perhaps far from the recovery areas could very easily make recovery difficult or impossible, though of course, the approximate position would be known. In both the American and Russian space vehicles an earth globe rotated at the same rate as the vehicle passed over the earth's surface, so that it showed at a glance the position of the vehicle relative to the surface of the earth.

To make his planned descent the astronaut uses his control pressure jets to turn the vehicle round so that his back now faces the descent orbit. The largest surface of the vehicle is now in front and on this is the heat shield of beryllium or resin-bonded fibre glass. The retro rockets are fired and slow the space vehicle down, reducing the centrifugal force produced by his angular velocity and allowing the earth's gravitational field to pull the craft in. The re-entry speed is about 15,000 miles per hour, but the atmosphere acts as a powerful brake producing higher g forces than those experienced on ascent, but as before, of short duration. The maximum temperature on the outside of the heat shield is over 1,500°C. The cabin temperature rises appreciably but not seriously during the 120 second period of the heating effect. Once in the lower layers of the atmosphere the parachute is ejected and the speed reduced to a safe landing value.

The problems of the immediate future are mainly concerned with how to produce bigger lift rockets so that large multi-manned space craft can be put in orbit and land on and return from the moon. Space flights of great distances occupying months, or even a year or more, raise all the old problems in a more acute form. The problem of providing food and water for such a flight seems at the moment quite unsolvable by the bigger and better rocket method. It is interesting to note that even small thrusts applied over a long period to a vehicle in space would achieve a velocity close to, or equalling, that of light which is 186,000 miles per second. According to the relativity theory, time in a spaceship moving at high velocity is slowed down relative to time on earth. A child could go on a space flight lasting many years and return, still a child, to find his twin brother an old man. Science, which once condemned miracles, now accepts them it seems.

SAVE THOSE SEEDS WITH THIS BIRD SCARER

(Continued from page 526)

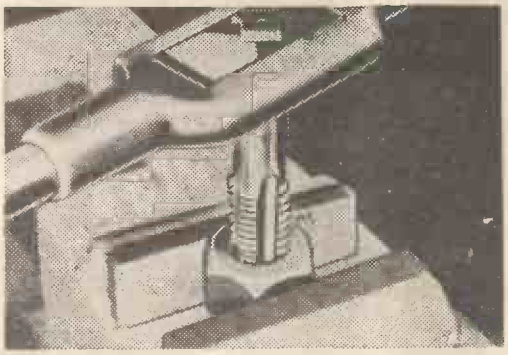
until balance is achieved. Mark this spot and through it drill a ½in. diameter hole. Into this hole insert a piece of metal tubing to prevent excessive wear and tear. The bird-scarer is now ready for mounting on a post in the garden. A heavy nail passing through the bar (with metal washers top and bottom) should be knocked into the post and the bird-scarer is then operational.

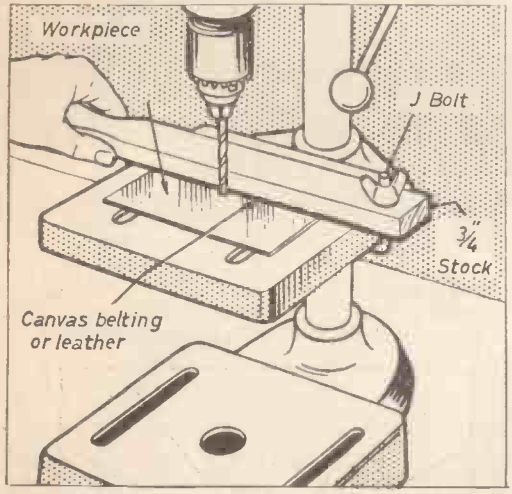
That's a good idea!

Useful hints passed on by our readers

Tap cuts oversize

TO thread a hole that is a little too large for the tap you have, or to slightly enlarge a tapped hole of the same thread size, use this method. Push a short length of rod of the right size in one of the flutes when starting the tap and leave it there. Numbered twist drills can be used, and provide a wide range of sizes. Insert them so only the shank end makes contact with the work.



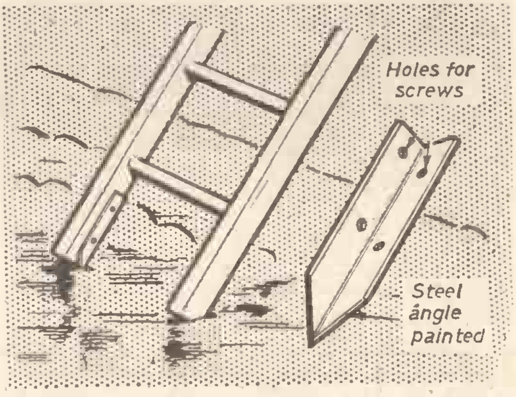


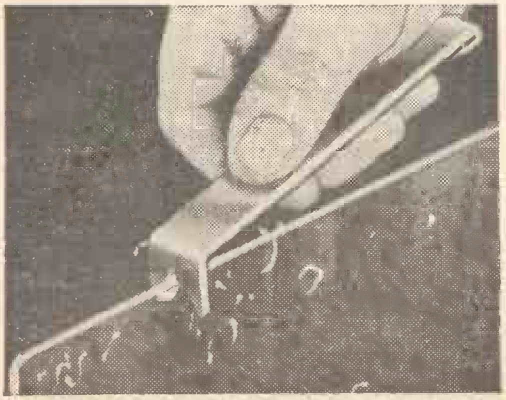
Quick clamp

THIS quick-acting strap clamp holds pieces of sheet metal securely on the drill-press table. It consists of a length of hardwood faced with canvas belting or leather and a J-bolt which hooks under the lip of the table. After locating the work, adjustment of the wing nut allows it to be held with light hand pressure.

Ladder creepers

TO prevent a ladder slipping when used on ice in an emergency, cut two lengths of steel angle, ⅛in. x 1in. x 1in. or larger, and file each to a sharp point. Then drill two holes for screws in each web and fasten the creepers to the lower ends of the ladder legs with the sharpened ends projecting.





Handy "deburring" tool

REMOVAL of sharp burrs from the edges of plastic or aluminium sheets can be done with speed and ease by using the little tool shown here. It is made from ⅛in. x ¾in. or 1in. flat steel. One end is bent at right angles and the other is doubled for a comfortable grip. A V-notch is filed or ground in the bent end. Sides of the notch are dressed to a slight angle, forming sharp edges on the inside so that the tool will cut as it is pulled. It should be held at an angle in order to prevent cutting your fingers while drawing it over the burred edges.

SEEING CAN BE DECEIVING

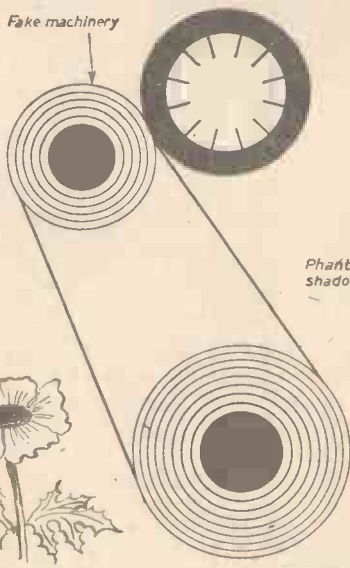
a selection of unusual and entertaining optical illusions

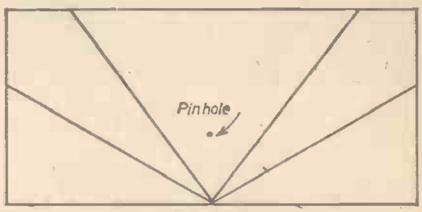
LOOK at the group of 16 black squares on this page. Do you see the grey "phantom" shadows which appear mysteriously at the white intersections? But you can never gaze directly at one of the ghosts—it will only be visible at the edge of your field of vision. Try to stare at it, and the patch of greyness vanishes. Hundreds of these optical illusions are known to oculists and psychologists. Such interesting phenomena can help us to understand how the eyes and visual centres of the human brain work together to let us "see" the world of shapes, solid forms and colours, but some of these effects are still hard to explain, or remain unaccounted for.

Stare hard at the "Honey Bee" diagram. Let your eye muscles grow tired and relax, or slowly bring the page close to your eyes. In either case you will see the insect slowly traverse the vertical line and settle upon the flower petals. The bee seemed to alight upon the petals when you deliberately induced poor co-ordination of the images projected into your eyes and transmitted, via nerves, to your brain. It was your brain that was responsible for blending the separate pictures and producing an illusion of bee and flower together. Slowly rotate this page between both hands and look fixedly at the "Fake Machinery". The wheels should appear to come alive and revolve in different directions. Copy the "Circles from Nowhere" diagram upon a card measuring 2in. x 4in. Push a pin through the point indicated and spin the drawing upon this improvised pivot. You will be able to see two perfect circles. There will be no impression of straight lines at all.

Complicated arrangements of curves will usually make accurately ruled straight lines seem bent. If you copy the semi-circular diagram upon a large sheet of paper and then rest a 6in. ruler across the curves, the ruler will really look bent in the middle. To make a lady vanish, paste a little cut-out "X" and a tiny pin-up type picture ($\frac{1}{4}$in. tall) cut from an advertisement, three inches apart, upon a strip of black cardboard, as illustrated. Close your left eye. Hold the strip at arm's length and gaze fixedly at the cross with your right eye. Keep your right eye fixed upon the cross, as you slowly

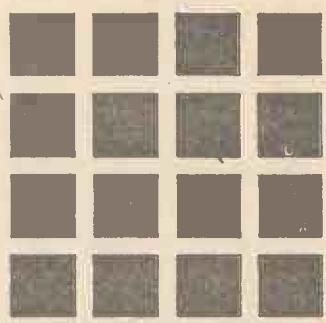
Fake machinery

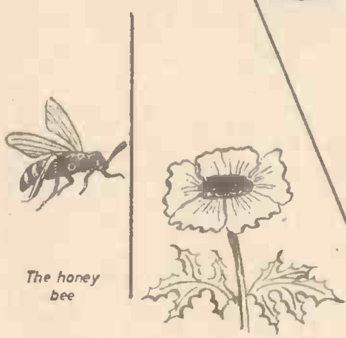




Circles from nowhere

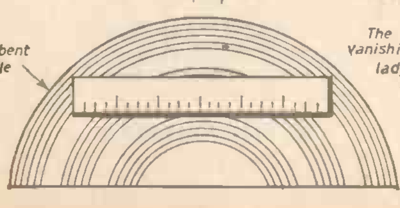
Phantom shadows



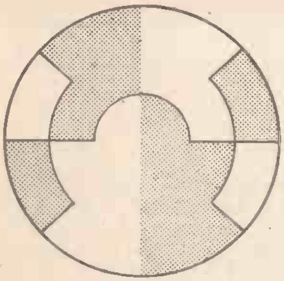


The honey bee

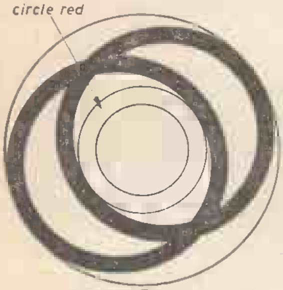
The bent rule



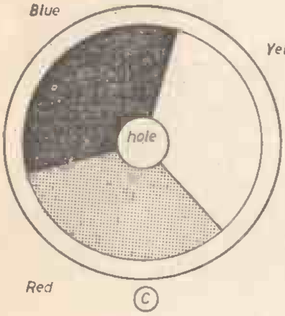
The vanishing lady



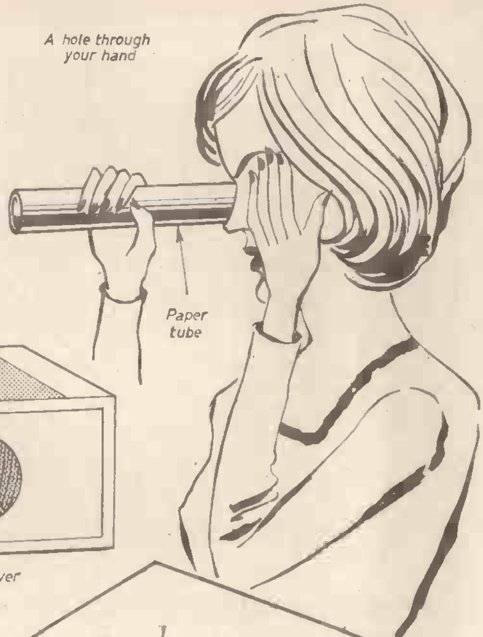
(A)

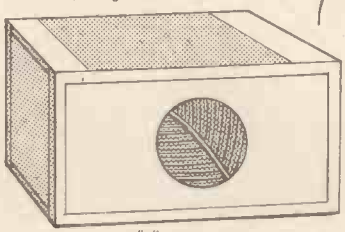


(B)

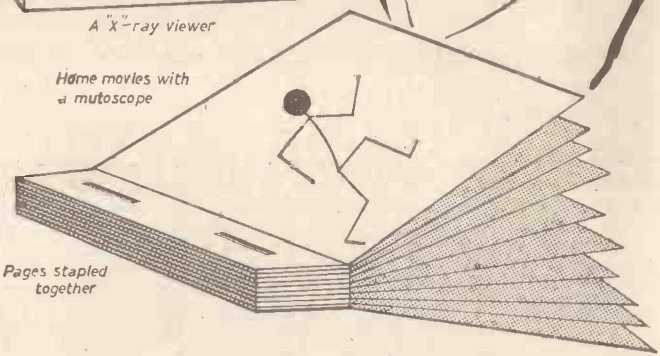


(C)





A "X"-ray viewer



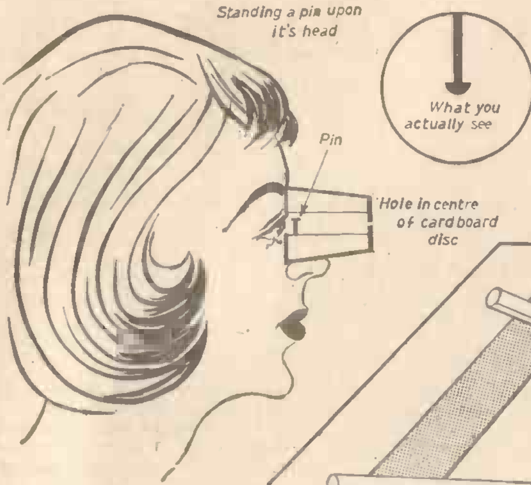
Home movies with a mutoscope

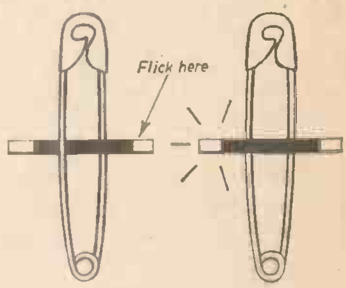
bring the paper towards you. You will be aware of the lady out of the corner of your eye. At a distance of less than 12in. from your eye, the lady will suddenly disappear. This will happen when light from the picture falls upon the non-sensitive blind spot of your retina, where the optic nerve leaves your eye for your brain.

Three spinning tops (this page) will provide some instructive amusement. Copy diagrams A and B on stout white cardboard. The diameters should be about 6in. You should use black ink for the shaded areas in diagram A and also for the black circles in diagram B. Cut out the discs and make them into tops by fitting them with 2in. pointed stubs cut from $\frac{1}{4}$in. diameter dowel rod. Spin the tops in a good light. When A is spinning fast you will see three concentric colour circles which appear to pass outwards like slow ripples as the top's speed decreases. Diagram B will resemble two hula hoops whizzing around the waist of a dancer, when the top is spun. The "colour ripple" effect may relate to the rate of growth and decay of colour impressions in the eye and brain. The principal of persistence of vision will help to explain the second experiment.

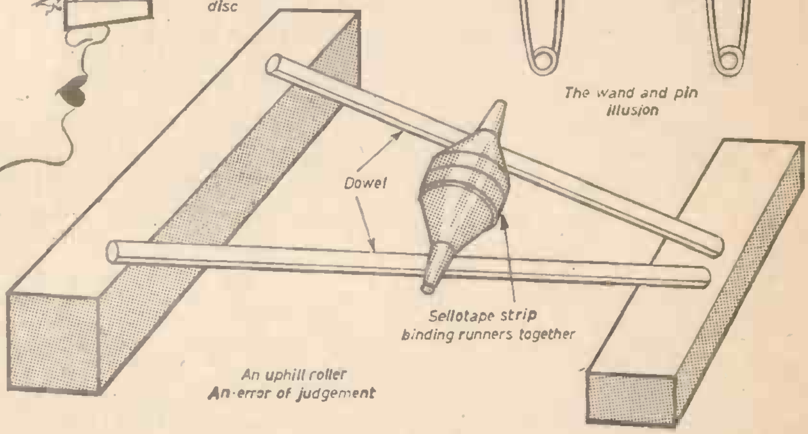
Draw diagram C, 4in. diameter, upon a piece of white cardboard and colour the three equal sectors red, blue and yellow, as indicated. Cut it out with scissors and cut out a $\frac{1}{2}$–$\frac{3}{4}$in. diameter centre hole. Thread the disc on a 24in. long cord. Hold the cord loosely between both hands and "wind it up" by twirling it around many times like a skipping rope. When you pull the cord taut, the disc will spin rapidly upon it. Different colour sectors will touch the string successively and different parts of the disc will turn at various speeds to produce beautiful effects of colour-blending.

A selection of simple apparatus you can make up is illustrated on the next page. Cut $\frac{1}{2}$in. diameter holes through the top, bottom and tray of a matchbox in central positions which will be in line when the box is closed. To make a fake "X-ray" viewer, fix a portion of a feather between one face of the box and the tray. Secure the feather with glue. Hold up your hand to the day-





The wand and pin illusion



An uphill roller
An error of judgement

light and peer through the viewer at your outspread fingers. The feather should be as close as possible to your eye. The grid formed by the parallel parts of the feather will interfere with the light rays coming past your fingers and you will appear to see the bones in your hand.

Prepare a 1in. diameter tube by rolling a piece of notepaper. Keep both eyes open. Hold the palm of your left hand close to your left eye and peer through the tube with your right eye. Aim the tube at a vase of flowers across the room. In a few moments you will be able to arrange the relative positions of your hand and the tube so that the separate pictures of hand and hole are blended by your brain. You will be able to see the flowers through a neat aperture apparently passing right through your hand!

Persistence of vision has already been mentioned. The principle depends on the fact that impressions of images are retained upon the light-sensitive "screen" or retina at the back of an eye for about 1/12th of a second after the light stimuli causing them have ceased. The idea is the basis of moving pictures, whether at the cinema, or upon a TV screen. A cinema sound projector actually throws about 24 complete *still* pictures per second upon the movie screen. The pictures are projected whole between instant of darkness, as the film is pulled in a series of rapid jerks through the film gate of the machine. The figures in each successive frame projected differ minutely, corresponding with the sequence of body positions of the moving actors. These pictures are registered, one after the other, upon the retinas of your eyes and the images are transmitted to your brain, where you become aware of a realistic impression of living movements.

Exploit the principle in a movie flick book, or "mutoscope", you can easily make. Staple together a bundle of 30 or 40 cardboard pages, each measuring about 3in. x 4½in., to form a long booklet. Now you are ready to be your own Walt Disney and make a cartoon film. Do not be too ambitious to begin with. Experiment with pin men drawings. Decide upon a subject for your pin men actors. Try dancing, boxing, or "catching a fish". Let the positions of arms, legs and bodies in each successive picture illustrate slight advances in some logical movement, or movements. To animate the completed series of drawings, merely flip over the pages slowly. When you are skilled, try making more interesting movies. Why not a balloonist descending, whilst flinging out an anchor to an assistant on the ground? You can employ the idea to "test" playing cards for unauthorised markings. Flick through the pack and examine the backs of the cards as they "flash" by your eyes. Any secret markings upon the respective designs will give an impression of "jumping" or of jerky movement if the cards have been tampered with unofficially.

Errors of judgement concerning phenomena imperfectly observed can produce confusion. Consider the roller made by fastening together a pair of plastic funnels, using cellulose tape, as illustrated on this page. Place the dowel rods, exactly as indicated to form a gradient between two bricks. Rest the roller upon the "rails" at the bottom of the slope. The device will appear to roll up the hill. Many observers have been taken in by this illusion; in fact one engineer once actually planned to exploit this apparent "perpetual motion" to carry passengers up an incline. However, if you examine the moving apparatus carefully, you will notice that the height in the air of the funnels gradually becomes less and the roller does not in fact defy nature.

(Continued on page 525)

A SLIDING TAILSTOCK DIEHOLDER

By C. R. YOUNG

Competition is always a healthy thing, nor do great minds always think alike, so we are sure our regular contributor L. C. Mason will not object to this alternative design for a tailstock dieholder.

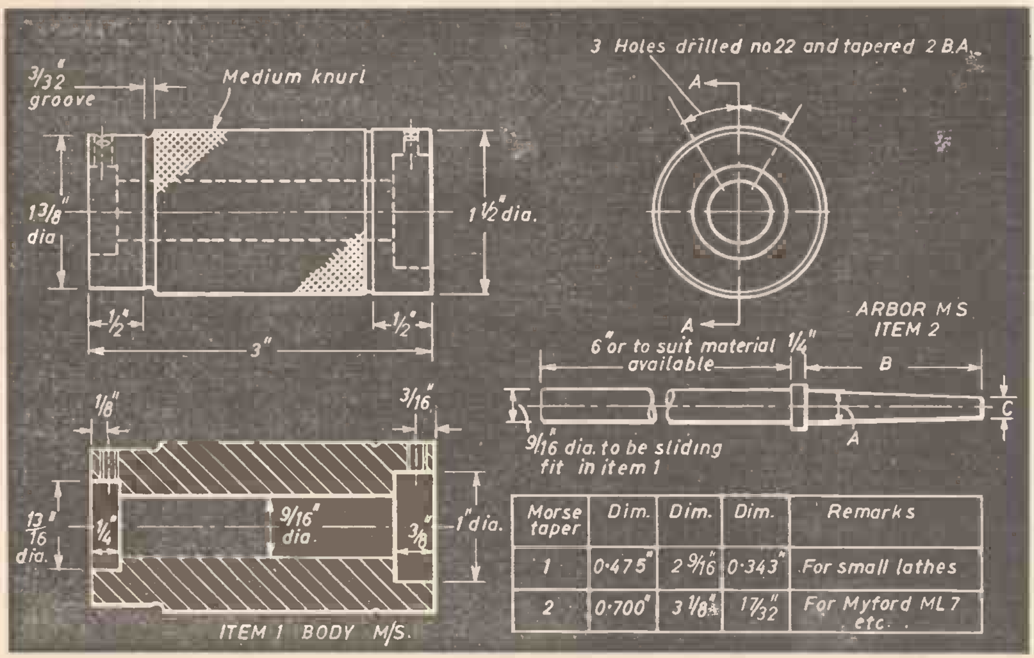
I READ with some interest the article by L. C. Mason on his sliding tailstock dieholder, in the June issue of PRACTICAL MECHANICS AND SCIENCE. While that dieholder is very suitable for heavy work *i.e.* $\frac{3}{8}$in. diameter upwards, it is rather cumbersome for the light work encountered by the locomotive building fraternity. Also, a casting must be procured which means pattern making etc. With the editor's permission I should like to describe the dieholder which I made for my Myford ML7 lathe, which has the advantage that it can be made for the price of the scrap material.

Item 1 is the dieholder body. This can be made from a piece of 1$\frac{3}{8}$in. diameter steel bar, but if 1$\frac{1}{2}$in. diameter bright bar can be obtained this will save some machining. I managed to find a piece about 3$\frac{1}{2}$in. long. One end was faced, and a $\frac{7}{16}$in. diameter hole drilled right through. The end was then bored out to suit 1in. diameter dies, after which the hole through the centre was bored out to $\frac{9}{16}$in. diameter. This can be done by making a boring bar from a piece of $\frac{1}{4}$in. diameter silver steel. A finishing cut was then taken over the outside of the body. The workpiece was then turned around and mounted truly in a 4-jaw chuck. The smaller end was bored out to take $\frac{13}{16}$in. diameter dies. To finish the tool off professionally I borrowed a knurling wheel and put a medium knurl on the centre of the body, which makes a nice grip.

The arbor calls for little comment except that it must be turned between centres. Two sizes of taper are shown in the drawing, number 2MT for Myford ML7 and Super 7 lathes, and number 1MT for smaller machines.

Finally the three holes for the screws were drilled and tapped 2B.A. It is worth spending a couple of shillings on Allen cap screws; mine are 2B.A. x $\frac{1}{2}$in. long. These finish the dieholder off perfectly.

The maximum diameter of thread that can be cut is limited by the bore of the centre hole, but I doubt if many model engineers have strong enough wrists to handle the dieholder with anything over $\frac{1}{2}$in. diameter, and on those rare occasions the thread will probably be screw cut.



Morse taper	Dim. A	Dim. B	Dim. C	Remarks
1	0·475"	2 9/16"	0·343"	For small lathes
2	0·700"	3 1/8"	17/32"	For Myford ML7 etc.

PICTURE NEWS

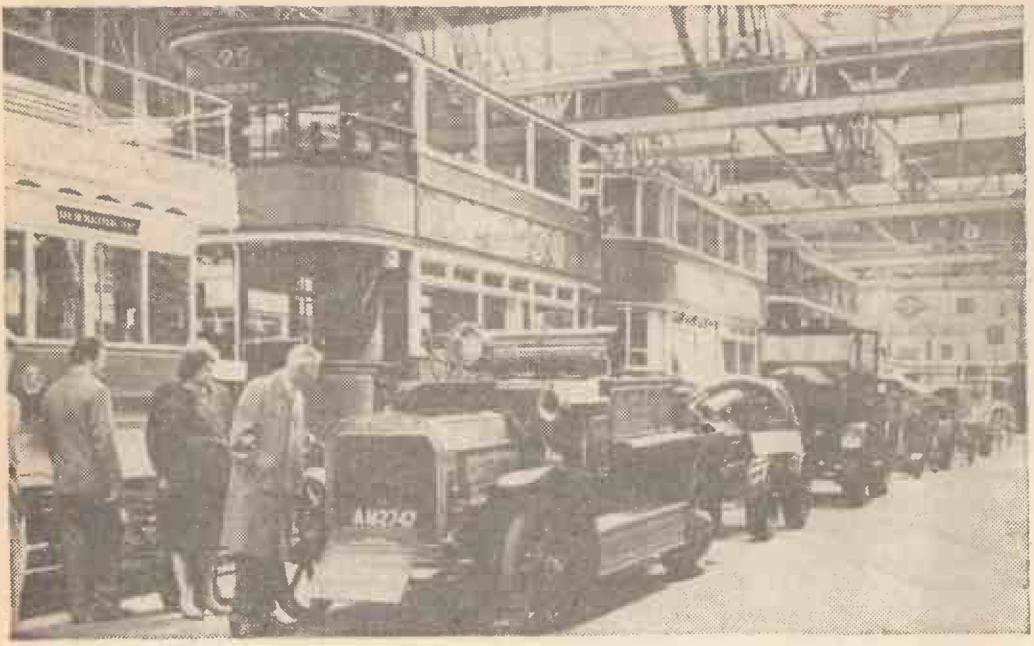
FROM THE WORLD OF SCIENCE

FIRST HOVERCRAFT IN CANADA

The British-made Westland Hovercraft, which can skim at 70 knots across water on a self-made cushion of air, made its first appearance in Canada when one was unloaded at Montreal after an Atlantic crossing from Southampton, England. The 70-seat vehicle will undergo Canadian trials over the difficult Lachine Rapids for the next two weeks before returning to Britain aboard the Canadian Pacific cargo ship *Beaverfir*.

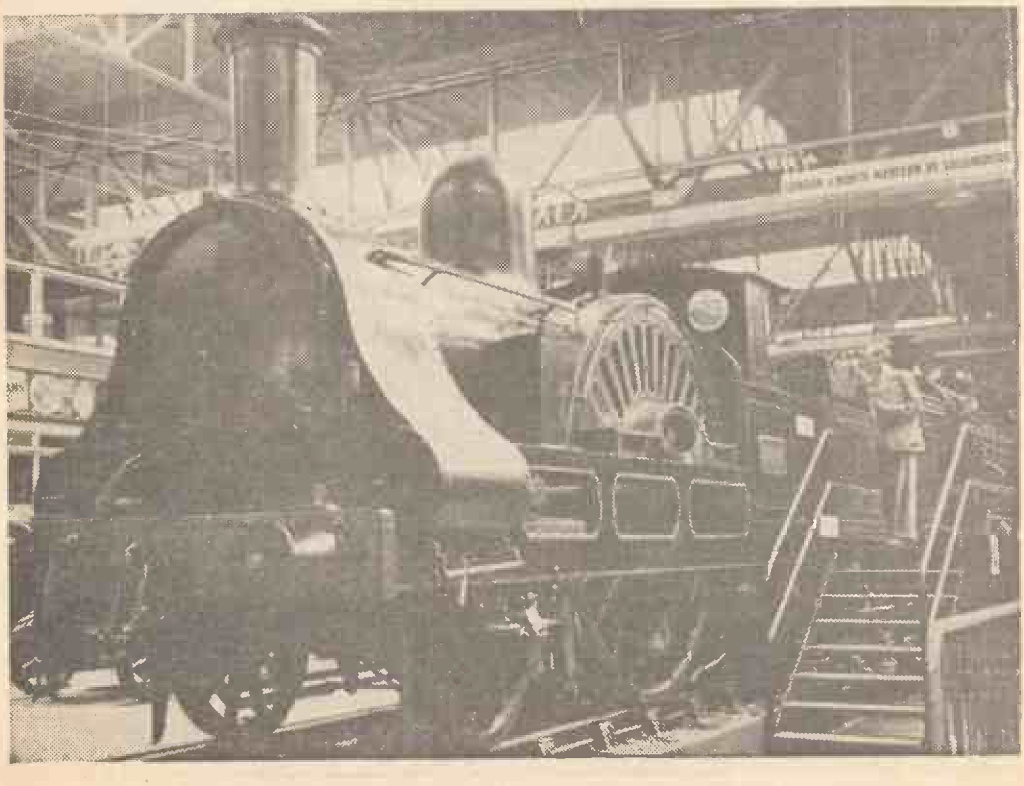
CADETS' HOVERCRAFT FAILS AT DEMONSTRATION

The Hovercraft C.H.I, designed and built by Cadets at the Royal Air Force College, Cranwell, failed during a demonstration on the lawn outside the Air Ministry in London on Friday, June 14th. Construction of the craft started in 1961, after a small working model had successfully completed tests. The machine measures 12½ft x 8½ft and weighs about 700lb. With the propulsion unit fitted it can travel at a speed of over 30 m.p.h. at a height of 5 inches off the ground. It was extremely unfortunate that the Hovercraft failed during the demonstration due to a minor clutch fault, as it was one of the entries for the R.A.F. Art & Handicrafts Exhibition, which opened at the Air Ministry on Monday, 17th June. Responsible for the design of the C.H.I is Under Officer David R. Green, of Bellingham, S. London, and closely associated with him during the construction have been Flt/Cdt. Peter J. Hayward, David J. Gurney, and Richard A. Cosens.



VEHICLES OF THE PAST ON SHOW AT CLAPHAM

A unique collection of historic vehicles is on show at the Museum of British Transport at Clapham, London. The locomotives, trams, buses, fire engines, etc., are attracting hundreds of visitors each day, from all parts of the country, to the exhibition, which has become an outstanding success.



CONVERTING FROM BATTERY TO CAPACITOR FLASH

By C. L. Jones, B.Sc.

FLASH bulbs require a short pulse of high current to fire them. Once the ignition has started, the wire quickly burns up the oxygen in the bulb without the need of further current, indeed the heater wire fuses almost at once. The ignition current may be provided in two ways, by means of low voltage batteries capable of giving a high current or by means of a high voltage battery of the type used in deaf-aids and pocket radios. These are capable of delivering only a relatively small current but are used in conjunction with a capacitator which overcomes this disadvantage.

A typical battery circuit is shown in Fig. 1. Two U2 cells in series provide the high current to fire the bulbs, which they are quite able to do while they are new. Deterioration quickly occurs in use however, and also while "on the shelf" and the internal resistance rises so that the batteries no longer give so high a current. Thus the batteries must continually be replaced, even though the flash gun is only used occasionally.

The capacitor circuit (Fig. 2) employs a battery of much smaller physical dimensions, but of high voltage (15V to 30V, though 22½V batteries are most often used). A capacitor is a device which can store electrical energy, and then give it up quickly when required to do so. If a flash bulb were connected directly across a 22½V deaf-aid battery insufficient current would flow to fire the bulb. In the circuit of Fig. 2 the action of plugging in the bulb completes the circuit, and the capacitor C charges up through the resistor R. This resistor limits the current is taken from the battery initially, while the condenser is in the discharged state, and thus protects the battery from damage. When the shutter

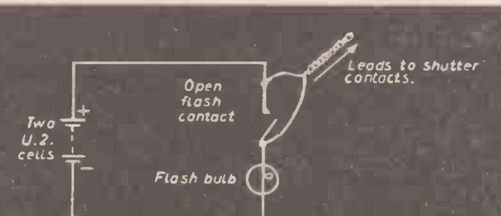


Fig. 1.

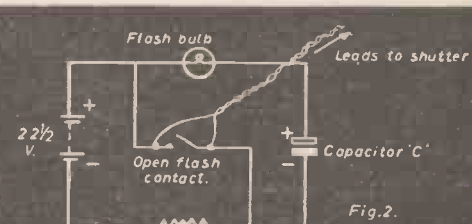


Fig. 2.

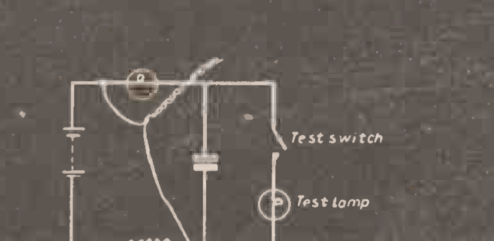


Fig. 3.

Fig. 4.

contacts close, the bulb is connected directly across the capacitor which gives up its charge extremely rapidly causing ignition to be very reliable. While the shutter contacts are closed, current can flow from the battery through the resistance R which again protects the battery from harm. This type of circuit allows reliable operation of flash bulbs even if the battery is well past its best as the internal resistance of the battery is no longer of great importance.

Test circuit

The addition of a small lamp and switch (Fig. 3) enables the circuit and bulb to be tested for continuity. Operation is as follows. The flash bulb is plugged in and a few seconds allowed for the capacitor to charge up. Pressing the test button causes the lamp to flash if all is well. After the test button has been released the circuit is again ready for use in a few seconds. (The open flash contacts have been omitted from Fig. 3.)

Practical details

The conversion of a Kodak Flasholder Model II is described in detail here, but since the new battery and extra components fit easily into the space occupied by two U2 cells no difficulty should be encountered with any other type of flash gun.

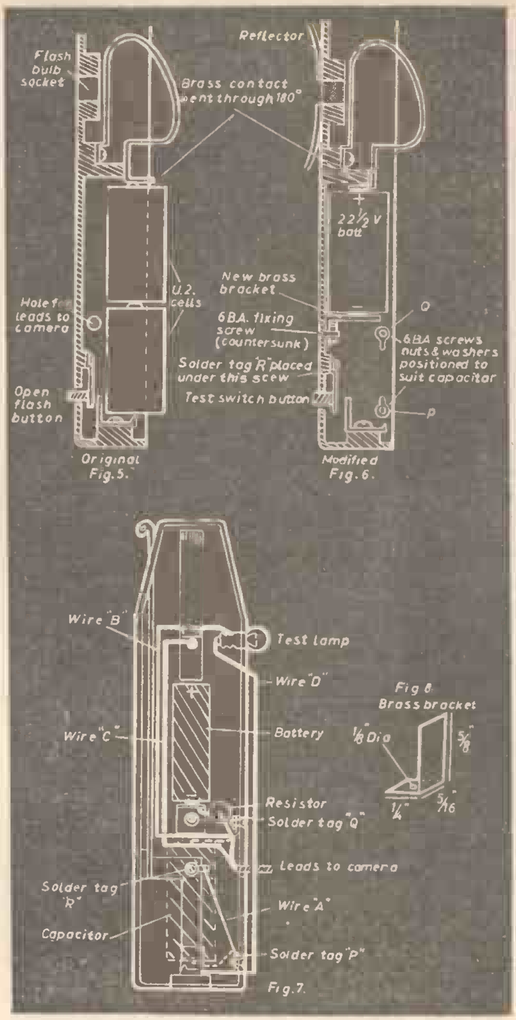
Figs. 5 and 6 are sections through the flash gun showing the modifications and additions. The curved brass strip should first be removed and the part which contacts the battery bent through 180°. The strip may then be replaced.

A small brass bracket should be made to the dimensions given in Fig. 8. The battery can be used as a guide to position this bracket, and a $\frac{1}{8}$in. diameter hole should be drilled in the plastic case to take the fixing screw. The hole should be countersunk on the outside and the bracket attached by a 6B.A. screw and nut. If sharp drills and reasonable care are used, no difficulty should be encountered in drilling the plastic.

A solder tag R should now be placed under the screw which holds the moving part of the open flash contact to the case. In the modified gun this switch will be used to test continuity, and not for open flash. Two more 6B.A. screws, nuts and solder tags P and Q should be fitted in the side of the gun, their position depending on the length of the capacitor used. The capacitor should occupy roughly the position previously taken up by the lower U2 cell.

The test lamp should have wires soldered directly to it, thus avoiding the use of a bulky holder. It should be fitted by drilling a $\frac{1}{4}$in. diameter hole and then filing this out until the lamp is a tight, push-fit into it. A groove may have to be cut in the side of the hole to allow for the blob of solder on the side of the lamp base.

The resistor should now be fitted, bending the wires so that it lies against the flashgun case, parallel with the battery contact. One end should be soldered to the new battery bracket and the other to the nearest solder tag. Only four extra wires are needed and these should be soldered into place in the following order. (1) Wire A, connecting solder tag P to solder tag R. (2) Wire B, which should be soldered to the screw cap of the test lamp and routed around the side of the case to solder tag Q. (3) Wire C, which should be soldered to the brass contact strip, and routed around to end near the exit hole for the camera leads. (4) Wire D, which should



be soldered to the centre contact of the lamp and to the fixed brass contact of the switch. The camera leads can now be connected to the free end of wire C and to tag Q. Fig. 7 shows a view into the back of the gun. All leads must be kept clear of the battery, to facilitate changing it. The capacitor should be soldered in last of all as it hides most of the wiring. The positive end *must* be connected to tag P and the negative end to tag Q. The components are easily obtainable from any radio spares shop, and a complete list is given at the end of the article.

No difficulty should be experienced in making the conversion but attention is drawn to the following points. The capacitor and battery *must* be connected correctly, the positive end is usually marked + or coloured red. If either battery or capacitor are connected the wrong way round, the circuit will not function and the capacitor may be ruined. When soldering, excess heat may adversely affect the components. As soon as a good

(Continued on page 525)

The Trident Automatic Landing System

BY OUR AIR CORRESPONDENT

WHEN the de Havilland Trident goes into service with BEA later this year, automatic landing devices will assure accurate approches and landings at all times, even in conditions of low visibility.

Statistics show that almost half the major airline accidents occur during the final approach and landing. On average, one such accident can be expected to happen in every 150,000 landings. So, taking the 33 principal airfields in Europe, where there are currently some 750,000 landings a year, the average expectation would be about five major landing accidents within twelve months.

Most landing accidents occur in conditions of good visibility and are due to errors in height during the final approach and flare-out phase, caused by misjudgement or failure to control pitch attitude and airspeed. The Trident automatic landing system is designed to eliminate practically all such accidents. The system design is based on an airworthiness requirement that it must show itself to have a reliability of not more than one failure in 10 million landings—a standard many times better than that achieved by even the most experienced airline. The Trident system has already shown itself to be capable of controlling the aircraft during the approach and landing with a consistency and accuracy well beyond human capability. This kind of reliability is achieved in aircraft systems by the multiplexing of systems, *i.e.* by having several systems operating side by side. In the Trident, both duplex and triplex systems are available. Both can make a considerable contribution to airline safety and regularity.

In the duplex system, two automatic pilots with their associated computers and radio receivers always work in parallel. If one malfunctions and thereby disagrees with the other, both are automatically cut out, leaving the pilot with his aircraft correctly trimmed to continue the landing or overshoot. For this reason, the duplex system cannot be certified for operation in visibilities in which the pilot is unable to see sufficiently to take over if the autopilots do cut out.

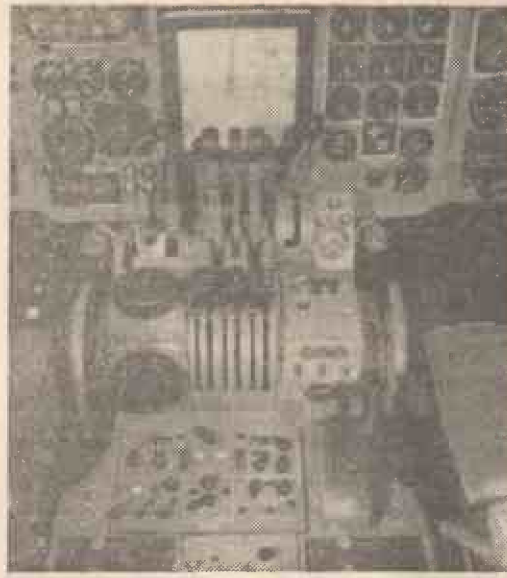
In the triplex system there are three autopilots working in parallel. If one malfunctions the remaining two will " out-vote", and cut out, the faulty system. A pilot would not, therefore, be required to take over during the approach and landing unless two autopilots were to fail together. It can be shown that a double autopilot failure is less likely than once in 10 million operations.

The only ground aid required for the Trident system is a good I.L.S. installation with appropriate standards of reliability. Leader cables are not required and, indeed, a new I.L.S. localiser, recently developed, has shown itself to be as accurate as the leader cable in azimuth guidance down to and along the runway.

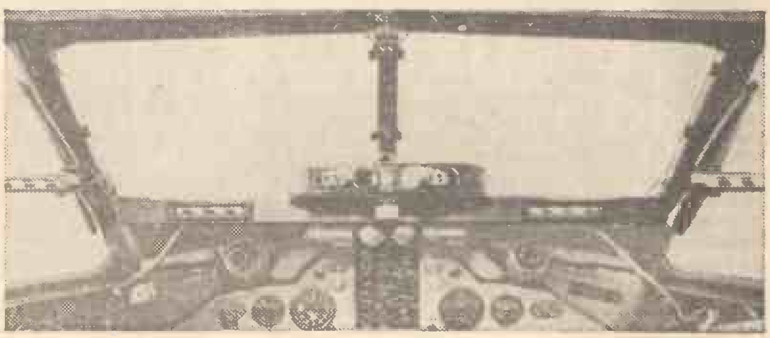
When the Trident goes into service with BEA, it will be equipped to the duplex level which will provide "autoflare" and "autoland". With autoflare the aircraft will carry out an automatic approach with the speed closely regulated by automatic throttle control, and will make an automatic flare-out. The pilot is concerned only with keeping the aircraft level and aligned with the runway.

So, although "autoflare" with the duplex system is not entirely automatic, it may well bring about a useful reduction in acceptable weather minima. And, because it can perform with great accuracy the difficult height and speed control tasks of the approach landing, it will certainly cut down the number of missed approaches and reduce the hazards in marginal weather conditions.

Recent assessments of the Smiths P. V. D. (Para-Visual Director) have shown that the director information to the human pilot is sufficient to enable him to continue the landing or to overshoot when the autopilot has cut down. This provides a third channel or means of controlling the aircraft, which is independent of the duplex autopilot. When this system is brought into use, an aircraft fitted with the duplex system and P. V. D. should be able to operate safely in weather minima much below present limits.



The automatic flight control panel in the Trident is placed horizontally between first and second pilots for the third pilot to monitor the landing.



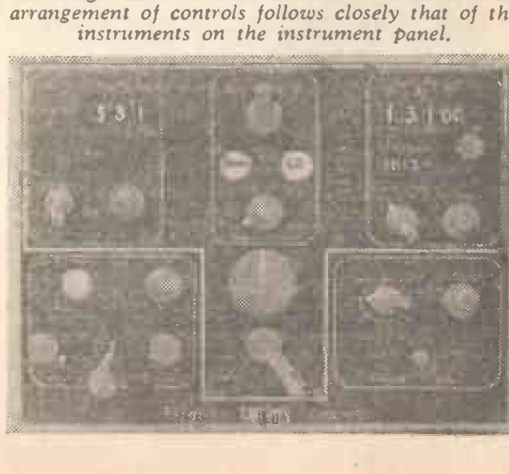
The Para-Visual-Director "barbers' poles", here installed in a D.H. Dove aircraft, provide the pilot with a compelling signal in pitch and yaw, enabling him to continue the landing or to overshoot with the duplex system disengaged.

It should be emphasised that the duplex system is capable of providing for both autoflare, as described above, or autoland—in which the whole landing operation is automatic, including guidance in azimuth and kicking off drift before touchdown. It therefore differs from the triplex system only in the minimum limits of visibility to which it can be certificated.

With the introduction of the fully developed triplexed system for the Trident, in five or six years' time, forward visibility will not be a factor in the landing manoeuvre and the ability of the pilot to control the aircraft on the ground will set the limiting weather conditions.

The operator's choice between "autoflare" at a duplex level or "autoland" at a duplex or triplex level will be governed largely by the incidence of bad weather on the routes concerned. Either system, in the appropriate circumstances, can be expected to bring about a significant saving in airline costs by a drastic reduction in delays, diversions, cancellations and aircraft damage.

The Flight Control Panel as used in Trident. The arrangement of controls follows closely that of the instruments on the instrument panel.



MAKE ENLARGEMENTS THIS WAY

By 'PHOTOGRAPHER'

THERE is considerable satisfaction to be gained from seeing a small negative "blown-up" to even a moderately sized enlargement, with a wealth of detail which was not previously noticeable. Enlarging does need skill, but that can be acquired with experience provided that the basic procedure you adopt is sound.

The room used for enlarging must, of course, exclude all outside light. However, this does not mean that it must be completely dark, for provided that safelights of the correct colour are used the illumination can be at quite a high level. Bromide paper, much used for making enlargements, can be safely handled in an orange or olive-green light, both of which are quite easy to work in.

A finger-marked or dusty lens will never throw a sharp image, so clean all the exterior surfaces *carefully* with a soft brush followed by chamois leather or lens tissue. It is inadvisable to take a lens to pieces in order to clean the interior surfaces of the glasses, since any internal anti-reflection coating is often softer than that on the outside and could easily be damaged. Condenser lenses, too, should be polished as otherwise any dust on them may show as white spots in the enlargement. If your enlarger has a negative carrier in which the negative is held between sheets of glass, this will also need to be cleaned. As an alternative to the chamois leather, special anti-static cloths can be obtained for a few shillings and will prevent dust from being attracted to the glass surfaces.

The negatives must also be perfectly clean; they should be cleaned in a similar manner to the enlarger components mentioned above. Take each negative from its place in the file as you wish to use it, and then replace it immediately. Never have negatives lying about uncovered while working. Very badly soiled negatives should be treated before attempting to make enlargements from them. Sometimes, rewashing is all that is required, but occasionally cine-film cleaner is called for. Be sure that damage is not caused to the negatives while inserting them in the enlarger carrier. Hold them only at their edges and do not drag the film strip from one frame to the next. In most enlargers, the entire carrier can be removed quite easily, and this should be done each time before moving the film on.

Always focus the enlarger with the lens wide open (at full aperture), and project the image onto a sheet of paper of approximately the same thickness as your enlarging paper. A scrap piece of bromide paper is ideal for this purpose. Do not rely on using a white-topped masking frame for focusing, as this permits the focus to be incorrect by the thickness of the paper. In addition, the white paint will reflect any projected light which penetrates the bromide paper and may cause it to degrade the lighter tones of the print. It is far better to paint the masking frame matt black and slip in a piece of white paper for focusing.

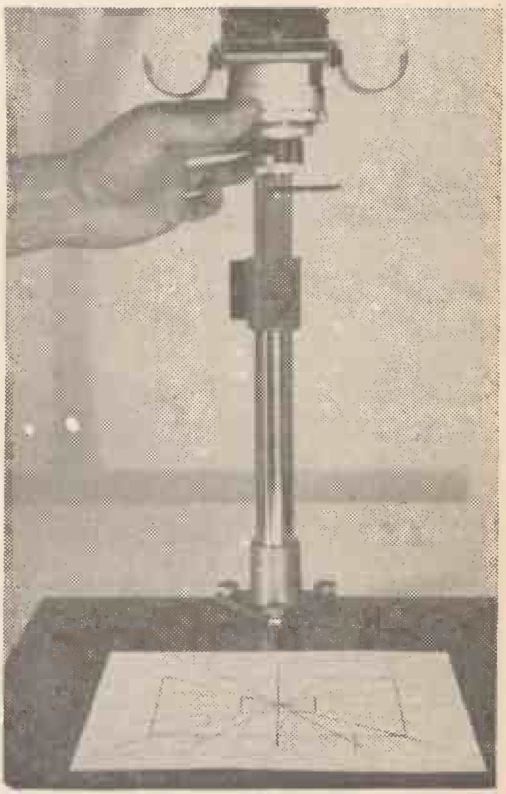


Fig. 1. Use a ruled negative if you find focusing difficult.

The more expensive enlargers are fitted with rangefinder focusing devices, which should enable sharp focus to be obtained simply by matching up two or three white lines which are projected onto the baseboard. In other cases, and particularly where dense negatives are concerned, difficulty may be experienced in adjusting the lens correctly. Black and white ruled negatives, specially made for focusing enlargers, can be purchased but one can easily be made by ruling a few indian ink lines on a clear piece of film. The startling clarity of the lines, as can be seen from Fig. 1, permits the lens to be sharply focused without any difficulty at all.

Only a very experienced operator can estimate the exposures required for different negatives without resorting to the making of test strips. Initially, therefore, it is advisable to make a test for each negative, and a reasonably sized piece of bromide paper should be employed. A tiny test strip does not cover a sufficiently large area for the average exposure to be properly determined, and it is unwise to attempt to economise in this direction. Close the lens down at least two stops from full aperture and switch off the enlarger. Then, place your test strip on the baseboard, or in the masking frame, and cover all of it except a narrow strip. Switch on the enlarger and give five seconds exposure, then move the covering card back a short way and give a further five seconds exposure. Continue to do this until all the paper has been exposed. On development for the normal time, a series of different exposures will be revealed, each five seconds longer than the previous one, and it should be possible to pick out the correct time without difficulty. The proper print then only requires exposure to the time found by this test strip.

There are occasions when a negative is a little weak in certain areas which thus need to be held back (exposed for a shorter time) during printing. If extensive shading is required this can often best be done with the hand, as shown in Fig. 2. Keep the hand moving slightly all the time so that a hard outline is not formed. Smaller areas can be shielded with a "dodger", which is a shaped piece of cardboard attached to a thin wire, as can be seen from Fig. 3. Again, movement while shielding is essential.

Dense areas of the negative will need to be printed for longer than the rest of the negative, or as it is often called, "burned in". This can be done by holding the hands in the path of the light beam so that they permit the rays to pass only where extra exposure is required. If preferred, a suitably sized hole can be cut in a sheet of thin card and held in the enlarger beam. Which ever method you adopt keep the hands or card moving slightly throughout the additional exposure, the duration of which will depend upon the density of the negative.

Having exposed the paper, slip it under the surface of the developer, face up, and immediately start rocking the dish from side to side and end to end, in an irregular sequence. This is essential if uneven development is to be avoided. The image should come to full strength in two minutes, and if left longer should not become any darker. After that time, if any areas have still not become dark enough, they can be treated by swabbing with concentrated developer on a cotton-wool pad held in the print tongs. This will have the effect of giving extra development to the required areas, but the print must be rinsed and passed into the fixing bath immediately in order to prevent it from becoming stained. Another method of increasing local development is to breathe on the paper while it is saturated with developer. The warmth provided by your breath will activate the developer and cause it to increase its effect in the weak areas. Again, the paper must be rinsed and fixed quickly.

Prints are best handled either with plastic tongs or with a spatula. As shown in Fig. 4, the tongs or spatula can be used to hold the prints under the surface of the fixing bath after they have been agitated freely to remove air bubbles which might be clinging to the surface of the paper. Give them a stir-up occasionally however. It is bad practice to allow your fingers to come in contact with any photographic solution because of the risk of contaminating film and paper or of leaving stains or chemical deposits on the apparatus, etc. There is also a risk that the solutions may affect a sensitive skin. Nevertheless, photographers are human and the temptation to pick up wet prints very strong. If you do, make it an invariable habit to rinse your fingers under the tap and dry them at once on a frequently changed towel kept in the darkroom for that purpose. If you have numerous enlargements to make, put the prints through two fixing baths, one after the other, to ensure complete chemical action. Wash the prints thoroughly in running water for at least half an hour before either glazing them or blotting them off and laying out to dry, according to the surface desired.

In time you will discover and perfect your own little tricks to produce better enlargements, but the hints given above should enable you to make a better start in this interesting field of photographic activity.

Fig. 2. Shading an area with the hand.

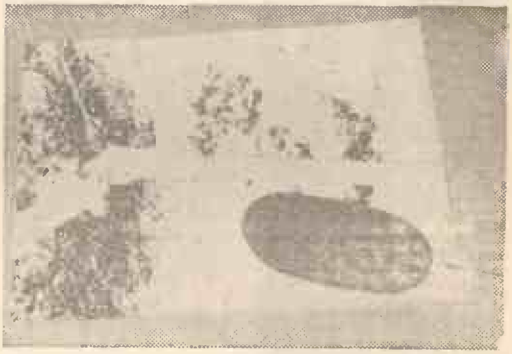


Fig. 3. Using a "dodger".

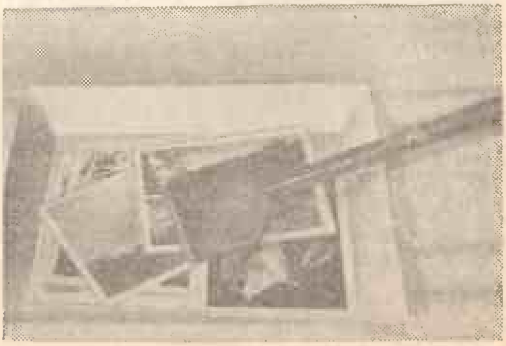


Fig. 4. A plastic spatula is useful for handling prints.

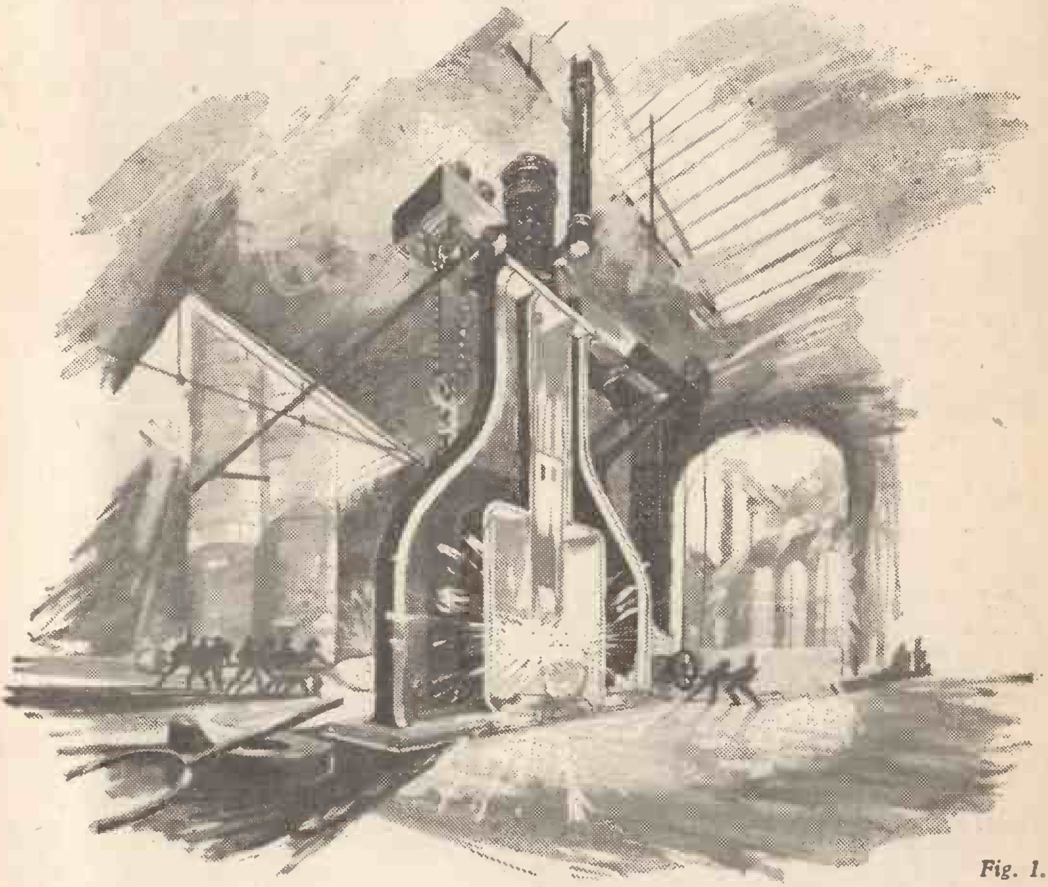


Fig. 1.

BIRTH OF THE Steam Hammer

PRACTICALLY all model engineers have been concerned with steam at one time or another. Steam driven locomotives and traction engines have a particular appeal, but the steam hammer, a machine highly suitable for reproduction in miniature, appears to have escaped the enthusiasm of model makers.

What is the background of this indispensable machine in the forge? For this we must turn to the memoirs of James Nasmyth, engineer of the 1800's. The great philosopher, Samuel Smiles, edited an autobiography about this extraordinary man, in which a short account of the steam hammer is given. It appears that a Mr. Francis Humphries, concerned with the construction of a large ship—the Great Britain—consulted Nasmyth about the immense engines needed for this enterprise. He mentioned the difficulty of finding a hammer powerful enough to forge the intermediate paddle-shaft. In short Nasmyth said, "I got out my 'scheme book', on the pages of which I generally thought out, with the aid of pen and pencil, such mechanical adaptations as I had conceived in my mind, and was thereby enabled to render them visible. I then rapidly sketched out my Steam Hammer . . ." This first drawing of his steam hammer, dated 24th November, 1839, is shown in Fig. 2. Nasmyth was good at hand sketching, as can be been. Indeed he frequently illustrated his letter by small sketches sandwiched between the written matter. In the right-hand lower corner of this page will be seen the old helve-hammer which he intended to replace, fancifully likened to a man doing press-ups.

It so transpired that the paddle-shaft was not forged because of the intervention of another invention—the screw or propeller, which was recommended by Brunel, another great engineer, for the Great Britain. Thus engineers had to wait for the Nasmyth hammer. At some time later, Nasmyth, visiting the Continent, saw "with surprise and pleasure . . . his own child" there. He, however succeeded in securing his patent in June 1842.

Fig. 1 shows the steam hammer in full work, based on a painting by the great engineer himself. As will be seen, the machine comprised an anvil to support the work and a hammer. The hammer was capable of sliding up and down between slipper guides and was coupled by a connecting rod to a piston moving in a cylinder. Steam was admitted to the underside of the piston, lifting it and the hammer to any desired height within the range of full stroke. By a suitable slide valve arrangement, the steam was

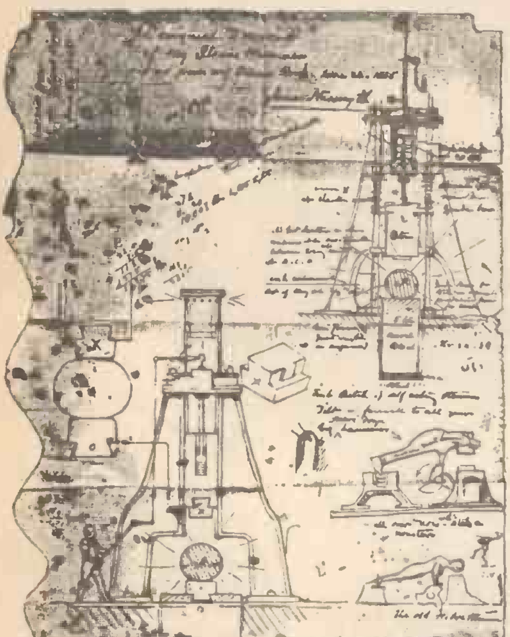


Fig. 2.—Facsimile of the page in Nasmyth's scheme book with the first drawing of a steam hammer.

permitted to escape and the piston, rod and hammer fell by gravity, on to the work. The model engineer will see at once that if the anvil and hammer were replaced by a cross-head, connecting rod, crank and flywheel, you have a single cylinder steam engine. Nasmyth was evidently surprised, as all newcomers are to power hammers, at the rapid action achievable. In 1843 Nasmyth admitted steam to the top of the piston, thus aiding gravity and intensifying the blow. Further, a self-acting mechanism was added to do away with manual valve operation.

SEEING CAN BE DECEIVING

(Continued from page 514)

Make up the "wand and pin" illusion by impaling a little wooden magic wand upon one prong of a safety pin. Hold the apparatus in your left hand and flick the wand sharply. The rapid movements of the wand will cause it to appear to penetrate the left side of the pin.

Bore a neat $\frac{1}{2}$in. diameter hole right through a large cork, from end to end, and glue a cardboard disc to the smaller end, as illustrated. Pierce the centre of the disc with a pin. Just inside the opposite end of the improvised viewer fix a small pin, upright. Direct the pinhole towards a bright light and hold the viewer with the pin "sight" close to your eye. The pin should still be upright when you do this. Look towards the "field" of light entering the hole. You will be convinced that you "see" the pin standing upon its head. Normally, images projected upon the retina are inverted, but your brain always corrects this topsy turvy impression of the world. When you used the viewer, you held the pin so close to your cornea that a proper (inverted) image could not form inside your eye. However, the cone of light rays cast an *upright shadow* of the pin upon your retina. Your brain "corrected" this impression and fooled you into seeing the pin upside down.

Perhaps, after you have completed some of these optical experiments, you will never be able to believe your eyes again. You will have proved that sometimes seeing can be deceiving.

CONVERTING A FLASHGUN

(Continued from page 519)

joint has been made the iron should be removed. Do not keep it on longer "for luck". It will be bad luck! The test lamp should not take a larger current than that specified or it will not flash.

These details should enable any flashholder to be converted, or a complete gun could be made.

COMPONENTS

Capacitor.	100Mfd, 25V working.
Resistor.	3,300 Ohm. $\frac{1}{2}$ or $\frac{1}{4}$ watt.
Battery.	$22\frac{1}{2}$V Ever Ready B.122.
Test lamp.	6V, 0·04 or 0·06 amp (cycle dynamo rear bulb).

SMALL WORKSHOP TOOLS

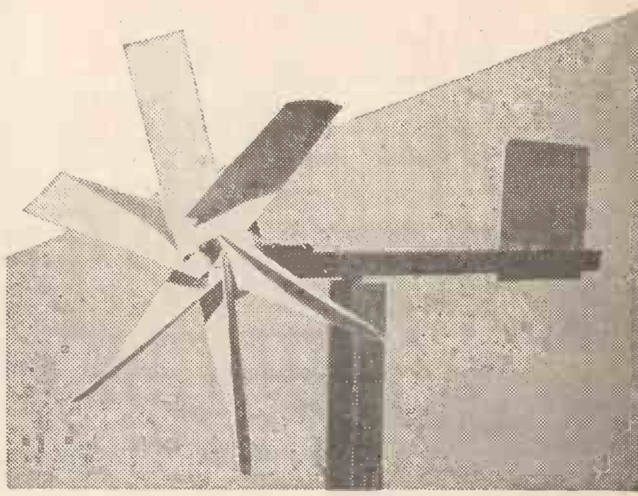
(Continued from page 502)

the workpiece between chuck and tailstock (a $\frac{5}{16}$in. B.S.F. hexagon nut will prevent the thread being damaged) for knurling. Finally drill out the handle.

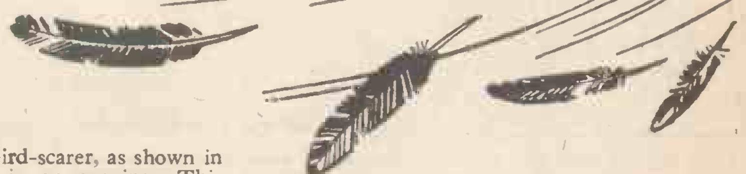
The pivot should be made from mild steel. The dimensions are quite critical as the smooth operation of the vice depends upon them. The brackets must be a firm fit in the gaps of the pivot. The bottom of each gap must be crowned very slightly to permit a rocking motion of the brackets. Drill the centre hole for the pivot and tap $\frac{5}{16}$in. B.S.F.

The brackets are two $2\frac{3}{8}$in. lengths of $\frac{1}{2}$in. x $\frac{1}{8}$in. mild steel. The semi-circular cut-outs to accommodate the jaws should be formed by drilling the brackets while they are clamped together. The jaws, two $\frac{3}{4}$in. lengths of $\frac{1}{8}$in. diameter steel, should be silver soldered into the sockets. Two $\frac{1}{8}$in. rivets 1in. long will complete the assembly. The rivets should be snap-headed at both ends and care must be taken to avoid binding.

SAVE THOSE SEEDS



with this bird scarer



A SIMPLY constructed bird-scarer, as shown in Fig. 1, can be made in an evening. This handy garden gadget will save your seeds and young plants from their biggest enemy—the birds.

The vanes

The vanes should be made from 3in. x 12in. tinplate, folded as shown in Fig. 2. The vanes can be made larger sizes if so desired, the only limit to size being the material you have to hand. The tinplate can either be purchased or may be cut from large tin canisters or boxes such as sweets or biscuits are supplied in. If you haven't any tin shears a pair of old heavy scissors will do just as well. The vanes should be riveted or soldered to a metal lid of any convenient size. The lid in its turn should be riveted to a wheel hub from an old pram or bicycle and the rotating head is then complete.

Bar and tail

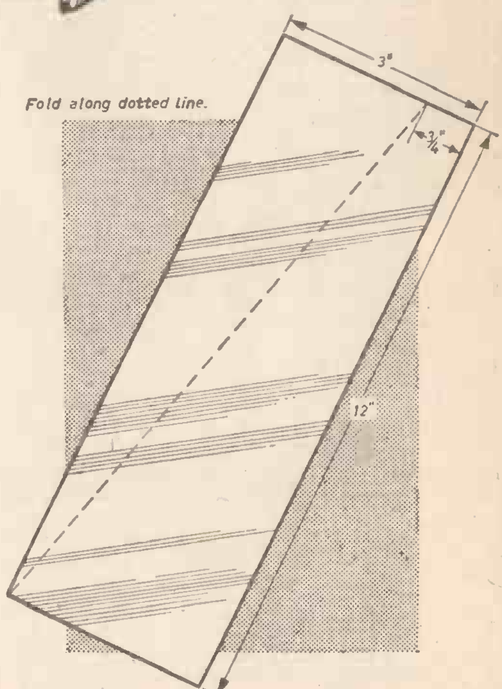
Attach to the horizontal wooden bar, approx. 1in. sq. x 25in.) part of the axle of the old pram, or a suitable rod if a bicycle hub has been used. Push on the rotating head and hold it in place by means of a split pin. The tail is of sheet tin (approximately 8in. x 7in.) and should be nailed to the wooden bar. Tail size is of little importance and any odd piece will do.

Balance

To balance the bar so that it moves horizontally under working conditions, is quite simple. Place the bar, with rotating head attached, on the top of a chair back and move it backwards and forwards

(Continued on page 510)

Fold along dotted line.



How to mark out and fold a sheet of metal for one vane.

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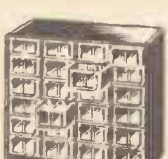

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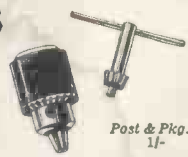

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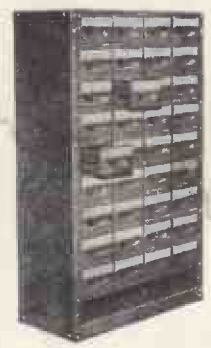

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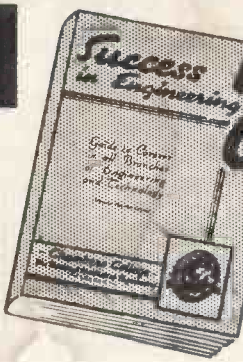

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