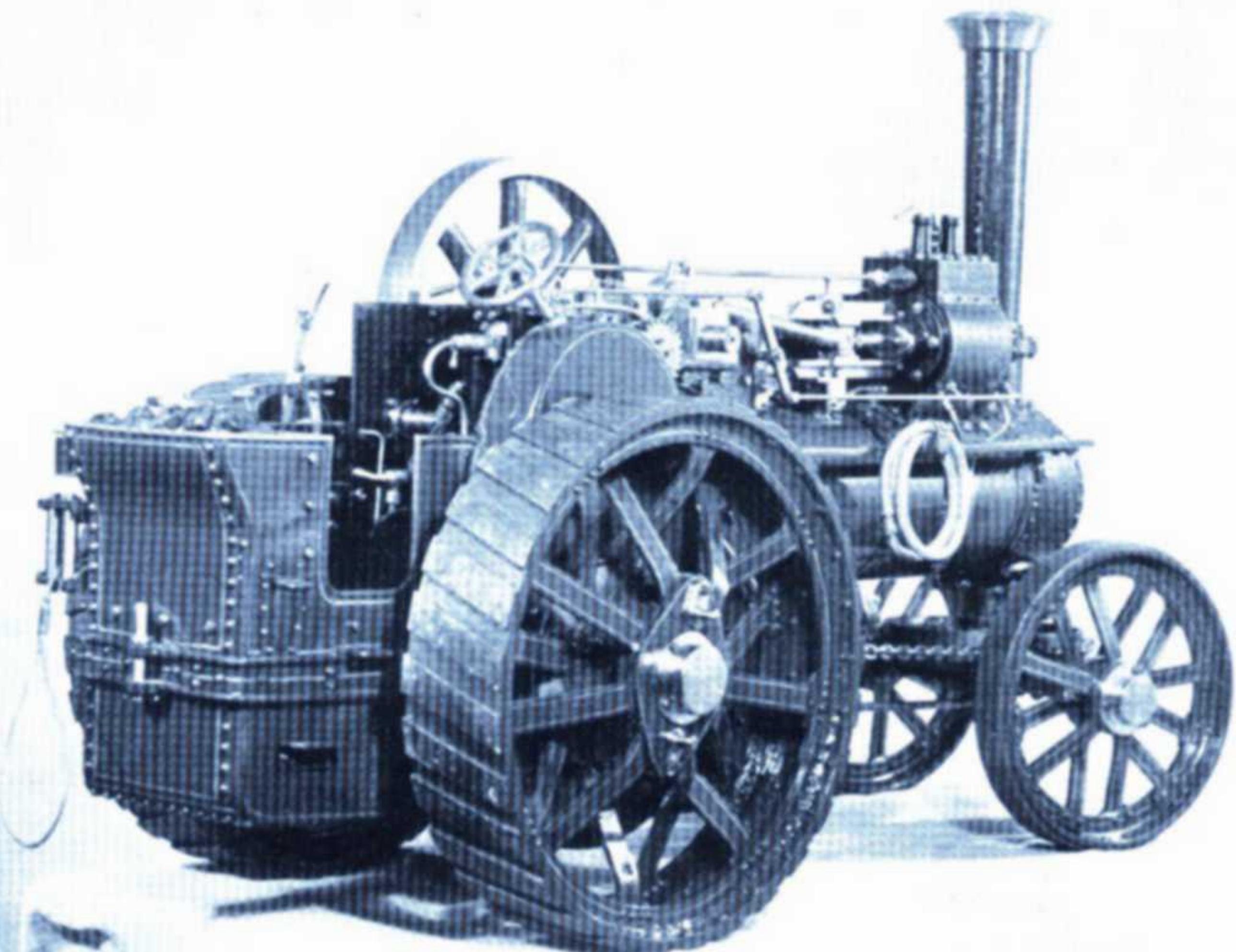
THE MODEL ENGINEER



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THE STORY OF AN 8 ft. RADIO-CONTROLLED CARGO LINER

MAY 26th 1955

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THE
MODEL ENGINEER
ESTABLISHED 1898

SMOKE RINGS

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OUR COVER PICTURE

The subject this week is a fine 2-in. scale traction built by Mr. A. Jenkins, of Lapworth, Warwicks. It was exhibited at the "M.E." Exhibition in 1950, when it won a Diploma. As will be seen, it is quite an imposing model, though it gives the impression of being somewhat unnecessarily massive. The workmanship and finish are good, if not absolutely accurate in some of the details, but its construction must have involved a lot of time, energy and patience.

"M.E." Exhibition Posters

NO DOUBT many readers will be willing, as in previous years, to display "M.E." Exhibition posters in their homes, offices, or shops. We would be glad to hear from anyone who would care to co-operate with us again in this way. A postcard is enough, but it should, of course, bear the name and address of the sender. Yes! That important information *can* be forgotten. The actual posters are not yet ready, and probably will not be until July; but we like to begin to compile a list of willing poster-displayers well beforehand, so as to avoid the possibility of a terrific rush during the week or two immediately prior to the date of the Exhibition. Applications for posters should be addressed to the Exhibition Manager, Percival Marshall & Co. Ltd., 19-20, Noel Street, London, W.1.

A Russian Enquiry

OUR EXHIBITION manager has had a surprise in the receipt of a cablegram from Moscow, apparently from the Army, Navy and Air Force Club in that city, asking for rules and regulations governing speed models, yachts and ships at the "Model Engineer" Exhibition. Needless to say, all possible information of this kind was immediately forwarded, and we are wondering whether the outcome will be the entry of some models from Russia at this year's show. If so, we believe it will be for the first time at the "M.E." Exhibition.

S.M.E.E. Affiliation Indian Exhibit

DUE LARGELY to the co-operation of Rear-Admiral (E) R. Cobb, (retd.) of the Science Department of the British Council, the S.M.E.E. Affiliation will be sending some examples of its members' work to be displayed in the International Section of the exhibition to be held by the Bombay S.M.E. during next November and December. Model engineering societies in the U.S.A., France, Germany and Switzerland have been invited to participate in the exhibition, and so, we believe, for the first time, examples of British, American, French, German and Swiss amateur model work will be seen side by side. It is a matter for considerable satisfaction that the British Council should interest itself in this matter and help the Affiliation to take part in an event that enables British model engineers to be represented at the Indian exhibition.

Her Fate no Longer in Doubt

A "SMOKE RING" in our issue for December 23rd last referred to engine No. 50621 of British Railways L.M.R., which had then been withdrawn from service and partially dismantled. In view of the fact that this engine, ex-Lancashire and Yorkshire Railway 2-4-2 tank engine No. 1008, was the first locomotive to be built at Horwich Works, as well as being the first of a long line of far-famed locomotives, a very strong plea for her preservation was made. We are glad to learn, at long last, that this plea has been successful and the engine has been saved from the scrap-heap.

Centenary of Aluminium

IT IS just one hundred years since the use of aluminium as a commercial metal was introduced into British industry. To mark the occasion, an exhibition is to be held at the Royal Festival Hall, London, from June 1st to 10th. The Duke of Edinburgh will visit it during the morning of June 3rd. The display will tell the story of an industry that has been built on research. The story will be vividly illustrated by a thousand exhibits including railway coaches, giant cranes, bus bodies, window frames, roofing, brewery vats, cooking pots, aluminium foil and a variety of other products fashioned out of this remarkable metal and its alloys. Not only are past achievements and present uses to be portrayed, but the future trends will also find a place in this most comprehensive display.

Although primarily intended for architects, engineers, designers, fabricators and potential users of the metal, the public will be admitted by ticket obtainable at a kiosk near the entrance of the Royal Festival Hall.

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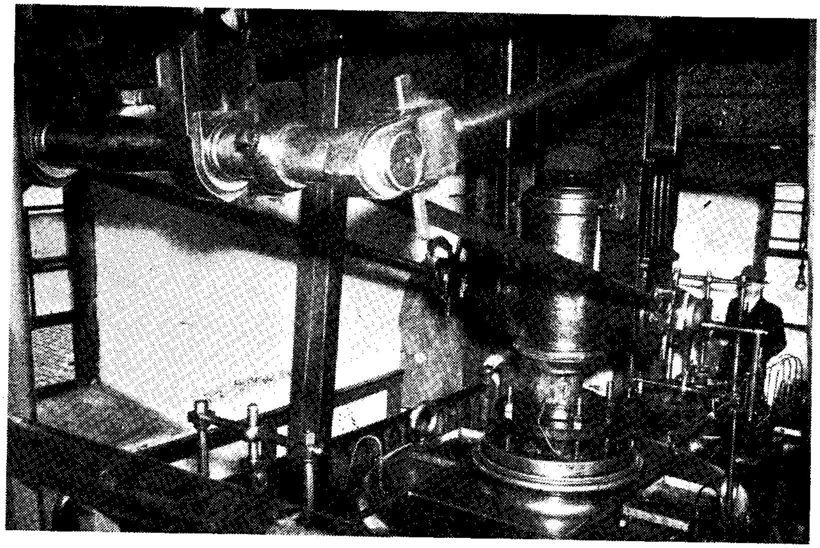
CORNISH PUMPING ENGINES

JOHN F. WELLINGTON DESCRIBES
THE GREAT 80-in. BEAM ENGINE AT SOUTH CROFTY MINE, CAMBORNE, CORNWALL

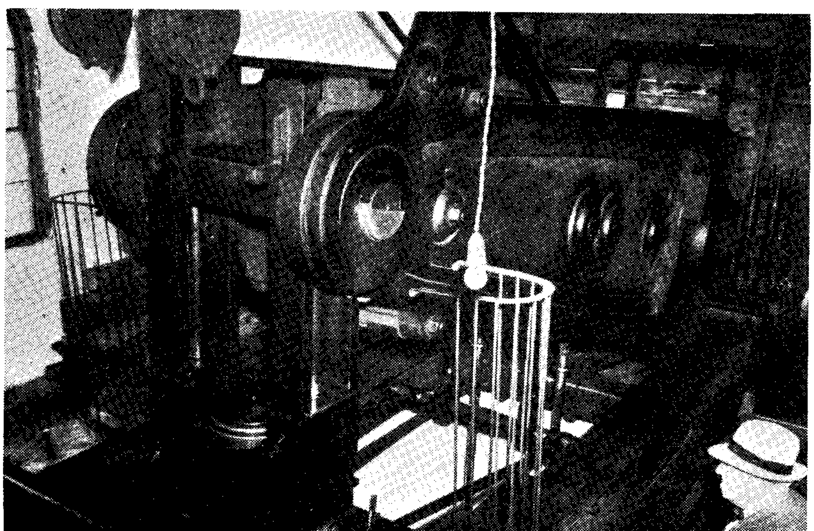
EVERYONE who is at all interested in steam engineering, has at some time heard of the famous Cornish pumping engines, a few examples of which still remain at work in Cornwall, and elsewhere. One of these, the great 80-in. engine at Robinson's shaft, South Crofty Mine, Camborne, recently reached its centenary. One hundred years of faithful service to its various owners. The occasion was observed by a meeting of the Cornish Engines Preservation Society at the engine house; but unfortunately, this engine will cease duty in the very near future. It was assisted until recently by the massive 90-in. engine at the old East Pool mine near by, but this one has already ceased work. Both engines are being superseded by electrically-driven pumps. The 90-in. Harvey engine, readers will be pleased to know, is the property of the Society, and is being put into a suitable state for preservation. It is hoped also to preserve the 80-in. Robinson engine when it becomes idle.

This engine, one of the most successful built in Cornwall, has had a very varied and chequered existence. It was built at a cost of £2,700 by Sandys Vivian & Co., at the Copperhouse Foundry, Hayle, to the design of Samuel Grose, a celebrated Cornish engineer, and was set to work in June, 1854 at the Wheal Alfred mine near Hayle and known as Davey's engine. This mine being forced to closed down in 1864 by the flooding of the nearby Great Wheal Alfred, the engine was then removed to the Crenver and Abraham mines, and known as "Pelly's engine." Subsequently, in 1882 the engine was again moved, and erected at the famous "Tregurtha Downs" mine, near Marazion. It was here the engine was said to have worked at 13 double strokes a minute, an unprecedented speed for an engine of this size. It was nearly destroyed by fire here when its house was burnt down around it, forcing the mine to close until the engine was started again. In 1902, the engine was purchased by South Crofty Ltd., and erected at the then new "Robinson" shaft, where it has continued to work day and night ever since. The engines' horsepower, according to Lean's engine reporter, was 335 at full load, Capt. Joel Lean, followed by his son, having introduced and carried out a method of checking and reporting the efficiency of Cornish engines from about 1813 onwards. It has an equal beam or "bob" of approx. 17 ft. 1 in. centres; i.e., the strokes in the shaft, and the engine cylinder being equal. This was 10 ft. 4 in. in the engine's younger days, but through wear and tear in the pumps, etc., this has been reduced to 9 ft. approx.



View of cylinder top, showing main loops and parallel motion. First floor chamber

Before describing this particular engine in detail, an explanation of the principle, and design of the Cornish engine, may be appreciated by readers not conversant with this form of prime mover. The Cornish engine was the final development by Cornish engineers of the single-acting beam pumping engine as introduced into Cornish mines by Thomas Newcomen in the 18th century, and later greatly improved by James Watt and others. The engine remains the same in general principle, and construction as the later designs of the Watt low-pressure engine, but has been much improved in detail, and designed to work high pressure steam on the expansion principle, as introduced by Richard Trevithick.



Showing indoor part of beam, main loops and beam trunnion bearings

In construction the beam is mounted on the engine-house wall, the outer end or " nose " over the mine shaft, and from it are suspended the wooden pump-rods, which descend the full depth of the shaft. The indoor end is connected to the piston-rod by the parallel-motion gear. The cylinder stands vertically on its foundations underneath the indoor " nose " of the beam, the valves and valve-gear standing vertically also, beside the cylinder and facing the aforementioned house wall.

The cycle of operations is as follows: With the engine at rest, the predominant weight of the pump-rods raises the piston to the top of the cylinder, the position at the commencement of the power stroke. The steam valve now opening, admits steam at 40 to 50 lb. per sq. in. above the piston, which descends, drawing up the pump-rods. The exhaust valve, which opens slightly before the steam valve, puts the underside of the piston in communication with the condenser. At a predetermined point of the stroke the steam valve is closed, and the remainder of the stroke performed by expansion assisted by the vacuum under the piston. The exhaust-valve now closes, and another valve opens allowing communication between the top and underside of the piston. Steam, now almost at atmospheric pressure, passes to the lower part of the cylinder, placing the engine in equilibrium, or state of balance. The pump-rods now descend under their own weight, forcing down the plunger poles in the shaft and sending the water to the adit level or surface. During the " outdoor " stroke or descent of the rods, the piston is lifted to the top of the cylinder by means of the beam. The exhaust valve again opens, putting the underside of the piston in communication with the condenser, followed by the opening of the steam valve, when the piston once more descends under steam pressure, and the cycle is repeated.

There are four double-beat, Cornish-type valves provided; the governor, or throttle, the steam, the equilibrium in the top valve chest, and the exhaust in the lower. The top and lower chests are connected by one, or sometimes two pipes, known as the perpendicular pipes. All valves, except the governor which is hand-controlled by the engine-man, are actuated by separate arbors. The top arbor operates the steam valve, the middle one the equilibrium, and the bottom the exhaust. Each valve is opened by a balanceweight, and closed by a tappet attached to the plug-rod suspended from the beam, each tappet striking the handle attached to its respective arbor. The steam tappet, due to its length, is known as the " slide." The valves are held closed by a catch and quadrant on each arbor. Catches are released by rods lifted by means of cataracts, which are weighted dashpots operating in water, and regulated by handwheels. Interlocking quadrants are fitted to the exhaust and equilibrium arbors to prevent both valves opening simultaneously. When starting an engine the exhaust and equilibrium handles are worked by hand. Their long curved shape, gracefully tapered, is peculiar to Cornish engines. The valve control imposed by the cataracts causes the engine to pause at the end of its stroke.

Engines were fitted with either one or two cataracts as required; when two are fitted, the engine halts at the end of each stroke, which has the advantage of giving the pumps in the shaft adequate time to fill, and the pump-valves to seat quietly without shock before and after delivery. If a single cataract is fitted, the engine pauses at the end of its outdoor or equilibrium stroke only.

The Cornish term for the beam is the " bob." The exhaust handle is known as the " bottom handle," the equilibrium as the " top handle," the steam handle as the " horn," the steam tappet as the " slide," and the equilibrium and exhaust tappets as the " clamps." The

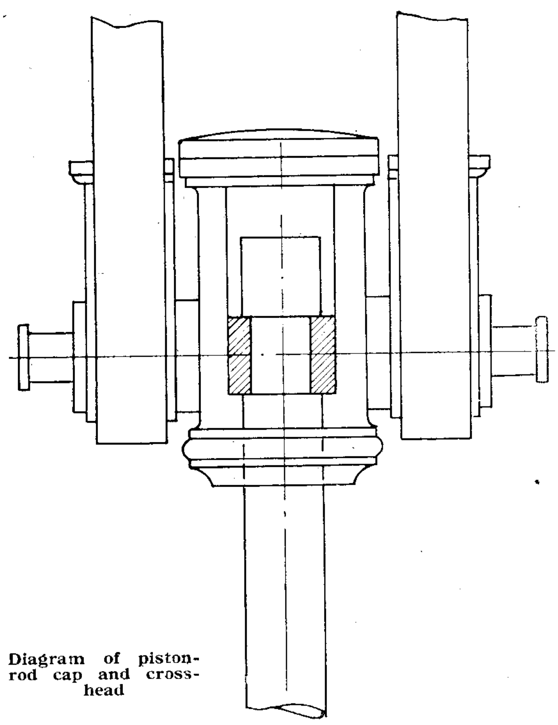
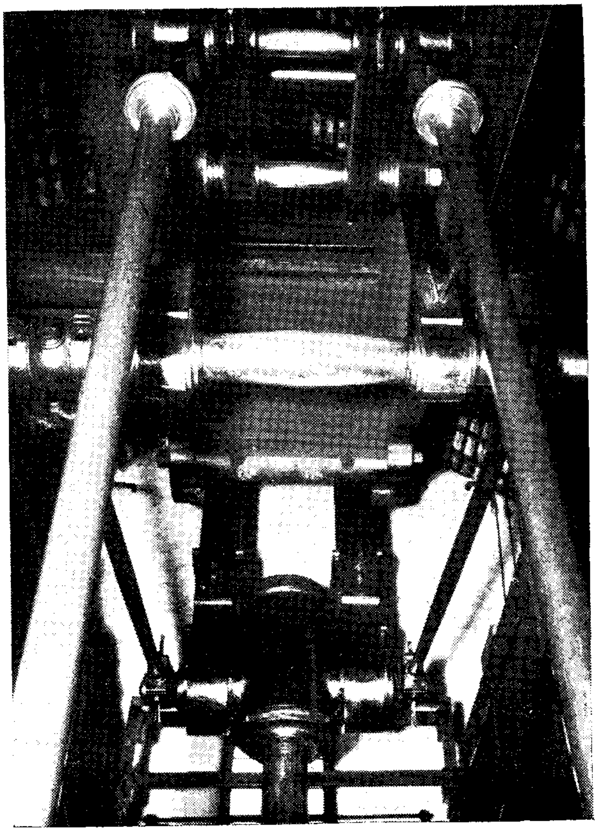


Diagram of piston-rod cap and cross-head



Right: Worm's eye view of beam, plug-rod and piston cap, etc., looking through opening into top floor valve retaining mechanism is known as the "scoggan" and "scoggan" catches. The top and bottom chests are top and bottom "nozzles."

Details of the "Robinson" engine

The "Robinson" engine is the only remaining example of the engines built to the design of Capt. W. Grose, who was a pupil of Trevithick and had very forward ideas regarding the period in which he lived. His engines contained many features not found in other contemporary designs although these were efficient and exemplary of the engine-builder's craft in Cornwall. The most notable feature of the "Robinson" engine is the placing of the steam and equilibrium valves in separate nozzles, on opposite sides of the cylinder to avoid heat losses between the live steam surfaces and those cooled by the expanded equilibrium steam. These can be clearly seen in the accompanying photograph of the engine's cylinder top. No doubt the idea somewhat anticipated the principle of the "Uniflow" steam engine of a later period. Another unusual feature of this engine, and common to all Grose's designs, is the omission of a governor or throttle-valve, the steam valve combining both functions. The intention of the designer was to work the engine with the steam valve wide open and a very early cut-off, thereby preventing "wiredrawing" of the live steam through a partially closed governor valve. A variable cut-off was being provided on the plug-rod for the purpose of controlling the engine whilst working.

As mines became deeper, breakage of rods occurred through the shock caused by the sudden entry of a large volume of steam to the cylinder. It therefore became necessary in engines of Grose's design to throttle the steam by limiting the lift of the steam valve, thereby wiredrawing the steam, as was common practice, and increasing the length of cut-off. Also, through the difficulty experienced by the drivers in regulating the engines by constant adjustment of the cut-off slide on the moving plug-rod, a handwheel operated device was fitted to vary the opening of the steam valve, which defeated Grose's original intention, of controlling his engines entirely by cut-off.

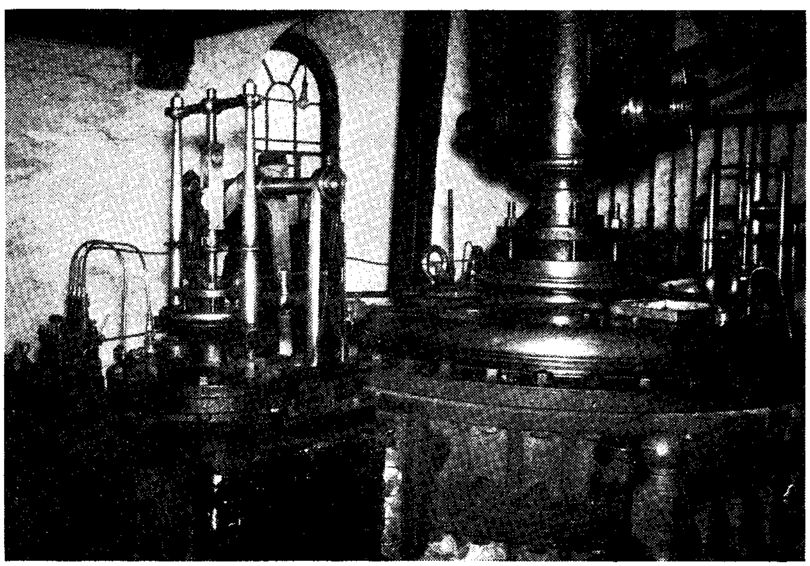
The "Bob"

At the topmost chamber or floor of the engine house is the great beam or "bob," just over 34 ft. in length and weighing about 38 tons. This is of double construction; i.e., there are two "flitches" side by side, and separated by the main trunnion shaft, the parallel motion arbors, the nose pins, and other arbors. This scientifically designed beam with its deep ribs, bosses, and mouldings, built to resist the heavy loading, is really a beautiful piece of work. The ribs are cast extra deep at the centre and taper off somewhat towards the nose-pins. The gudgeon and all the various arbors, are turned, fitted, and keyed into bored holes, not as was common practice at this time on many engines to "stake up" the arbors with hardwood and iron wedges in cast holes in the beam. Also, the tie bolts, where possible, appear to be fitted to cast lugs outside the most stressed metal of the beam, whilst others are on the centre-line as near as can be arranged to the neutral area of the metal, so as not to weaken the structure unnecessarily.

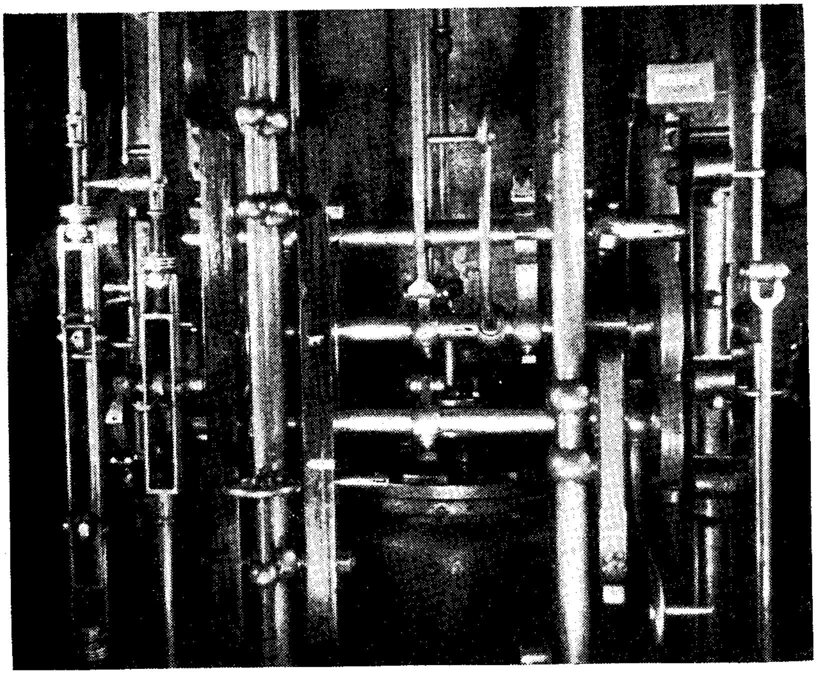
The large catch wings above the indoor nose of the beam are fitted to limit the length of piston travel, should the engine by any means such as drawing air in the pumps, or a rising steam pressure, "comes indoors" too fast. The catch wings touch down on the spring beams beneath the "bob" and are immediately heard by the engine driver. They are also a means of preventing damage, should the engine "come indoors" violently through rod breakage in the shaft. It will be noted that the trunnion bearings on the engine-house wall, and the two nose pins are fitted only with half-brasses; the thrust being unidirectional, full bearings are not required. The outer nose of the beam is not fitted with parallel motion, there being ample flexibility in the very long pump-rods to accommodate the arc of the nose.

At the middle chamber, or first floor, we have the top of the great 80-in. dia. cylinder before us, with the long piston-rod, the parallel motion, and the nose of the beam, alternately rising and falling through the floor level above. The Watt type parallel motion appears very slender in proportion for so large an engine and, together with the main loops or links, is suspended from inside the beam and not from pins on the two outer sides, as was usual practice on most rotative beam engines. The main loops, of Gothic design, are fitted with their open ends uppermost, the gibs and cotters being fitted above the nose-pin, within the beam itself. An unusual feature is the fitting of an additional set of gibs and cotters above the piston cap trunnion brasses, as well as the usual distance bars. It is not apparent why these were so placed, as the normal gib and cotters plus the distance bars should be sufficient. As the engine is single-acting, it would be possible, theoretically, to work with open loops.

The pleasing Gothic shaped curves to the ends of the loops, and parallel motion straps are a feature apparent throughout the engine's design. It is noticeable also that the piston-rod is not secured to the cap or cross-head by means of the usual gib and cotter, but by two "C" rings, similar to split cotters, as used in automobile practice, fitted around a rectangular groove in the piston-rod, and resting within a recess in the cap. (See sketch of piston-rod and cap.) Therefore, should the beam overrun the piston through accidental causes, it is possible for the rings to release themselves and the piston-rod, and so prevent damage to the cylinder bottom; this was a common feature on most of the larger Cornish engines. Walking around the huge cylinder top, we can examine in turn, the separate steam and equilibrium valve nozzles, the beautifully designed and finished valve spindles and supporting brackets, excellently turned and tapered. The turned and polished false cover to the cylinder, is also a good example of the engine builder's art of the period, but as a concession to modernisation, the engine has been fitted with a mechanical lubricator seen near the steam valve nozzle.



The cylinder top and steam valve. First floor chamber



Showing gearwork of engine, with cataract-rods and steam slide on left. Exhaust valve and cylinder in rear. Ground floor chamber (A "Shell Photo.")

On the ground floor can be seen the impressive bulk of the engine's cylinder. Being fitted with a steam case and lagging it is somewhat larger than the 80-in. piston diameter would have us expect.

The painted cast-iron casings around the cylinder base, with a Gothic design in relief, the brightly burnished foundation bolts, and white plastering of the cylinder wall have a striking effect; and here, facing the main engine house wall, and supported by the two swan-necked "weighposts," is the gearwork of the engine. The weighposts are secured at their upper ends to the two perpendicular pipes descending from the equilibrium valve chest in the chamber above. Situated between these at floor level are the exhaust valve and nozzle.

The handles operating the gear for starting are round in section shaped and tapered with curled ends; these are separate from the actual "horns," and longer, thereby giving a greater leverage over the valve dead weights. Most engines were built with the handles as extensions of the actual horns. The arbors are pivoted in brasses split horizontally, and adjusted by draw-wedge bolts as opposed to the more usual vertically split brasses and caps bolted to the sides of the weighposts. The "cataract"-rods are both on one side of the engine, another unusual feature. The cataracts themselves are below floor level in a small chamber known as the "cockpit," and are operated by the extension of the plug-rod, which can be seen alternately rising and falling in front of the gearwork, with the long steam slide, the exhaust and equilibrium clamps operating their respective valve-rods. It should be remembered that, in a Cornish engine, the clamps on the plug-rod close the valves, which are opened at the appropriate moments by the balance-weights suspended from the valve arbors, when released by the action of the cataracts.

The boiler feed pump, condenser and air pump are situated outside the engine house and, together with the wooden cistern, can be seen through the doorway facing the cylinder and gearwork. These follow the usual design as far as is known for a Grose engine, but are situated rather high in relation to the cylinder bottom. This has led to some controversy, and according to an engineer at the mine, remains unexplained.

The condenser and boiler pumps are driven by rods from the outer, or outdoor part of the beam above. The condenser injection valve opens simultaneously with the exhaust valve. Seen from this doorway, the massive pump-rod, of timber, heavily strapped at its upper end, depending from the great beam above, and disappearing into the depth of the shaft below, is impressive.

There are "plunger pole" pumps of three sizes in the shaft, 15, 14, and 10 in. diameter, respectively, pumping from a total depth of 2,021 ft. At the engines' present stroke, the delivery is approximately 340 gall. per min. at a speed of five and half strokes per minute, equalling 62 gall. per stroke.

This engine and two or three smaller engines in the china clay district are the very last working examples of the Cornish engine in Cornwall. It is now known that the Robinson engine will be preserved, after it ceases work in the very near future. This will be the fifth engine to be preserved by the Cornish Engines Preservation Society, the others being the great 90-in. mentioned before, a unique 22-in. single-acting rotative pumping engine, and two double-acting beam winding engines of 24 and 30 in. respectively. The little 22-in. beam engine is probably the only one of its kind in the world.

I wish to express my appreciation to Mr. G. Boulden for his assistance in obtaining the first four photographs used in this article.

For the BOOKSHELF

Oxford Junior Encyclopaedia, Volume VIII. (London: Geoffrey Cumberlege, Oxford University Press.) 496 pages, 7¼ in. by 9¾ in. 8 colour plates. Numerous illustrations. Price 30s. net.

This volume of a popular and reasonably comprehensive encyclopaedia is devoted to the subject of engineering and everything that is now implied by that word, covering Power, Mechanical, Electrical and Civil, as well as certain scientific, mathematical and special branches. The several hundred articles are arranged in alphabetical order ranging from "Acoustics" to "Zuider Zee Project," and all are written in clear, simple language that can be very easily assimilated by intelligent, technically-minded young people whose ambitions may involve the acquisition of good, basic knowledge of a variety of technical matters. But this encyclopaedia is, in no sense, intended to be read only by children; it is essentially a reference book with a very wide appeal, especially to students beginning a technical training.

The production and make-up are, in every way, excellent; the illustrations, whether in colour, line or half-tone, are clear and sufficient, while the paper and printing leave nothing to be desired. In short, the volume is wonderful value at the price.

A Self-centring Die Holder

By F. Jessop

THIS die holder I venture to state is simple to make and even simpler to use, and I should know, for I am no engineer, being but an engine driver, in the employ of British Railways, whose hobbies are my job and a small lathe and its tools.

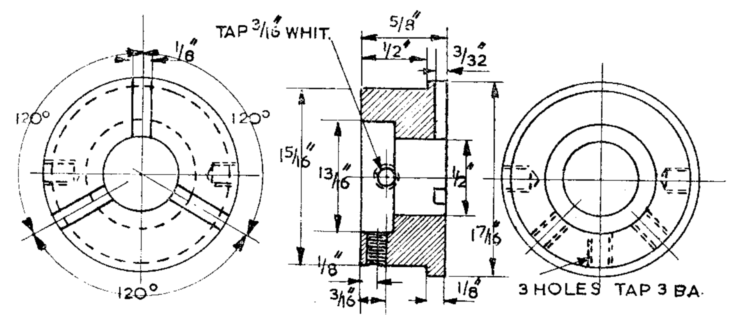
First, take a piece of mild-steel of suitable size, put in the four jaw, face off and drill $\frac{1}{2}$ in. right through, then with an internal boring tool open out to $\frac{13}{16}$ in. for a depth of $\frac{1}{4}$ in. Next turn down the outside to $1\frac{5}{16}$ in. for a distance of $\frac{1}{2}$ in. This takes us to the beginning of the flange which is turned to a dia. of $1\frac{7}{16}$ in. and then parted off leaving the flange $\frac{1}{8}$ in. thick.

The next operation is to cut the slots in the flange for the jaws to slide in, and for those fortunate people who have shapers or milling machines it will be an easy task, but for those of us who have no such facilities we must use other methods. I did mine the hard way as follows:—First, I removed both screws from the cross-slide, then I packed up to centre height in the tool rest a small flat file of suitable thickness and with the body chucked in the three jaw with the flange outward and using the jaws as an index I pushed the top-slide backwards and forwards until I had cut the slots to a depth of 3/32 in., afterwards polishing the base of the flange with fine emery and a flat oilstone with the lathe running at its fastest speed, this polishing being necessary to obtain smooth working when in use. Next drill and tap the holes for the handles and also drill and tap the holes for the die setting screws.

Item No. 2 shows the knurled ring and needs no description, but be careful to bore out to the exact thickness of the flange on the body, this is most important or the jaws will have a sloppy fit.

Item No. 3 is perhaps the trickiest piece of all and will need very careful marking out. First a piece of sheet steel is centre popped and a $\frac{1}{2}$-in. circle marked with the dividers, then another circle of $1\frac{5}{8}$ in. marking the position of the securing screws. Next divide the circles 120 deg. and scribe lines right across the centre mark thus dividing into six sections. Where the lines cross the $\frac{1}{2}$-in. circle, centre pop, and using three of the marks as centres, mark out at $\frac{5}{8}$ in. radius the curved guides that expand and contract the jaws. After marking out, drill $\frac{1}{8}$ in. at the beginning of each curved guide, and also drill $\frac{1}{8}$-in. holes through the centre pop marks and using these holes to pivot the plate on a $\frac{1}{8}$-in. stub mounted in the tool-rest when milling out the guides with a $\frac{1}{8}$-in. end mill. That sounds a bit rough on the fingers, but if the plate is screwed to the knurled ring the task is not impossible and could be easier still if holes for a small tommy bar were drilled in the side of the ring with a No. 34 drill, one of which could afterwards be tapped 4-B.A. and used for a stop screw to prevent the jaws easing off when in use.

The jaws are cut from flat plate, file carefully to fit, making sure they are the exact thickness to the depth of the slots in the body, this is very important, because if too thin the jaws will have an unpleasant wobble, and if too thick a decided strong arm movement will be required to open and close the jaws. The pins in the jaws are best if screwed in and mine are screwed 6-B.A. and afterwards riveted into countersinks



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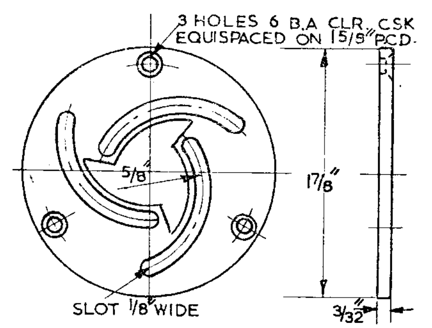
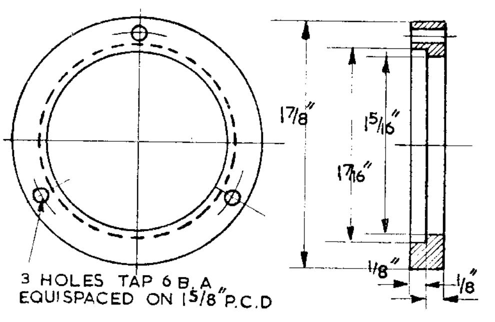
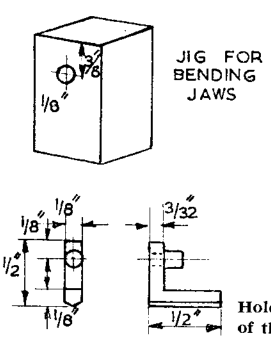


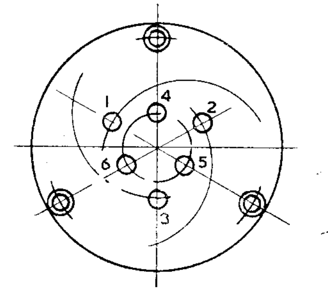
(3) BOTTOM PLATE - 1 OFF



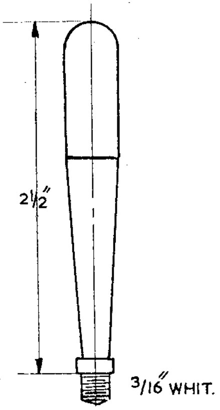
(2) KNURLED RING - 1 OFF



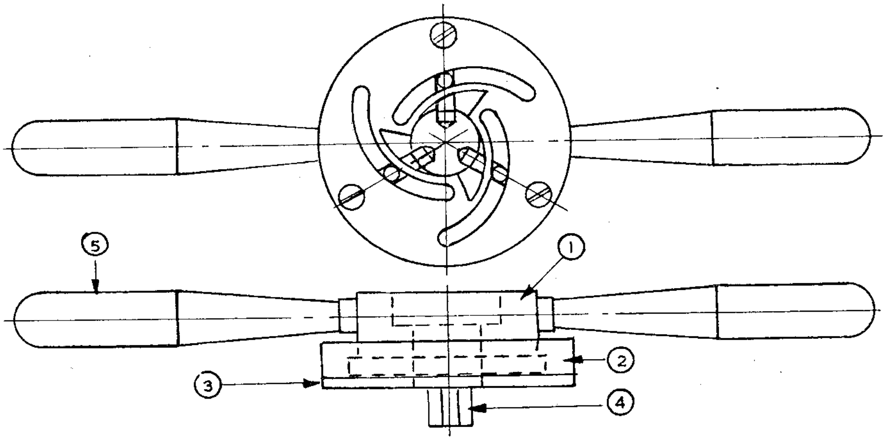
(4) JAWS - 3 OFF



Holes 1, 2 and 3 are the commencements of the curved guides. Holes 4, 5 and 6 are drilled out after using the centres to scribe the position of the guides



(5) HANDLE –2 OFF



Plan and elevation of the completed job

to prevent unscrewing. After all the pins have been fitted, place each pin in the hole in the bending jig and hammer over, this will ensure that each jaw is exactly the same size, a most desirable feature if the tool is to function correctly. The bending jig is merely a flat piece of steel squared off in the lathe and a $\frac{1}{8}$-in. hole drilled $\frac{3}{8}$ in. from the end.

The handles are a straightforward turning job needing no description, the screw ends fitting into holes in the body that are drilled and tapped $\frac{3}{16}$-Whit.

To assemble, first place the knurled ring over the body and then screw in the handles, then place the jaws in the slots, not forgetting to put a smear of thin oil on each one; next comes the bottom plate, and with three countersunk screws, screw plate to the knurled ring.

In use the die is placed in the holder upside down and secured with the usual setting screws (not shown) then with the rod to be threaded set firmly in the vice, the jaws are closed by turning the knurled ring, press the die down on the end of the rod and turning by the handles no difficulty will be found in starting the thread true to the axis of the rod. I have in fact deliberately filed the ends of pieces of steel to an acute angle to test the tool and each time have been delighted to see as a result a thread correctly cut.

It would no doubt be better to case harden the jaws but I leave that to individual taste; mine are not hardened but only because I doubt my ability to carry out the operation.

AN ELECTRIC CLOCK CONTACT DEVICE

By R. D. Moss

THE following is a very brief description of an electric clock with pendulum motor which I constructed some years ago, before World War II. It is of simple construction, and includes Bain's method of maintaining the pendulum in vibration with an electro-magnet and armature fitted at the lower end of the pendulum, and the Synchronome 15-tooth wheel and gathering arm.

The total cost of the movement components, when I made it, did not exceed 6s. 6d. It is at present working and is keeping time within + or − .5 sec. per day. It works a $\frac{1}{2}$-min. impulse dial through a similar contact to the one shown for the movement, but with a $4\frac{1}{2}$-volt bicycle battery as the electric supply. The contacts have never given any trouble, but I clean them occasionally with petrol on a light brush.

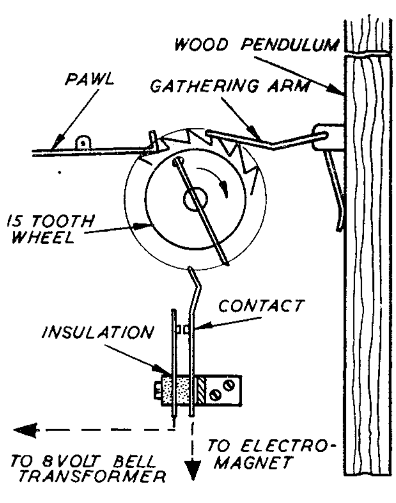
At first I ran it off a $4\frac{1}{2}$-volt dry battery, but this proved unsatisfactory, owing to the gradual drop in volts.

Refinements in construction could, of course, be made, such as an Invar pendulum.

The clock has a one-seconds pendulum which provides the motive power, by means of an electro-magnet fitted on a fixed bracket at the foot of the pendulum rod. Fixed to the rod is an armature which is attracted towards the magnet every 30 sec., when an electric current is made to pass through the coils of the electro-magnet. The current is supplied from the a.c. 230-volt mains through a bell transformer with an output of 8 volts. The current impulse is timed to take place, by careful adjustment, at the zero point of the pendulum arc by means of an arm fixed, friction-tight, to the arbor of a 15-tooth wheel. This wheel is moved every two seconds by a gathering arm hinged to a fixing on the pendulum about 12 in. from the point of suspension, the wheel being prevented returning by means of a light pawl.

The pendulum is of well-seasoned straight-grained oak (deal could be used) of about $\frac{1}{2}$-in. square section. The pendulum bob is made from a cylindrical tin filled with approximately 7 lb. of lead. The bob is a sliding fit on the pendulum rod which is fitted with a screw firmly secured to the rod, and fitted with a rating nut and washer which support the bob.

[*The principle of this movement is quite a common one, and is known to work reasonably satisfactorily, if the voltage of the supply is constant, but it suffers from the disadvantage that there is no positive control of the impulse frequency or the force exerted on the pendulum, and is thus inferior to the Hipp movement, in which the frequency of the impulse is automatically controlled, and also the Synchronome and similar systems where a constant impulse is applied at regular intervals to the pendulum by means of a falling weight.—Ed.*, THE MODEL ENGINEER.]



A Vee-Block for the Top-Slide

By "Duplex"

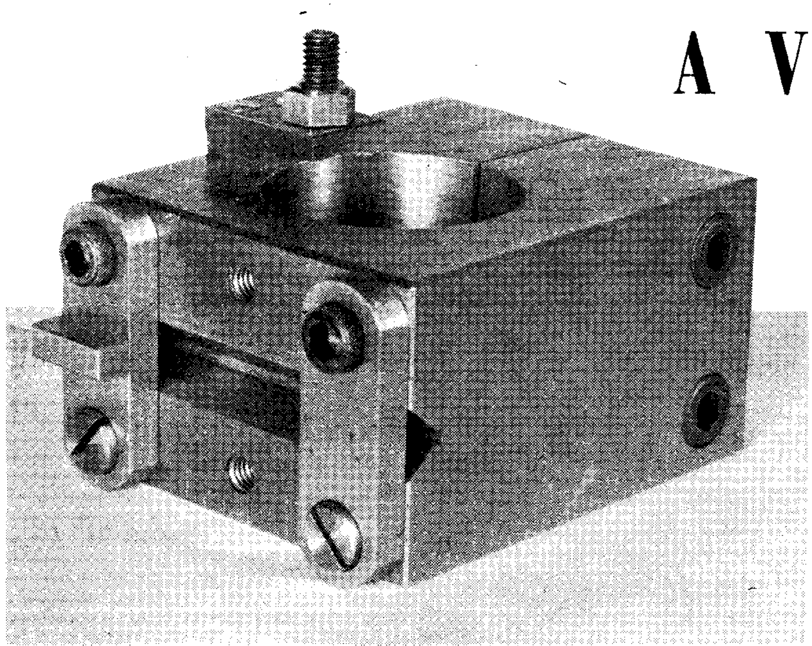


Fig. 1. The finished attachment

THIS fitting was made for attaching to the toolpost of the Drummond lathe topslide, and it enables round material to be mounted and firmly held at lathe centre height, without the necessity of making any height adjustment. For this purpose, the V in which the work is located is machined at centre height, and the work material is secured in place by means of two clamping bars that can be attached in any of three positions to accommodate work of various lengths and sizes.

The body of the attachment consists of a fitting that was originally made with a detachable spindle for securing a drilling-machine head and other appliances to the lathe toolpost; the threaded bore for mounting this spindle is shown in broken line in the drawings, but for the present purpose this can be disregarded. The block of mild-steel forming the body is machined all over and bored to a close push-fit on the lathe toolpost; accurate fitting is here called for, in order to avoid distortion of the body when the two ¼-in. Allen clamping-screws are firmly tightened. To allow the under side of the body to seat on the upper surface of the top-slide, the mouth of the bore will have to be chamfered at its lower end.

After the holes for the two clamping-screws have been drilled and tapped ¼-in. B.S.F., the block is slit either with the hacksaw or by means of a thin circular saw mounted on the lathe mandrel. Where the latter method is adopted, the work is clamped to the lathe cross-slide and set at approximately centre height. However, in the present instance, the block was slit in the jig-saw machine we described recently in this journal, and the guide fence was used to keep the line of the cut exactly straight and square.

For forming the V-groove at exactly centre height, the block was mounted in place and aligned squarely by first slackening the clamping-screws, and then traversing the saddle to press the part against a rule held in contact with the chuck face. Next, the centre-line was marked-out across the work with a pointed countersink, gripped in the chuck and rotated by running the lathe. Before going further, the centres of the six holes to receive the screws for the clamping bars are marked-out from the scribed centre-line and then drilled and tapped 2 B.A.

Forming the V-Groove

A shallow groove can quite well be machined by using a 90 deg. countersink as a milling cutter; but, as the groove in the present instance is 7/32 in. deep, this method entails removing rather too much metal for satisfactory machining.

Instead, therefore, the face of the block was marked-out from the scribed centre-line and the bulk of the metal was cut away in the shaping machine by first putting in a narrow parting tool to the full depth of the groove, and then machining the side faces of the V by using a tool with a point formed to a right-angle. To ensure that the V was at exactly centre height, the block was

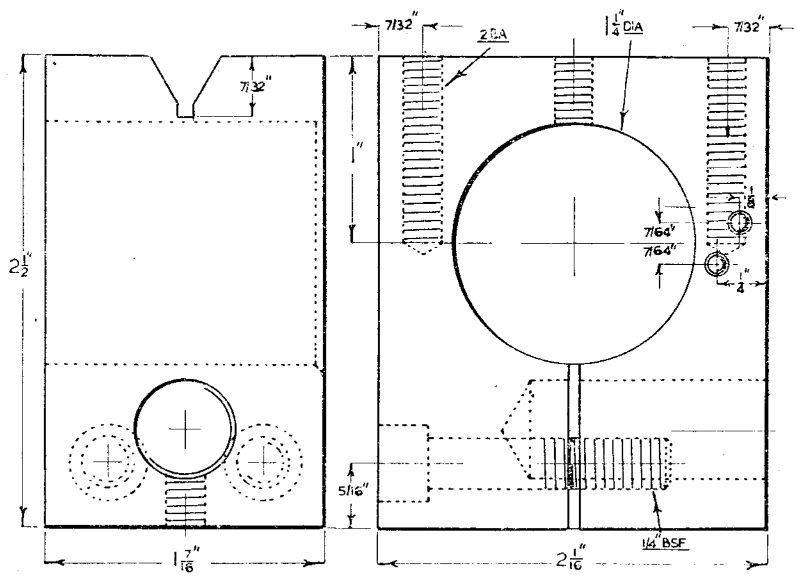


Fig. 2. Side and plan views of the Vee-block

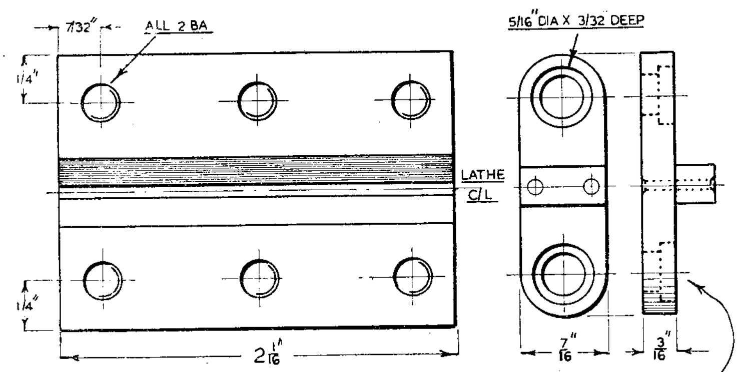


Fig. 3. End view of the Vee-block and the clamp bars

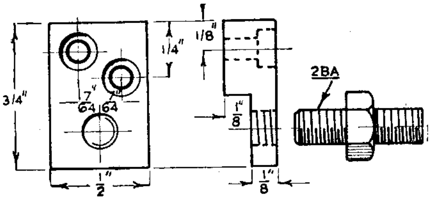


Fig. 6. The height adjustment fitting

again mounted on the top-slide, and a light, finishing cut was taken with a 90 deg. countersink to include both faces of the groove.

The Work Clamps

These were made from 3/16-in. × 1/2-in. mild-steel strip, and the screw holes were counter-bored to a depth of 3/32 in. to form flat seatings for the screw heads. It will be noted that these screws are placed widely enough apart to enable 3/4-in. diameter round material to be gripped. To save expense, cheese-head screws can be substituted for Allen cap-screws in the lower positions, for the work can at any time be released by slackening only the upper screws. Shorter screws may on occasion have to be fitted when the clamp bar is used in the central position.

As will be seen, one of the clamps is furnished with a small projecting bar; this is to enable work-pieces of small diameter to be gripped when the clamp is tightened with its outer face turned inwards.

The Vee-Block in Use

Open-ended keyways in snafts can be cut at exactly centre height with an end-mill and, for this purpose, the work is gripped with the two clamp bars, but is set to overhang. Closed keyways are machined in the same way, but the cutter should then operate in the space between the two clamps.

The two members of a fork-joint are best machined with a circular milling cutter, and both components can be afterwards centrally drilled for the pivot-pin by means of a drill gripped in the lathe chuck.

Slotting screw heads is readily done by centring the circular slitting saw on the pip left after parting off and then locking the saddle. The screw blanks can be quickly changed by turning only the upper screw of the clamp bar, and for holding small screws the clamp is reversed. A uniform depth of slot is

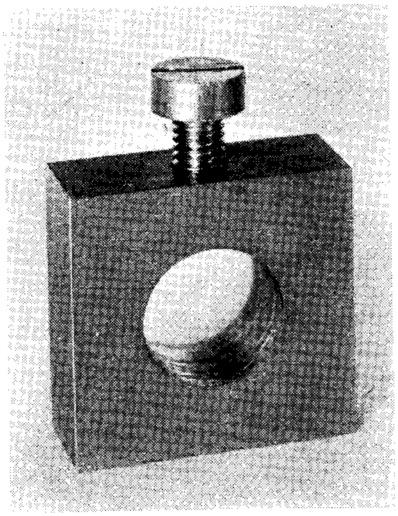


Fig. 4. The setting gauge for squaring the ends of shafts

obtained by noting the reading of the cross-slide index.

Machining multiple flats on the ends of round material is facilitated by using a setting gauge of the kind illustrated in Fig. 4. This consists of a squared piece of material furnished with a brass clamping-screw. After the gauge has been secured to the projecting end of the shaft facing the operator, a square, resting on the lathe saddle, is used to set one of the guide faces vertical, and the first flat is then machined with an end-mill or a circular cutter, or a fly-cutter.

The remaining flats are formed by rotating the work to bring the other faces of the guide successively into the vertical position. This method of working has been found useful both for squaring the shanks of threading taps and for locating two keyways at exactly 180 deg. apart. Needless to say, to obtain accurate results the gauge must be made truly rectangular.

Machining Hexagons

For machining hexagons, either a six-sided guide plate can be specially made, or a disc parted off from a length of hexagonal rod will serve. To mark out a regular hexagon is one of the first steps in geometry; from a punched centre, scribe a circle with the dividers and, with the dividers remaining set, step round the circle to mark six equidistant points; if the adjacent points are now joined by straight lines, the work will be marked-out for filing to shape and drilling the central hole.

Height Adjustment

Where the block is not machined in the way described, a means of adjustment may be required for setting the V at exactly centre height by raising the block on the toolpost.

To allow of this, where the accuracy of the machining is in doubt, the V should be cut somewhat below lathe centre height.

The adjustment for height will then be facilitated by fixing the setting device illustrated to the upper surface of the block.

This fitting is secured in place by two 6-B.A. cheese-head screws, and the point of the Allen grub-screw, by bearing on the upper surface of the toolpost, serves to raise the block.

The V-groove can be set to centre height when brought to bear against a coned centre, turned to an included angle of 90 deg. in the chuck, and once this adjustment has been made, the grub-screw is locked to preserve the setting for future use.

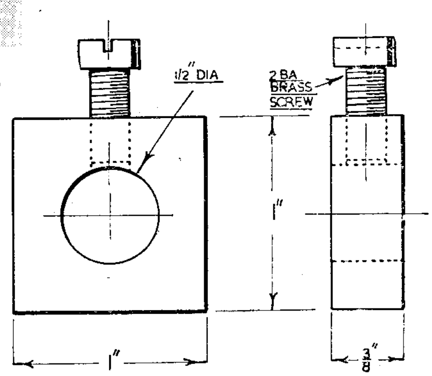


Fig. 5. Showing details of the setting gauge

L.B.S.C.'s "Netta"

REGULATOR FOR THE $2\frac{1}{2}$-in. GAUGE BOILER

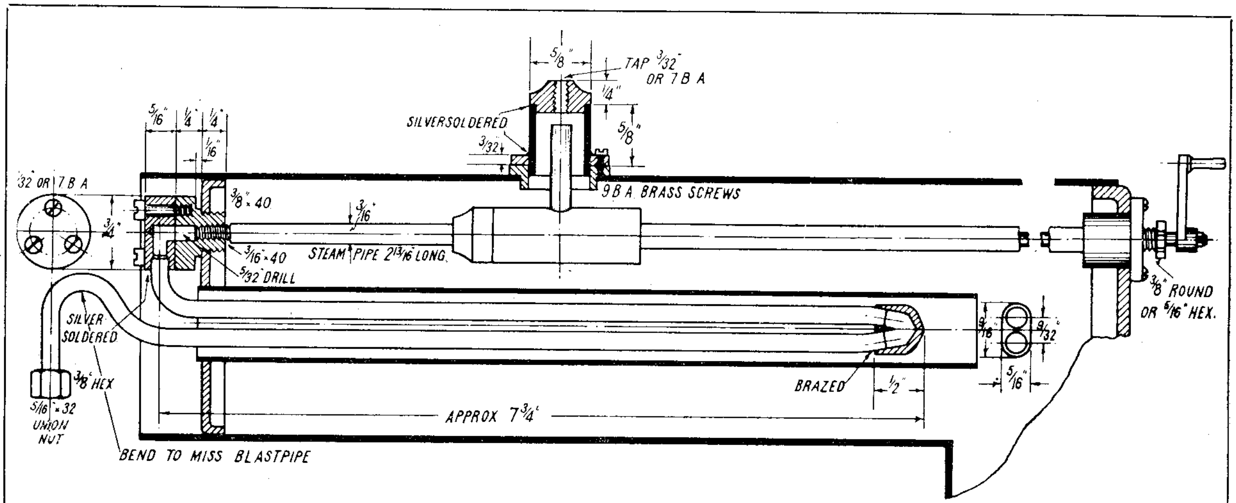
IT was my original intention to specify a regulator of the "Joco" type, with overhead valve operated by a bridle and eccentric, for the $2\frac{1}{2}$-in. gauge quin; but when I came to draw it out, I found it wasn't a practical proposition in such a small size. The internal diameter of the inner dome is only $\frac{1}{2}$ in. and to get the whole bag of tricks into it, the parts would have to be of wrist-watch proportions, which would be of little use on a locomotive intended for real work. Builders of the $2\frac{1}{2}$-in. gauge engine can take their choice of two regulators; they can either use the simple screwdown type specified for the $1\frac{3}{4}$-in. gauge job, or adopt the one shown in the accompanying illustrations. If they choose the former, the only alteration to be made is to enlarge the hole in the valve seating a little, say to 7/64 in. or No. 36 drill, and turn the cone end of the valve pin 1/32 in. larger diameter, to suit. Use a $\frac{3}{16}$-in. steam pipe between regulator and superheater flange, and lengthen the pipe connecting regulator to backhead flange, to suit the extra length of boiler.

The other alternative is a "modernised" version of the "disc-in-a-tube" type of regulator, which is easy to make and erect. Several of my own locomotives have the ordinary pattern, with a barrel made from tube (hence the designation) and as the valve is easily lubricated by dropping a spot of cylinder oil occasionally down the steam pipe, through the screw hole in the dome top, they work easily and keep steamtight. Steam goes direct to the superheater flange, and the backhead fitting is about the neatest it is possible to have; no ugly excrescence, and no handle stops, just a simple flange and gland like those on the old Brighton engines in the early part of the century. In the variation shown, it will be seen that the port block and valve are the same; but instead of the long tube, the valve body is made from rod material, and connected by a small tube, carrying the regulator rod, to the gland fitting on the backhead. I have shown a plain handle, of the kind used on most locomotives in earlier days; but the "ram's horn" pattern which was also used on the old North-Eastern, can of course be fitted if the builder desires.

Body and Valve

The body of the regulator is made from a piece of $\frac{9}{16}$-in. round brass rod, sawn or parted off to a full $1\frac{1}{2}$ in. length. Chuck in three-jaw, face the end, centre, and drill right through with No. 30 drill. Open out to 1 in. depth with $\frac{3}{8}$-in. drill, and bottom with a $\frac{3}{8}$-in. D-bit, until the final depth is $1\frac{1}{8}$ in. Bore out $\frac{7}{16}$ in. of the end, to $\frac{1}{2}$ in. bare diameter, and watch your step on that bit, as there isn't much metal left around the hole, although plenty for the job. Reverse in chuck, skim the other end truly, open out the hole with 7/32-in. drill for $\frac{3}{16}$ in. depth, and tap $\frac{1}{4}$ in. $\times$ 40. At $\frac{11}{16}$ in. from the big end, drill a 5/32-in. hole into the $\frac{3}{8}$ in. section, and tap it $\frac{3}{16}$ in. $\times$ 40.

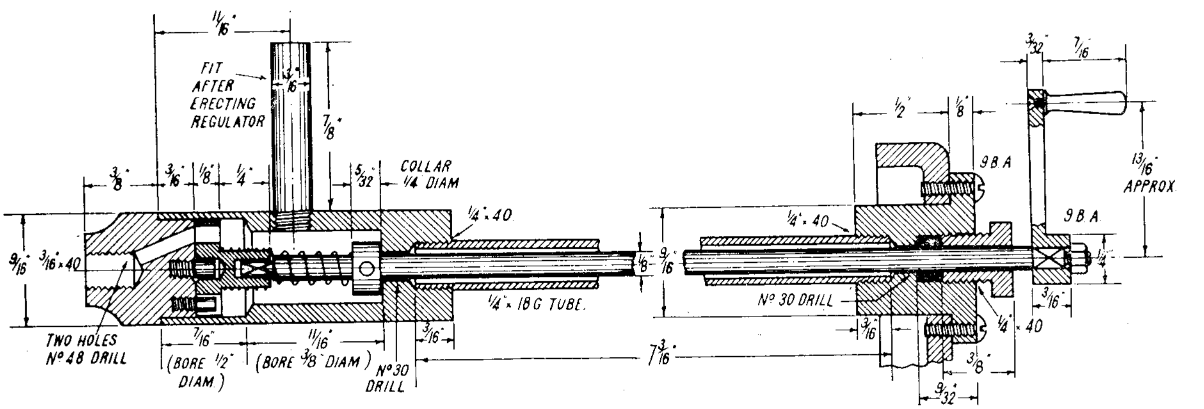
The port block should be made from good quality bronze or gunmetal, either drawn or cast. If the former, it should be $\frac{9}{16}$ in. diameter, and, if the latter, turned to that size. Chuck in three-jaw, face the end, centre, and drill down about $\frac{3}{16}$ in. depth with No. 48 drill; slightly countersink the end, and tap 3/32 in. or 7-B.A. Turn down $\frac{3}{16}$ in. of the end, to a tight fit in the regulator body. Part off at $\frac{9}{16}$ in. from the end, reverse in chuck, centre, drill to $\frac{1}{4}$ in. depth with 5/32-in. or No. 22 drill, and tap $\frac{3}{16}$ in. $\times$ 40. Bevel off the outside as shown. At 5/32 in. from the centre, make two centrepops a full $\frac{1}{16}$ in. apart, and drill two No. 48 holes on the slant, as shown in the section, breaking into the $\frac{3}{16}$ in. tapped hole in the bevelled end. Chip or end-mill away the wall between the holes, for a depth of about $\frac{1}{16}$ in. forming the end into a curved slot, as shown in the detail drawing; then at the angle shown, drill a No. 53 hole about $\frac{1}{8}$ in. deep, and tap it 9-B.A. In it, fit a stop pin made from a bit of 15-gauge wire, bronze or rustless steel; and fit a similar pin, 3/32 in. diameter, in the middle hole. Before screwing



Regulator and superheater for the $2\frac{1}{2}$-in. gauge engine

them in "for keeps," true up the face by rubbing it on a piece of fine emery-cloth, or similar abrasive, laid on something true and flat, such as the lathe bed. For beginners' benefit, may I repeat that the surface should *not* be finished dead smooth and bright, by rubbing with metal polish on a smooth surface. A matt surface holds oil, and ensures that the working faces keep steamtight.

The valve should be made of a different grade of material to the portface; drawn bronze or gunmetal works fine on cast ditto, or vice-versa, and rustless steel makes good valves. Chuck a piece of $\frac{1}{2}$-in. rod in the three-jaw, face the end, turn down $\frac{1}{4}$ in. length to $\frac{3}{16}$ in. diameter, and part off at a full $\frac{1}{8}$ in. from the shoulder. Reverse in chuck, take a skim off the outside, so that the valve will fit easily in the body; centre, and drill down with No. 41 drill, to $\frac{3}{16}$ in. depth. Slightly countersink the hole, skim the face truly, and slot the boss a full $\frac{1}{16}$ in. wide, to a depth of $\frac{3}{16}$ in. Finish off the face on emery-cloth as described above, after cutting the port, and slotting for stop pin.



Section of regulator

Backhead Fitting

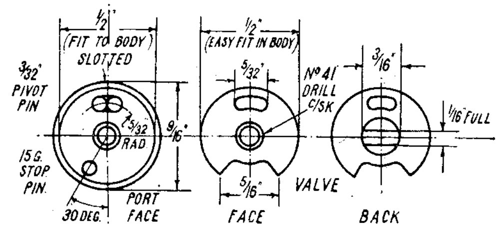
The flanged fitting containing the gland, can be made from a casting, or a piece of $\frac{7}{8}$-in. round brass rod. Chuck in three-jaw, face, centre, and drill to $\frac{3}{4}$ in. depth with No. 30 drill; open out $\frac{3}{16}$ in. of the end with 7/32-in. drill, and tap $\frac{1}{4}$ in. $\times$ 40. Turn down $\frac{1}{2}$ in. of the outside to $\frac{9}{16}$ in. diameter, and part off a full $\frac{1}{8}$ in. from the shoulder. Reverse in chuck, open out the hole to 9/32 in. depth with 7/32-in. drill, and tap $\frac{1}{4}$ in. $\times$ 40. Skim the end true, and make a gland to suit, from $\frac{5}{16}$-in. hexagon or $\frac{3}{8}$-in. round rod, as desired; no detailing needed for that! Set out and drill the six No. 48 screwholes as shown. Cut a piece of $\frac{1}{4}$ in. by about 18-gauge tube, to a length of $7\frac{3}{16}$ in. and screw each end $\frac{1}{4}$ in. $\times$ 40 for $\frac{3}{16}$ in. length; do this by holding the tube in three-jaw, and the die in tailstock holder, to get true threads. Warning—don't use thin tube for this job, or it will probably break at the end of the thread when the boiler expands and contracts. Screw the regulator body on one end, and the gland fitting on the other, as shown.

Assembly and Erection

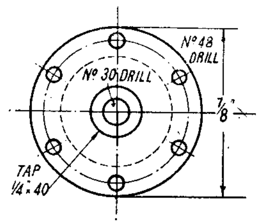
A piece of $\frac{1}{8}$-in. bronze or rustless steel rod $9\frac{1}{8}$ in. long will be needed for the regulator rod. If the latter is preferred, make quite sure that it *is* rustless, or there will be trouble in the offing. One end is milled or filed flat on opposite sides, until it will just fit easily in the slot in the valve boss; the length of the flat should be 5/32 in. Turn down the other end for a full $\frac{1}{8}$ in. to 5/64 in. diameter, and screw 9-B.A.; file the next 5/32 in. square, using chuck jaw as guide, as I've described many a time and oft, as the poet says. The collar is a 5/32-in. slice of $\frac{1}{4}$-in. round brass rod, with a No. 32 hole drilled through it before parting off. The spring is made from bronze or hard brass wire, wound around a piece of $\frac{3}{16}$-in. rod, and should be roughly 1 in. long when uncompressed. It doesn't need to be very strong, 20-gauge wire will do nicely.

Squeeze the collar on the rod, as shown in the section, so that there is approximately $\frac{3}{8}$ in. of rod showing between the collar and the flats. Poke the rod right through the whole doings, so that the collar is up against the D-bitted end of the hole in the regulator body, then anoint the valve with a smear of cylinder oil, and put it on the portface, to which it should stick. Then press the lot into the enlargement of the bore, wangling the rod until the tongue enters the slot in the valve boss. When right home, the rod should have about 1/32 in. endplay; if more or less, the collar needs adjusting. Make the adjustment, if needed, then pin the collar to the rod; I use bits of brass blanket pins for jobs like these, a No. 57 drill being just right for a drive fit. The rod can then be replaced, with the spring over the end; carefully fit the port-block, with valve attached, entering the tongue of the rod into the slot in the valve-boss, and press home. If the port block is a good tight fit in the end of the valve body, no further fixing will be needed; if it is slack, put a $\frac{1}{16}$-in. or 10-B.A. countersunk screw through each side of the valve body, into the port block. To test, put a small tapwrench on the gland end, and this will enable the rod to be turned, to see if the valve opens and shuts all right. You can easily ascertain if it shuts off steamtight, by sucking at the end of the portblock—primitive, I freely admit, but mighty effective! I nearly forgot to mention that when pressing in the port block, see that the steamways in the block are on top, so that the slotted port, lines up with the tapped hole in the regulator body which carries the vertical pipe; see section.

Cut a piece of $\frac{3}{16}$-in. copper tube to a length of $2\frac{13}{16}$ in. Screw one end for a full $\frac{1}{8}$ in. length, and the other for a full $\frac{3}{16}$ in. length, with $\frac{3}{16}$ in. $\times$ 40 thread. The shorter end goes into the tapped hole in the port block, and don't forget a taste of plumbers' jointing on the threads. Open out the hole in the backhead to $\frac{9}{16}$ in., smoothing off any burring, to form a true seating for the flange, then insert the complete regulator, taking care to have the hole for vertical steam pipe right under the dome bush. Cut a piece of $\frac{3}{16}$-in. pipe to 1 in. length, put a few $\frac{3}{16}$ in. $\times$ 40 threads on one end, and screw it into the hole mentioned. If you put a tapwrench over it, you can set it vertically with the tapwrench resting on the dome bush, and it will stay there whilst the screwholes for attaching flange are being located on the backhead, a job which is done exactly as if attaching a cylinder cover to its cylinder. Locate with No. 48 drill, through holes in flange, drill holes in backhead No. 53, and tap 9-B.A. Remove vertical pipe, take out regulator, fit a gasket of 1/64-in. Hallite or similar jointing between flange and backhead, replace regulator and fix with 9-B.A. roundhead brass



Port face and valve



Backhead flange

screws, with a smear of plumbers' jointing on the threads. The vertical steam pipe can then be replaced.

To make the tubeplate flange, chuck a piece of $\frac{3}{4}$-in. round or hexagon rod in the three-jaw, face the end, centre, and drill down for $\frac{5}{8}$ in. depth with 5/32-in. or No. 22 drill. Tap $\frac{3}{16}$ in. × 40 for $\frac{3}{8}$ in. depth. Turn down $\frac{1}{4}$ in. of the outside to $\frac{3}{8}$ in. diameter, and screw $\frac{3}{8}$ in. × 40; reduce a further $\frac{1}{16}$ in. to $\frac{9}{16}$ in. diameter; and part off at $\frac{3}{16}$ in. from the shoulder. Reverse in chuck, and skim the face true. Screw this on to the projecting end of the steam pipe, until the outer threads engage the tapped hole in the tubeplate, and the short section beds well home against it; with a smear of plumbers' jointing on all threads, the lot will be steamtight.

The dome is a simple job, and merely consists of a $\frac{3}{4}$ in. length of $\frac{5}{8}$-in. copper tube with a 1-in. brass washer, 3/32 in. thick, silver-soldered on at $\frac{1}{8}$ in. from the bottom, the top being closed by a brass plug which is a replica of the port block in the regulator, except that it has no ports, and only a tapped hole through it for the screw holding the outer cover, and for oiling purposes as mentioned earlier. After drilling the screwholes, as shown in the plan view, chuck the tube in three-jaw with the flange outwards, and take a skim off the contact face of the flange, to ensure a proper fit against the dome bush. Locate, drill and tap the holes in the latter, like fitting a cylinder cover, put a 1/64-in. Hallite or similar gasket between flange and bush, and attach dome with 9-B.A. brass screws, any heads that you fancy.

The regulator handle, if of the pattern shown, is filed up from a bit of 3/32-in. mild-steel strip, the boss being brazed on. Drill a No. 50 hole in the narrow end; and when turning the grip from a bit of $\frac{1}{8}$-in. rod, leave a pip on the end which will fit the hole tightly, and $\frac{1}{8}$ in. long, so that it can be pushed through and riveted over. If the hole is countersunk, the pip can be riveted in and filed flush, for neatness sake. The hole in the boss is drilled No. 43 or 3/32 in. and punched or filed square to fit the squared part of the regulator rod; but be sure to form the square, so that the handle, when placed on the rod with the valve in the " shut " position, inclines to the right at approximately a 30-deg. angle, otherwise the driver won't know whether steam is on or off. For the " ram's-horn " handle, make a circular boss $\frac{3}{16}$ in. long, similar to the one shown, and screw about an inch of 3/32 in. soft steel or nickel-bronze wire into each side of it, bending into the shape of the horns. When fitting, form the square so that the left horn is up, and the right horn down, about 30 deg. above and below centre, when the valve is shut.

Superheater

The superheater consists of a single element with a simple flange header, a block return bend, and a swan-neck and union for connecting to the vertical steam pipe in the smokebox. To make the header, chuck a piece of $\frac{3}{4}$ in. round or hexagon brass rod in three-jaw, face the end, centre, and drill down to $\frac{1}{4}$ in. depth with 5/32-in. or No. 22 drill. Part off at a full $\frac{5}{16}$ in. from the end. Drill a 5/32-in. hole in the side, breaking into the centre hole, and enlarge the end with No. 13 drill, to take a $\frac{3}{16}$-in. pipe. The three holes for the fixing screws are drilled with No. 41 drill.

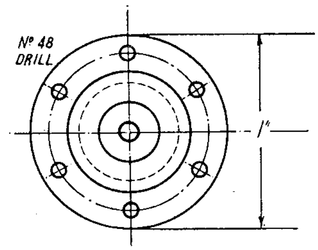
The block bend is made from a piece of copper $\frac{9}{16}$ in. wide, $\frac{5}{16}$ in. thick, and $\frac{1}{2}$ in. long. On one end, make two heavy centrepops, 9/32 in. apart, and with No. 14 drill, make two holes about $\frac{5}{16}$ in. deep, drilling in on the slant, so that the holes break into each other; see section. The block can then be rounded off as shown.

The elements are made from $\frac{3}{16}$-in. by 20-gauge copper tube, the upper one needing a piece approximately $7\frac{3}{4}$ in. long, and the lower one about 10 in. long. Squeeze one end of each into the holes in the block bend, leaving them sprawled out like the letter V for the time being, and braze the joints. *Don't* use silver-solder on this job, as the bend is plenty close to the fire; use either brass wire, or Sifbronze. While the job is hot, heat up the other ends of the elements to dull red; then when the lot is quenched out in the pickle, they will be soft enough to bend easily. Wash off, then bend as shown, after which, the header can be attached to the short bend, and a $\frac{5}{16}$ in. × 32 union nut slipped over the swan neck. Fit a union cone to the end, then silver-solder the two at one heat. Silver-solder is all right at the smokebox end. After pickling, well wash in running water, letting the water run through the complete element, to remove any scaling inside the pipes, and make sure that there is no obstruction, by noting if the water flows freely from the end. When you are sure that all is O.K. insert the element into the flue, and attach the header to the steampipe flange with three 3/32-in. or 7-B.A. screws as shown, putting a 1/64-in. Hallite or similar gasket between the faces. The actual elements for the bigger boilers are made up in much the same way, but there are more of them, with top and bottom headers; see coming instalments.

Tail Lamp

Extract from one of my " tales of the future ":

" Driver Joy, gazing intently through *Queen Mabel's* cab window at the line ahead, heard an excited voice through the telephone loud-speaker exclaim: ' Hooray, girls, she's done it—three miles in the last minute ! ' followed by a burst of feminine cheering, and the strains of the childhood chorus: ' Good luck to our engine-driver.' Joy smiled, and snatched a hasty glance at the speedometer, the needle of which was just quivering on the 180 mark."



Plan of dome

Chorus of the Brethren of the Most Ignoble Order of Aginits:

" Ridiculous ! Impossible ! ! Even if the speed were attained, the train would leave the rails."

From another kind of loud-speaker, comes the voice of a B.B.C. radio announcer: " A French electric locomotive, pulling a train of three coaches, has just attained a speed of 204 miles per hour. . . ."

Ridiculous ? Impossible ? ?

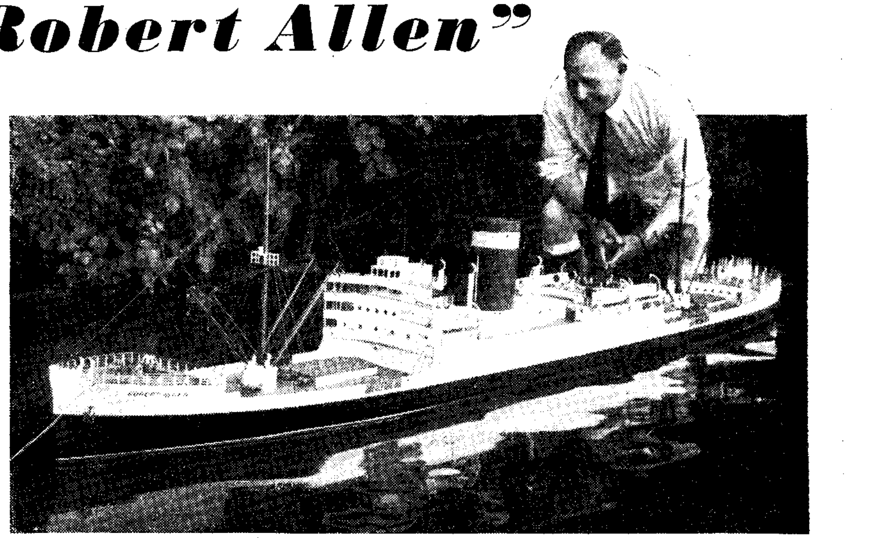
ENQUIRY FROM SWEDEN

Mr. Allan Andersson, Amiralsgat 85.g, Malmö, Sweden, informs us that, at the exhibition to be held at Hälsingborg, from June 6th until August 28th next, he will be running a $3\frac{1}{2}$-in. gauge railway. He would like to know whether any reader owning a $3\frac{1}{2}$-in. gauge locomotive and car would be able to visit Hälsingborg during the run of the exhibition, and run his engine in co-operation with Mr. Andersson. Perhaps the idea will appeal to more than one reader; but anyone interested should write to Mr. Andersson at the address given above.

The S.S. "Robert Allen"

THE STORY OF AN 8-ft. RADIO-CONTROLLED CARGO LINER

By Ivan P. Millar



The completed model of the s.s. "Robert Allen" in the water

IT all started just after the last war at a private view, over a cup of tea, of a 32-in. steam launch just completed by my old friend and collaborator Mr. L. G. Warner (hereafter called Leonard from force of habit over nearly 40 years). After duly admiring the hull and steam plant, I murmured that "I would like to have a go at a boat, too," notwithstanding still painful memories of a boyhood effort when trials in the bath finished with the curtains on fire, methylated spirit burning in patches on walls and ceiling and myself in bed with a burn or two. (Something of the same sort was to happen again, with *Robert Allen*, but that is another story.) But just having finished a "OO"-gauge double electric motor 4-8-4 Delaware and Lackawanna locomotive with all wheels sprung, fluted hinged coupling rods, etc., I fancied something bigger than say a 3- or 4-footer—and said so.

We then agreed that even a 4-ft. steamer was practically invisible at 30 yards on the Round Pound, and there followed those fateful words: "It is probably easier to build a big 'un than a little 'un—so what about 6 ft.? A 6-ft. plank was promptly dragged to the bottom of the garden about 25 yards away to see what it looked like. It seemed to be very small.

"All right, then," we said. "Make it 8 ft. long." And so it came to be.

As to the type of ship (not "boat" any longer) to choose, we heartily agreed that there should not be too much detail but enough to be interesting to look at. Visions of making thousands of ship's lifeboats and millions of ventilators and portholes put away any idea of a Queen, and after ferreting in "Shipping Wonders of the World" chose a typical inland cargo liner of Bracklebank Line. A scale of $\frac{3}{16}$-in. was selected, giving a length of approx. 8 ft., a beam just under 1 ft., one nice big funnel and—only six lifeboats about 4 in. long. She'd not be fast, her movements would be stately and one could at least see her when afloat. Motive power? Steam for a steamer, without a doubt, and we would try to free her from waterside tinkering and make her generally behave herself like a lady.

Leonard said he would "knock out the lines of the hull," and I got busy with plant design, gathering of materials, etc.

Soon after, Leonard dropped in to say in his usual quiet way that he supposed I knew "that the hull would weigh all of 70 lb. and that the ship's displacement would be about $1\frac{1}{2}$ cwt.?" and I confess that for a moment the problems of power, sailing water and transport loomed large. However, I had already found some timber and earmarked the drawing room as a shipbuilders' yard, and just, therefore, could not abandon the project. Besides, we were also both keen to get busy again on something worth while.

About this time we recalled a 2-cyl. $\frac{3}{4}$-in. × $\frac{3}{4}$-in. marine engine, which reposed amongst Leonard's other models in a cabinet, and it was brought out for consideration. At first we were dubious about its small size but after just a little thought it was clear that the size of the cylinders was not the sole criterion so far as power was concerned and, if need be, we could push up the working pressure and r.p.m. to get what we required; mechanically, the engine was sound, but again, when our needs were better understood, we could if necessary improve details. At the worst we could build another engine, somewhat larger and sturdier; but the old one still does its stuff happily after nearly 10 years.

Generally, we intended that the ship as a whole should be as reliable and efficient as possible, carry plenty of fuel, have a boiler with plenty of heating surface, fired not too ferociously by paraffin, be equipped with the proper auxiliaries such as feed pumps, condenser, hot well lubricator, etc., and if possible, automatic burner control as a safety measure in case of engine stoppage. Radio-control was then in its infancy so far as models were concerned, which was a pity, as adaptation, and additions to a pre-conceived design usually bring imperfections in their train. Radio-control was later added, and a very fascinating and rewarding effort it proved to be, especially as it worked in well with the automatic burner control.

Constructional details of hull, machinery, etc., and radio-control gear follow:

Hull

Length (between perpendiculars), 8ft.

Beam, $11\frac{3}{4}$ in.

Draught, (1 in. deeper than scale), $5\frac{1}{8}$ in.

Built of Columbian pine "bread and butter" fashion, cut from planks $1\frac{1}{8}$ in. thick, all parts secured with Croid Aero glue and with $1\frac{1}{2}$ in. No. 4 screws at 4 in. centres.

To ensure that the ship would be symmetrical about the centre-line, free from "wind" and be straight, the selected plank, 12 in. wide × 10 ft. long, which was to be the floor of the ship, was screwed to the prepared top of a sturdy table, and the overhanging ends were supported by 3 ft. × 2 in. × 1 in. battens strutted from and screwed to the floor (of the room), thus enabling "wind" to be taken out by "sighting" and for levels to be preserved in the ordinary way. This plank was then carefully given a centre-line and was marked with principal dimensions and numbered cross lines at 4 in. intervals.

A start was then made with the centre island which is practically flat sided and so forms a box section with the two principal bulkheads. The sides extend about 2 in. beyond the bulkheads to enable the fore and aft laminations to be secured thereto.

Then was erected the curved $\frac{3}{4}$ in. × $\frac{1}{4}$ in. brass stem which had been prepared with two heavy gauge brass plates silver-soldered thereto at such heights that they would lie and be screwed (1) at the floor-level, and (2) between the 4th and 5th laminations of the forepart of the ship. The stem was made some 2½ in. over long and was diagonally strutted to the floor plank during the building of the ship. A second but false post was also erected and strutted astern of the "ship to be" so that a fine piano wire could be stretched down the centre of the ship to act as a guide during erections.

The shaped pieces required to form the fore and aft portions of the ship were cut by hand in pairs (port and starboard), with a bow saw, from the 1⅛-in. planks, carefully dodging knots and watching the grain of the timber to ensure criss-crossing with other pieces. These pieces, which were broad enough to take screws without risk of the points breaking surface, were finished to size and shape by offering them carefully to the ship's lines which had been prepared full size and pinned to the wall. When finished they were in turn glued and screwed in pairs from the "floor" upwards. The pieces forming the fore part of the ship inbutted on to the stem after careful fitting, absorbing the brass plates mentioned above in the process. Similar action was taken with the pieces forming the aft portion of the ship, but in this case the "pairs" were tongued and grooved and butted together with the stretched piano wire as a guide. Butting pairs had in all cases two wriggly nails driven across the joints to pull them together.

The hull now appeared with stepped surfaces inside and out, and it remained to free it from its fixings, turn it over and get to work with chisel, spokeshave, plane and file until the steps were removed, watching always that "flats" did not appear. No steps were cut away from the interior as it was considered not worth while seeing that some 80 lb. or so of bouyancy was available, a "near" mistake if the truth were told.

Then followed the stern post, which was fabricated from ⅝-in. brass channel with suitable fairings, and hole being swaged in the former to receive the ⅝ in. diameter brass stern tube. The stern tube complete with three 1¼ in. long bushes and gland was then inserted in a central slot left in the laminations, and lined up with the propeller shaft and thrust bearing *in situ*. When the shaft was found to spin freely the stern tube was sweated into the stern post by a gas blow-pipe and similarly screwed to a heavy brass plate already screwed down on a bed on one of the internal surfaces of the laminations.

The fin, made up in two pieces of ⅝ in. thick hard wood, was then set into the ⅝-in. channel, one above the stern tube and one below with fairing strips pinned and glued in place. A ⅝ in. × ⅛ in. steel strip was fixed under all, terminating at the stern post with a removable top to enable the rudder to be unshipped.

The hull was now ready for the 18-s.w.g. bulwarks, topsides, etc., all of which were sawn out, as no shears are allowed for any sheet metal work. After the hull has been suitably rebated, the sides were attached by ¾-in. screws. (Incidentally, the edges of all sheet metal were very easily finished with appropriate "sheer" by means of a 4-in. motor plane the blade of which had been turned over to reduce the "top rake.") "OO"-gauge brass rail was used for handrails, being blown on *in situ* with the web horizontal by a gas blow pipe, and then fitted on the upper side with soft solder run in with a soldering iron.

The 18-S.W.G. brass decks, carried on stiff hardwood beams let into the hull sides were cut to fit and pierced for the hatchways. After being screwed down all joints were blown in with a gas blow pipe 1⁄16-in. square copper wire acting as fillets and strengthening the joints. The requisite camber on the decks was formed by heating the cut plates over the domestic cooker until they were practically red hot and then wiping down the centre-line with a really wet cloth, when distortion did the trick. (Beware hot steam !)

A 3/32-in. hard brass wire was sweated along the sheet metal sides at the level of the well deck and continued around the ship, being soldered to the heads of countersunk screws set flush with the surface, where necessary.

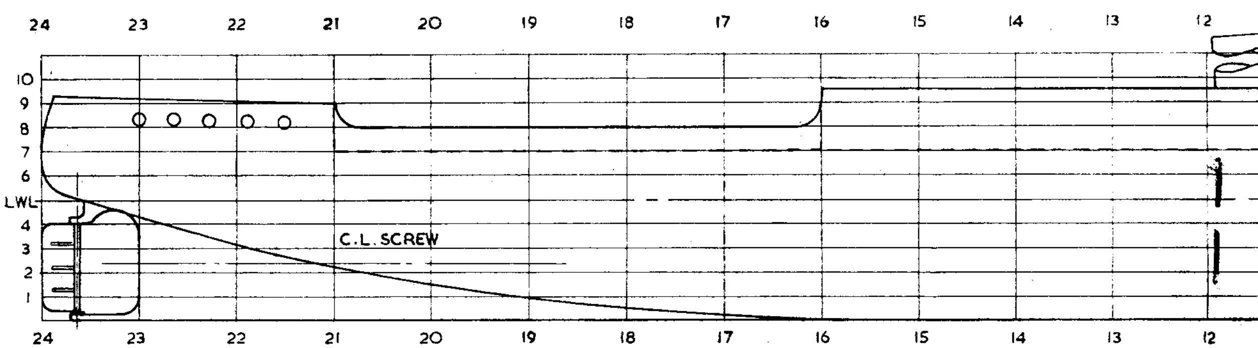
Hatchway openings are framed in 1-in. × 18-S.W.G. brass strip with 1⁄16-in. square copper wire fillets blown in with soft solder, whilst hatchway covers are made from light-gauge hard brass sheet and tin.

The rudder is made from 3⁄16-in. brass plate secured to the ¼-in. diameter phosphor-bronze rudder post by three fork-shaped straps, the whole being sweated together and faired off around the edges. A 1½ in. diameter aluminium grooved pulley is mounted at the top for operation by Bowden wires.

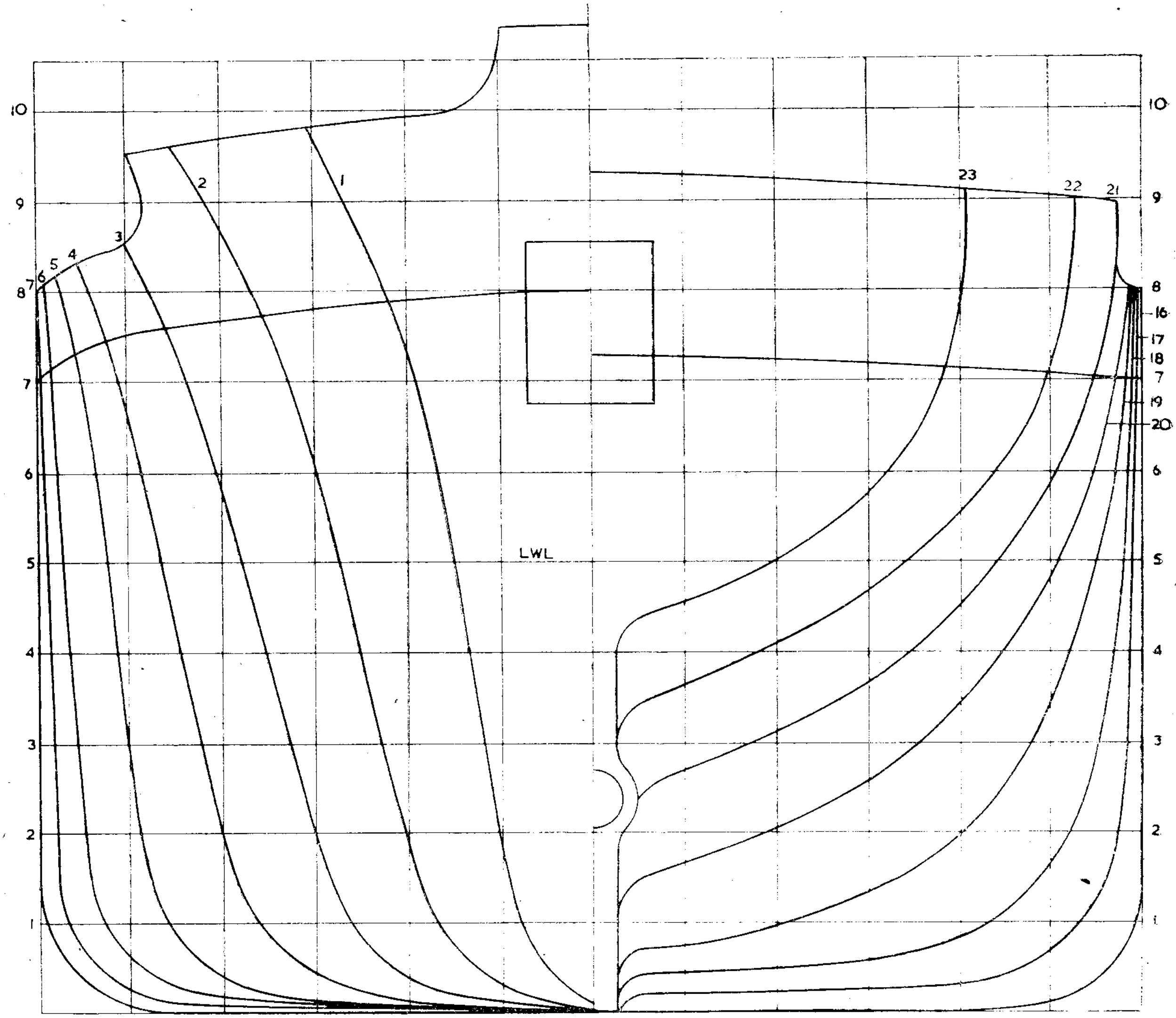
At this stage, the ship was given a good rub down and, after treating the surface with plaster of paris, was given two coats of redlead and goldsize and two coats of white undercoating all rubbed down in turn, in readiness for a first test (after weighing) in an old static water tank near at hand.

For this test the hull was loaded down to her designed draught of 5⅛ in. with slabs of iron and chunks of 3-in. steel shafting on the floor of the ship, each piece being weighed and measured and its exact position in the ship noted. Then, leaving all in place, a 5-lb. mass was set 4 in. above the centre island deck to represent the weight of top hamper. From this we were able to get a good idea of what she would carry in the three compartments and yet leave enough buoyancy overall to allow for final trimming fore and aft, and also satisfy ourselves about the conditions governing stability and the permissible weight which could be carried "up above."

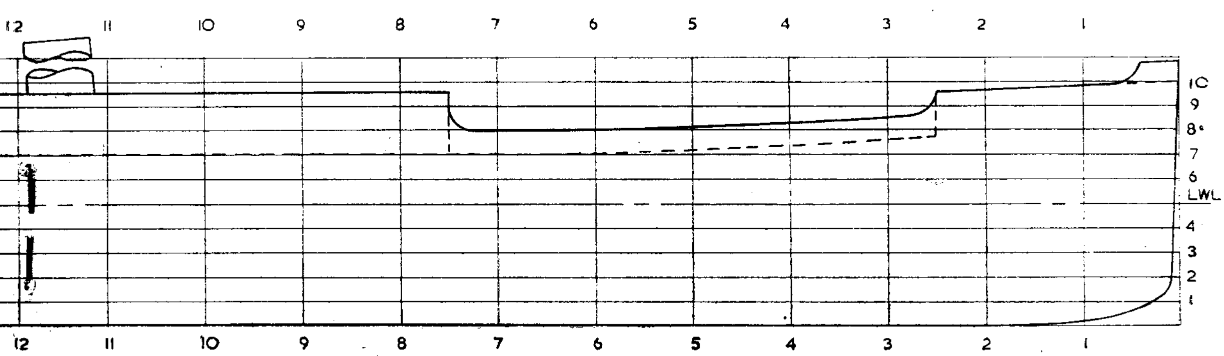
The desire that the ship should have a slow roll meant, of course, that her ability to right herself would be small, but we assured ourselves later on a second test, when the boiler, engine, navigating bridge and masts had been shipped, that she would, without fail, recover herself after being heeled over till water was entering the hatchways. This capacity was retained after a mass of 5 lb. was set on top of the boiler casing.



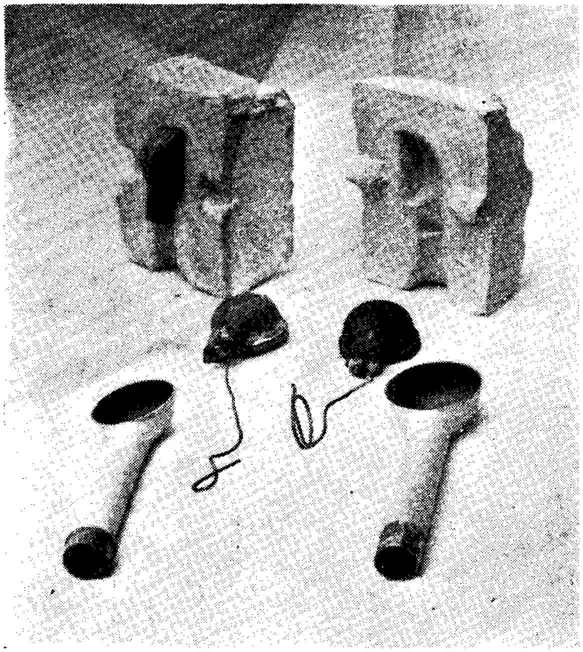
Sheer plan, scale one-eighth size for model. Stations for sections



Body plan, scale half-size for model, each square represents one inch



sections are 4 in. apart and horizontal sections one inch apart



The ventilators; patterns mould and lead castings

they are fitted with dummy engine casings, propellers, rudders and seats. The boats are fixed down on chocks screwed to the decks.

The masts are made from ½-in. copper tube (only material at hand at the time of shortage) as far as the crosstrees which are fabricated from sheet brass and silver-soldered; the upper portions were turned from beech, and are drilled axially for electric wiring to the mast lights. The masts pass through the decks into built-up shoes screwed to the floor of the ship and are firmly held by the stays which were made from rustless stranded steel wire cable fitted with turn-buckles.

The stability of the vessel was later impaired more than expected by the gear carried aloft, not forgetting pounds of paint, and when the radio-control gear was ultimately taken into account, it was decided to lower the boiler by 1⅜ in. "just in case." The effect could not but be beneficial, as the boiler weighs nearly 30 lb.; but in stormy weather she still heels over at speed with the helm hard down.

The final trim down to water-line, after all gear had been fixed and with boiler and fuel tank full, was adjusted by fixing twin ⅜-in. × 14-in. iron bars on the underside of the ship. The bars, apart from acting as ballast, form fenders for the flat tubular condenser which lies between them.

Superstructure, etc.

The navigating bridge, made of 24 and 26-S.W.G. hard brass sweated up with ¼-in. brass angle, is made in two sections, the upper part lifting off to give access to the radio receiver and flag hoisting gear. Two lifeboats are carried on davits on the principal deck. The cabin superstructure over the engine-room is of similar construction and carries the remaining four lifeboats, also on davits. The davits were turned from ¼-in. brass rod, the tapered upper portion being bent to suitable curvature and fitted with blocks and falls. The davits swivel on flanges taking on the deck surface and pass through to the lower deck where they are secured by control screws. The lifeboats were built up from three laminae, fretsawed out to suit the interiors and carved externally to shape with a pen-knife;

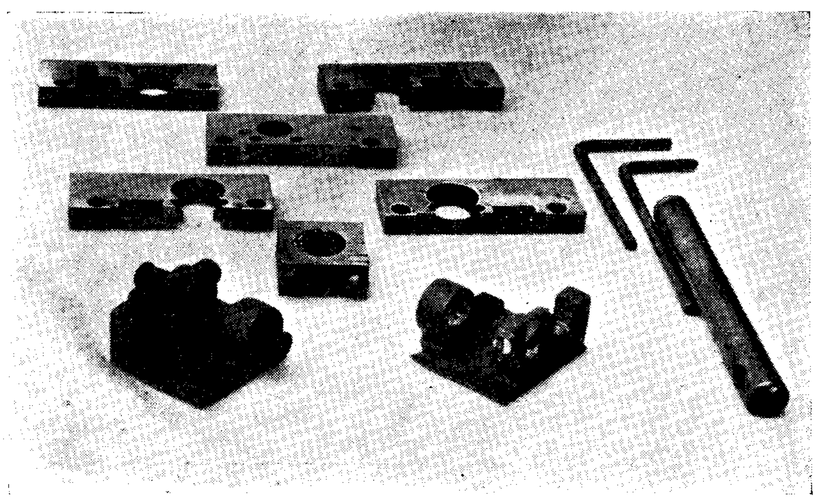
The rest of the rigging, including the funnel stays, is made from fine stranded wire cable used by model aircraft constructors for control-lines. Boom rigging is carried out in very heavy linen thread.

All small blocks were made from boxwood, being drilled and cut by hand. The larger type were made with turned brass pulleys and fitted with skeleton type frames with the requisite hooks, etc.

The mast ladders seemed at first to be a hopeless task, but after all were easily made in the following manner: Along one side of a length of 1-in. square hardwood were set two rows of gimp-pins about ½ in. apart. The space between any one pair of gimp-pins and the next was accurately set by a $\frac{3}{16}$ in. wide gauge as being the distance separating one rung from the next. Two pieces of copper wire (20-S.W.G.) were stretched to take out kinks and placed lengthwise ¼ in. apart between the two rows of pins, being attached to screws at one end and provided with 4-lb. weights at the other. The wooden bar was set at about 45 deg. in the bench vice, and wrapped around with 22-S.W.G. brass wire one turn per pair of pins. These "turns" were then pushed against the pins to separate them uniformly, one from the other. After fluxing, a hot soldering iron was run down the length of the wire, thus uniting the wires at all crossing points, the weights permitting expansion and contraction of the long wires without which buckling would surely have taken place. The "turns" were then cut, thus releasing the ladder which was cut to length and trimmed over by draw-filing after the odd ends had been carefully snipped off. To finish the job, the ladders so formed were laid rungs upwards on a hard surface (not the lathe bed) with a piece of $\frac{3}{16}$-in. steel laid lengthwise thereon, and given a few blows with a small hammer to push the rungs between the longitudinals. A coat of paint thickened up all dimensions somewhat and provided fillets to give a realistic job.

The taffrails are made from "OO"-gauge brass rail carried on stanchions cut from 16-S.W.G. steel welding rod, and also partly sawn through at appropriate intervals in a simple jig, made from ¼-in. square silver-steel and hardened. The stanchions, saw-cuts outwards, were then lightly driven, after tinning, into spaced holes in the brass deck with a tube sleeve gauge over them to ensure uniform height and then sweated in.

(To be continued)



Winches; showing the components of the metal moulds

ROTARY PUMPS AND MOTORS

A PRACTICAL REVIEW OF THEIR DESIGN AND CONSTRUCTION

By "Artificer"

FROM the very earliest days of mechanical development, inventors have attempted to simplify the mode of motion in the working parts of all types of machines, with a view to making them more efficient, and reducing the complication and cost of construction. In the case of the steam engine, for instance, the primitive idea of placing the engine at one end of a beam and the connecting-rod at the other gradually gave place to the direct-acting engine, and at a still later date it was found possible to eliminate heavy and cumbersome reciprocating parts by using simple rotary motion, in the turbine; the development of this form of motive power still proceeds apace, and now embraces both steam and internal combustion engines.

The advantages of rotary over reciprocating motion appear, on the face of it, so obvious that it is not at all surprising that it has been adopted with more or less success in almost every form of mechanism. Innumerable patents have been and still are being filed for rotary machines of all kinds, and of these, pumps and motors are predominant. Considerable ingenuity has been devoted to their design, and nearly all of them are at least potentially capable of operating effectively. But their practical advantages are sometimes outweighed by difficulty or complication of construction and maintenance, and in these devices, as in so many other mechanisms, it often happens that ingenuity is wasted; crude and primitive ideas, if well executed, often give the best results in practice.

Modern progress in production methods and metallurgy, however, have vastly improved the prospects of success of many of these rotary mechanisms, and there is renewed interest in their many applications. So many requests for technical information on rotary pumps and motors have been received by the "M.E." Queries Department, that a general review of the subject appears to be justified.

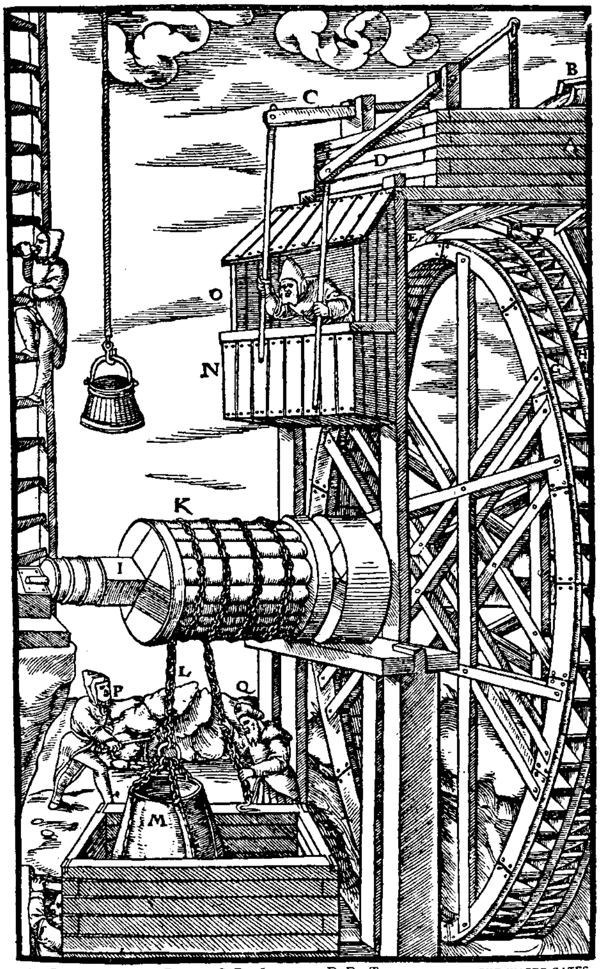
Early History

Long before the dawn of the mechanical age, as we understand it, primitive forms of pumps and motors were employed for irrigation, and also in connection with mining and metal-working industries. The earliest motors, strangely enough, were of the rotary type, such as the water-wheel and the Aelopile, or Hero's steam turbine, though it is doubtful whether the latter was ever used for performing any useful work. A drawing in Agricola's work *De Re Metallica* (1556), showing the working of iron ore, includes a primitive tilt hammer, driven presumably by a water wheel, though this is not actually shown. Another of Agricola's highly informative drawings, however, shows a large double water wheel, for producing rotation in either direction for working a mine hoist (Fig. 1).

Most early pumps, before atmospheric pressure was exploited to produce suction lift, were merely bailers, embodying one or more pots or buckets which were lowered into the water, then lifted to a higher level and emptied into a tank or aqueduct. The best-known example of this device is the Shaduf, which was used in Egypt as early as 1400 B.C. from evidence in tomb paintings, and is still to be seen in everyday use in Oriental countries. This might be regarded as the progenitor of the beam engine, in respect at least of the mode of mechanical operation.

The development of this device into a rotary machine was conceived not later than the Roman era, in the form of the Sakiya, consisting of a chain of pots attached to the rim of a wheel, which was turned by men or animals. The continuous filling and discharge of these pots was an obvious improvement over the intermittent action of the Shaduf, and it was probably the most efficient of the animal-powered appliances of early days. Water power was also applied to driving the chain of pots, and a later modification of the idea was an ingenious undershot water wheel which trapped a certain amount of the water passing through it and carried it up to the top of the wheel, where it was discharged into a trough.

A further development of the chain of pots may be found in the chain pump, which has been extensively used in ships, and for many other purposes. This consisted of a rope or chain running over upper and lower pulleys or sprockets, and having a number of discs of wood, metal or leather, or



A—Reservoir. B—Race. C, D—Levers. E, F—Troughs under the water gates. G, H—Double rows of buckets. I—Axle. K—Larger drum. L—Drawing-chain. M—Bag. N—Hanging cage. O—Man who directs the machine. P, Q—Men emptying bags.

Fig. 1. An early example of the use of water power in industry, from Agricola's "De Re Metallica." (By courtesy of the director of the Science Museum, South Kensington)

balls of rag or tow, attached to it at regular intervals. The upward run of the chain passed through a vertical or oblique tube, in which the discs fitted to act virtually as pistons, which carried water continuously before them and discharged it at the top. This was something better than a bailer, as it was capable of producing a suction lift if the discs fitted closely enough in the tube; but such precision was rarely attained in practice (Fig. 2).

Perhaps the first type of pump which was essentially and necessarily rotary in action was the Archimedean screw, which is believed to have been in use over 200 years B.C. It utilises the principle of the helix expounded by Archimedes, though whether he personally applied it to pumping water is not clear.

In an example of this device in the South Kensington Science Museum, the screw is built up of a number of cross-bars with a hole in the centre, threaded on an iron shaft, and each set at a slight angle to the adjacent one to produce, in effect, a progressive helix. The tube is similarly formed of strips of wood, in this case laid axially and bound with hoop iron; both the tube and screw are heavily coated with tar or pitch to make them waterproof. In the application of this type of pump, it is disposed at an angle of about 30 deg. to the horizontal, with the lower end half submerged in the water and, when rotated in the appropriate direction, the lower convolution of the helix picks up a certain quantity of water, and carries it to the top end, where it is discharged into an aqueduct. This particular example, it is stated, will not work if the inlet end is fully submerged, as it is necessary for air as well as water to enter the tube; but this does not apply to all applications of Archimedean screws.

Another very early form of rotary bailing device was the Roman Tympanum; it would appear that this was regarded as an ancient appliance even when described by Vitruvuis in the first century A.D. This was a hollow drum, mounted on a horizontal shaft, and divided into four chambers by radial partitions. It was partially immersed in water, and when rotated, water entered each chamber through an opening in the circumference, and was raised to the height of the axle, where it was carried away by a pipe or trough.

Improved forms of this device have survived up to modern times, including that designed by De la Faye, in the 18th century in which the radial partitions were replaced by curved ducts which increased the mechanical efficiency. A still later version, by Cavé in the 19th century, employed helical partitions, combining the primitive bailer with the Archimedean screw; several wheels of this type as large as 23 ft. in diameter were made, and when driven at 10 r.p.m., with 4 ft. immersion in the water, are stated to have raised 8,800 gallons of water per minute to a height of 3.28 ft., with a mechanical efficiency of 85 per cent.

Capillary attraction and surface tension of liquids have been employed in primitive pumping appliances, such as by the use of endless ropes of loose-woven yarn, wound on a large drum or over top and bottom pulleys, the lower part being immersed. This principle was employed in the Caruelle elevator band, while the chain-helice elevator used metal chains wound with closely wound wire coils to effect the same purpose; both these devices are of 20th century design and application.

The types of rotary pumps which operate by virtue of kinetic energy imparted to them by mechanical means appear to be a relatively modern innovation. These include the centrifugal pump, the practical application of which as a pump for liquids appears to be scarcely more than 100 years old. Centrifugal fans of a crude type, however, were mentioned by Agricola in the 16th century, in connection with mine ventilation, though their working prin-

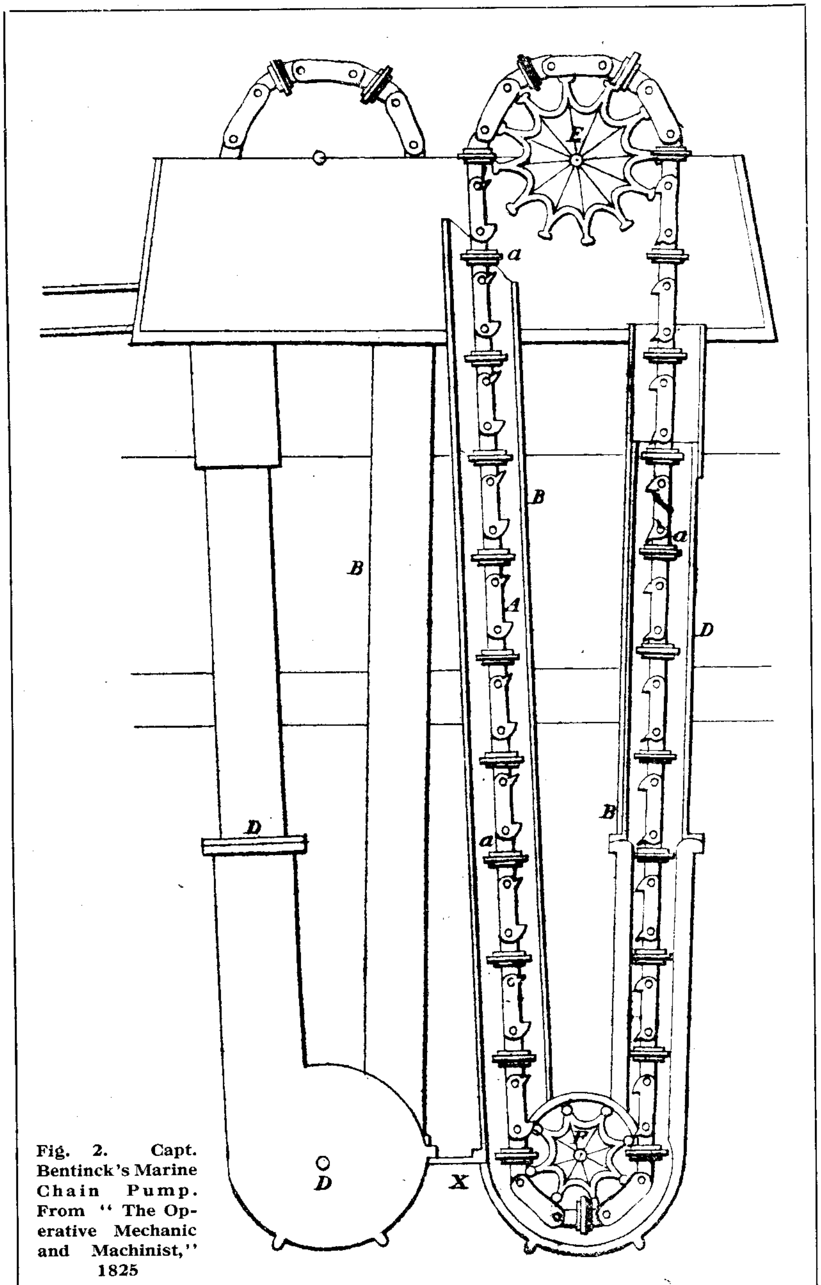


Fig. 2. Capt. Bentinck's Marine Chain Pump. From "The Operative Mechanic and Machinist," 1825

ciples do not seem to have been fully understood, and there is some confusion between these and axial-flow (propeller or windmill) fans. Manual power was used for driving these fans, usually through belt drive or other form of multiplying gear.

Leonardo da Vinci is said to have discovered a form of centrifugal pump for liquids—possibly, however, only as a theoretical conception—but the claim for its practical application is more usually credited to Johann Jordan at the end of the 17th century. Denis Papin, however, at about the same time described a pump which apparently worked on the same principle, known as the Hessian pump. The fact that the centrifugal pump did not come into general use until much later, however, is easily explained by the fact that means to drive it at an efficient speed were not available until the advent of the high-speed rotative steam engine and the electric motor. At present it is perhaps the most widely used of all types of pumps, in sizes from tiny circulating pumps for radio valve cooling to the colossal pumps used for draining dry docks.

Axial-flow or propeller pumps may be regarded as a modern development of the Archimedean screw, but their application is more likely to have been influenced by the success of the marine screw propeller; for pumping against any considerable head or pressure, they are generally much less efficient than centrifugal pumps, but they have been used in preference to this type for low-lift duties, such as fen drainage in Holland, as the power required to drive them varies less when the pressure head is variable. The modern examples of these pumps usually have the propeller located at the throat of a double-tapered flume or venturi tube, and have a large diameter streamlined boss with blades of relatively small radial length, with the object of minimising the variation of velocity and pressure produced at different radii of the blades.

Positive displacement rotary pumps also may generally be regarded as mainly modern in their development and use, but a very interesting early example appears in Ramelli's *Le Diverse et Artificiose* (1588), which differs very little in essentials from modern types of eccentric-rotor sliding-vane types. The illustration (Fig. 3) shows a pump in use, driven by an overshot water wheel, also a spare casing with the rotor and blades *in situ*. Construction was mainly in wood, and it appears that the weight of the blades was relied upon to keep them in contact with the inner circumference of the casing as they revolved.

The same author also described rotary pumps of the cam type, with sliding vanes or rollers, and the gear-wheel type of pump was also known about the same period, but the lack of means for making any such devices accurately must have seriously impaired their practical efficiency.

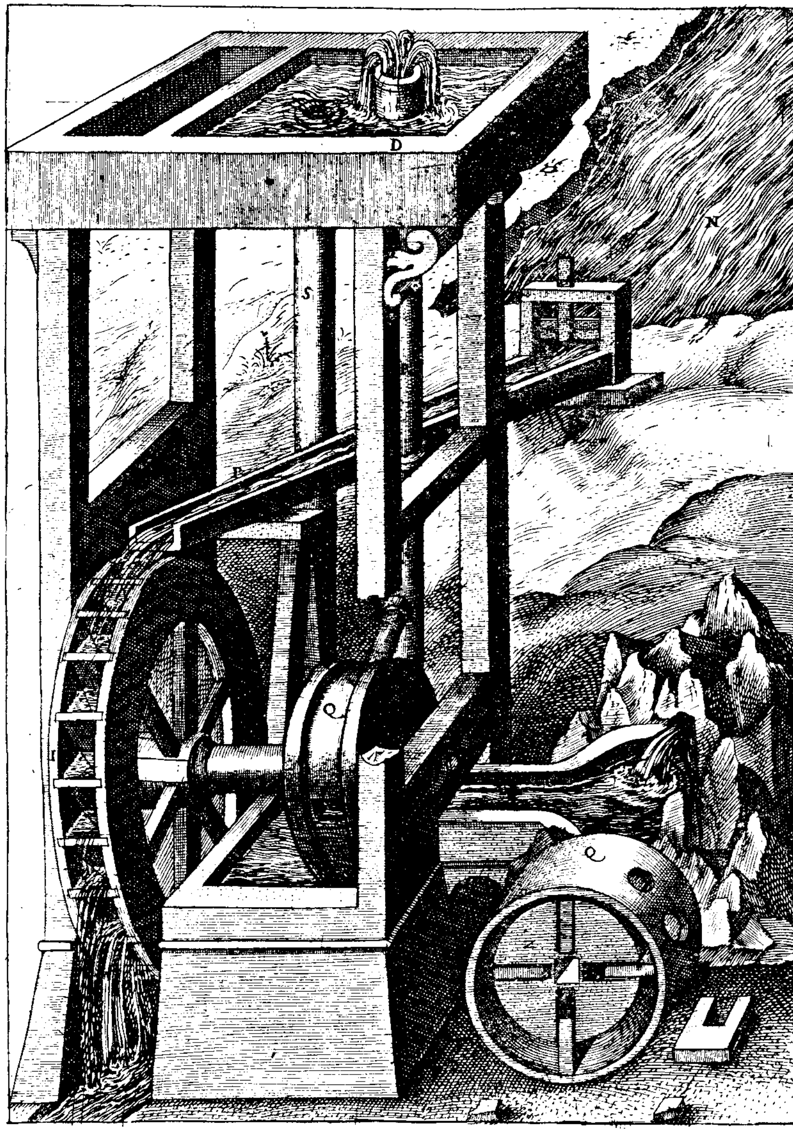


Fig. 3. A primitive form of positive-displacement rotary pump, from Ramelli's "Le Diverse et Artificiose. (By courtesy of the director of the Science Museum, South Kensington)

Modern Rotary Pumps

Having made some attempt to outline the evolution of these devices, it is proposed to follow this up with detailed descriptions of typical modern rotary pumps, with special emphasis on the types which are reversible in function, i.e., applicable for working either as pumps or motors. So much attention has been focussed in recent years on such machines, in the hydraulic and pneumatic operation of guns, aircraft controls, machine tools, and so on, that there is a wide demand for some classified information on their working principles, design and construction.

I have encountered many prevalent fallacies regarding these matters, such as the idea that a centrifugal pump ought to have the concave face of the blade facing forward in the direction of rotation, or that a gear-wheel pump should rotate towards the discharge port at the meshing point of the gears. For these reasons, it is hoped that these articles will serve a useful practical purpose.

It is not proposed to embrace, within the present discourse, such devices as fans, windmills, or turbines for liquids or other working fluids, because, while they might be quite legitimately classed under the same general heading, they are in fact a science unto themselves, and really call for entirely separate treatment. Whether it is possible to deal with them in a later series will depend on the reception accorded to this series of articles.

(*To be continued*)

A Bureau-to-Workshop Conversion

By H. T. Morley

As a tobacconist with a mechanical bent, I had, some time after the war, equipped myself with the various metal-working tools ascribed to the model engineer, i.e., lathe, drilling machine and sundry hand tools, etc., and installed them in a top room of the house. The idea was to work in metal; exactly what to make did not matter. However, the acquiring of a lighter spares agency did much to crystallise my ideas, and before long lighter repairs were the order of the day, or rather night, in my spare time.

For about 18 months, I turned out small bolts, screws, tubes, stems, bushes and various other items, and I began to think I was becoming fairly proficient. I had been aware for some time, however, that a smaller, faster lathe would have been a great advantage for the making of some of the smaller items, and had conceived the idea of a self-contained shop in the sitting room. My wife was agreeable; there is little swarf or mess from the small parts made and since it was to be totally enclosed, the sitting room would not be defaced.

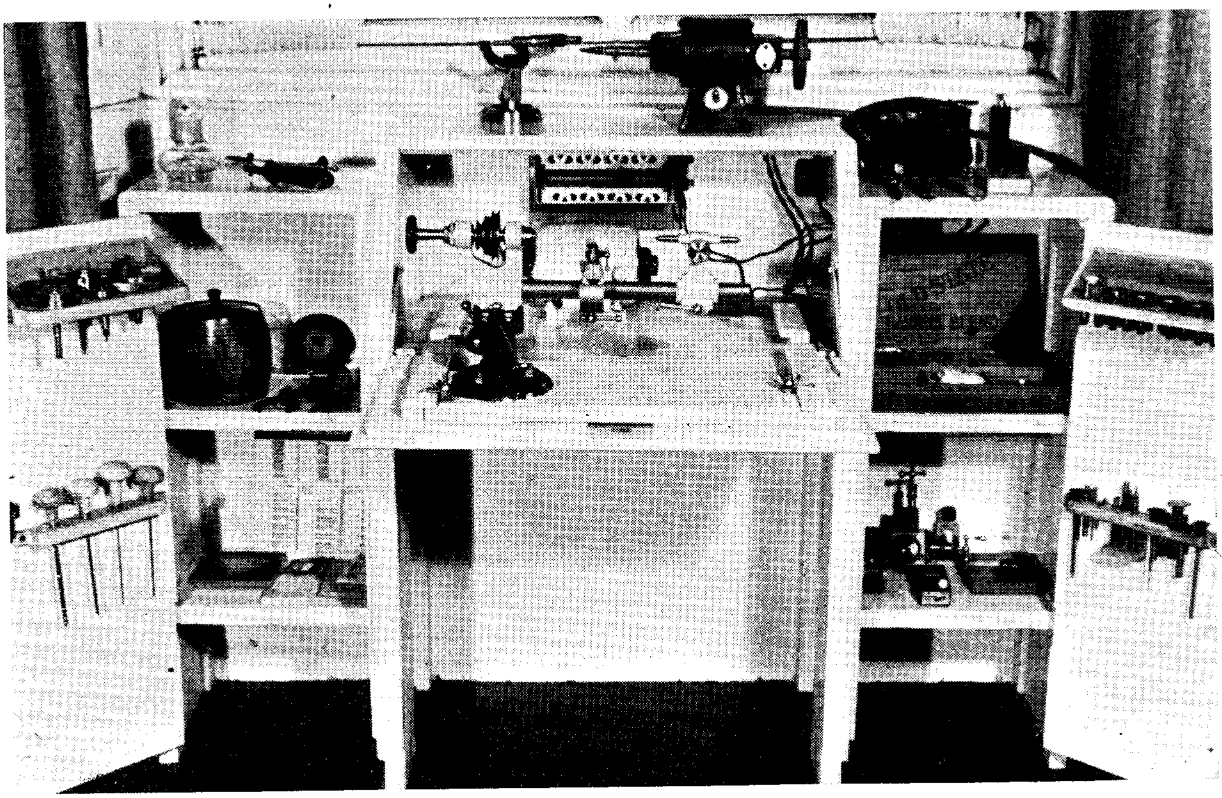
I decided that hand-turning would cover most requirements for this class of work, and I started a quest for a second-hand watch lathe. This appeared to be the only further item required, as my existing equipment was adequate for fitting and soldering.

Briefly, the search took eight months, and ended, following the spotting of an advert in our local paper. This was followed up, the lathe proved to be just what was needed, and the price was right. It was duly bought and taken home for a more thorough examination. For the record, the following details are given:—

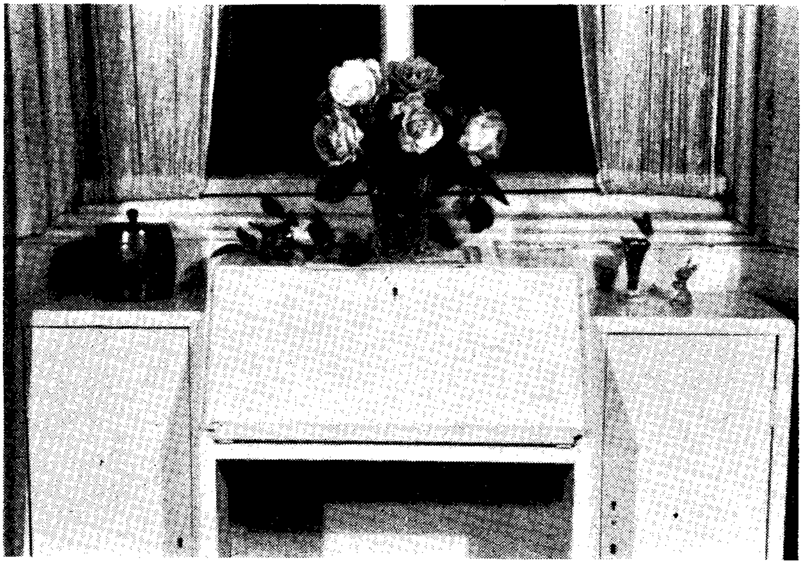
The lathe was an 8 mm. B.T.M. (Boley type) with round bed and flat top guideway, with three-step headstock pulley, the front face of the largest pulley having several rows of holes for dividing purposes, and index plunger fitted to the base of the headstock. Two tailstocks, suitable for using as a pair of watchmaker's turns, one three-jaw chuck with reversible jaws, one screw chuck, several pulley runners, 18 collet chucks, five step chucks, compound slide rest, motor and adjustable resistance control.

When purchased, this array of equipment was indescribably dirty, but, curiously enough, almost entirely free from rust. I spent one complete week of spare time in making it fit for use.

The headstock was, with a little difficulty, dismantled, cleaned, oiled, reassembled and adjusted to run freely. It was noticed at this point that the headstock pulleys were rather nicked around the edge, and slightly rusty on the face of the dividing pulley. Using a "graver," the watchmaker's hand turning tool, and one of the two tee rests, I turned down each pulley slightly to remove the nicks, and used a little fine emery cloth and some thin oil to remove the rust. The result? What



The bureau completely open, showing lathe in working position



The bureau as sitting-room furniture—workshop totally enclosed

almost appeared like a brand new pulley.

The 3-jaw chuck next came in for some attention; it was dismantled, cleaned, oiled and reassembled, and found to run perfectly true. The 18 wire or collet chucks were washed in paraffin, dried and oiled, and their faces polished *in situ* with the lathe running. I noticed at this stage that the collet chucks of most use to me were almost like new, and appeared to have seen very little use.

The compound slide-rest, a precision-made affair, baffled me for some little time before I discovered how to dismantle it. The leadscrews are so fine that it takes several minutes to wind each to its full extremity, which I did, hoping to wind each slide off its screw. It was not until a little while later when I discovered a small round bar with a hole in the end that I realised I had been on the wrong tack. Using a small tommy-bar in the hole, the slides were soon dismantled. I might observe here that when assembled and adjusted, both leadscrews admit of absolutely no back-lash whatever, and that the lead-screw collars are friction set.

This particular item also appeared to be quite new; at least there were no visible signs of use when once it was cleaned up.

At the end of the cleaning-up period, I had the lathe with motor directly behind it, mounted on a piece of mahogany, the whole affair being easily transportable, if a trifle cumbersome.

The collets, chucks and other accessories I mounted on a board made for the purpose and bolted to one side of the baseboard. The lathe was used in this manner for several months.

In the meantime, I was toying with the idea of using the available, but rather shallow window recess in the sitting room; I had almost made up my mind to buy some wood and make a start, when a chance visit to a woodworking friend, and a passing remark, elicited the information that he had an old writing bureau no longer in use ! Upon inspection, this proved to be a very useful find, and was duly purchased. To adapt it to my purpose proved simple enough, but for one major snag: it was a foot too tall to fit the recess and still allow the shutters to close. To avoid domestic upset, twelve inches was sawn off the bottom, after which there was no further trouble in installation.

The next item was to remove the two doors from the centre portion, leaving the space thus obtained, as a knee-hole. The two doors were then adjusted for size and hinged to fit either side of the recess, providing, by so doing, a small shelved cupboard either side. Adapting the flap-down portion to take the lathe was a simple enough job, but some method of clamping the lathe in working position was necessary. This was achieved in three stages :—

(*a*) The motor and resistance were bolted down as far back as I could manage, and in easy access for control;

(*b*) The lathe was bolted to a wooden base, somewhat longer overall than the lathe; and

(*c*) Two wooden guides were made, with an undercut portion which enabled the lathe to move back and forth without being raised. At the end of each guide (nearest the operator), I have fitted an ordinary brass latch hook, which engages with a bolt standing proud at each end of the wooden lathe base, and is clamped tight by a wing-cut on each bolt.

The on/off switch is fitted inside the right-hand cupboard screwed to the underside of the top surface. This is very convenient (being reached from normal sitting position) and also not in the way of items on the shelves.

Provision is made for a small light and a soldering iron to be plugged in on the inside of the well which houses the lathe.

Setting up the lathe for duty is the work of a moment. Simply open the drop-down position flap, pull the lathe along the guides to the distance determined by the length of belt and situation of the holding latches and tighten down.

The racks on the inside of each door are made specifically to accommodate every accessory for the lathe except the compound slide rest.

The cigar box in the upper right-hand shelf contains a varied assortment of odd parts taken from old or dismantled foreign lighters, spares for which are unobtainable in this country.

When closed, the bureau forms a not unattractive addition to the sitting-room, as can be seen from the accompanying photograph. Both doors and the flap-down portion are provided with locks, since the younger members of the family, in common with all other children, have boundless curiosity and inquisitive fingers.

Next Week . . .

MODELS OF INDUSTRIAL PLANT

A description of some interesting scale models used to illustrate and demonstrate the working of factory machinery.

A WORKSHOP ENGINE

" Duplex " describes an interesting home-built engine which supplied power to workshop machine tools for several years.

COIL WINDING

A simple counter attachment to the lathe for use in winding coils for electrical apparatus.

PETROL ENGINES

The design and construction of a special carburettor for the general-purpose 10 c.c. four-stroke.

A CAMERA TRIPOD

Constructional details of a robust telescopic tripod, complete with pan and tilt-head.

" NETTA "

It is now time for the regulator and super-heater for the 3½-in. gauge engine to be dealt with; so the full drawings and instructions will be given.

QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London. W.1.

Lamp for Steam Boiler

Can you give me particulars of a reliable spirit lamp suitable for model steam boats of about 2 ft. 6 in. in length? I wish to make a lamp of the blow torch type, but with two or three jets, and shallow enough to fit in a space 3 in. high. The wick type of lamp does not supply sufficient heat for my purpose, and is not easy to keep steady in windy conditions.

L.G.D. (Bexhill).

We note that you specify the use of spirit for these lamps, but lamps of the blow torch type generally operate on petrol or paraffin. We do not understand why you wish to use two or three nozzles, as this very much complicates the design of the burner, and the majority of successful blowlamps used in boats, except those of extremely high power, have single nozzles. For a multiple-jet burner, it would be necessary to use nozzles of extremely small diameter unless the burner was of very large size, with equivalent fuel consumption. It may be, however, that you are referring, not to the jets themselves, but to the flame apertures in the burner, as it is quite possible to use a burner having a large number of flame apertures but only a single jet.

Several suitable lamps have been described in THE MODEL ENGINEER, including a simple vaporising burner (blow torch type) described in the July 8th, 1954, issue and a diffused flame vaporising burner appearing in the July 22nd, 1954, issue.

Our handbook *Flash Steam* contains a chapter on burners and would probably be found extremely helpful to you. This can be obtained from our Publishing Department price 3s. 6d.

Flash Steam

I have seen frequent references to "flash steam" in THE MODEL ENGINEER *and other publications. Will you please give me an exact definition of flash steam, how it is produced and for what purposes it is used.*

J.S. (Liverpool).

The term "flash steam" is used to denote steam which is generated practically instantaneously in a boiler consisting almost or completely of a single length of tube, which is coiled or otherwise disposed so as to form a highly efficient heating surface. Flash steam is used for the propulsion of many types of light steam plant, its chief advantages being the rapidity with which it can be brought into action, and also the relatively low weight for a given steam generating capacity.

Our handbook *Flash Steam*, price 3s. 6d., gives fully detailed descriptions of many types of flash steam plants, including boilers, burners and engines, and also their application to model racing boats and other purposes.

Adapting a Bench Grinder

I am proposing to adapt a small casting similar to the contershaft head of a small lathe, for the purpose of converting it to a double-ended bench grinder. It is proposed to use two 4-in. dia. carborundum wheels, one fine and the other medium, and the spindle will be driven by pulley from a $\frac{1}{8}$ h.p. motor running at 1,425 r.p.m. Please inform me if there are any practical difficulties in this idea and also advise of the safe working speed for the grinder. Can you also advise me of the most suitable mean speed for a $\frac{1}{4}$-in. three-speed sensitive bench drill?

F.S.C. (Crewe).

This scheme would appear to be quite practicable, provided that the bearings are adequate to stand up to the load and speed, and are kept well lubricated. As the device will presumably be for only intermittent use, this should not present any very great difficulty. For use with a 4-in. dia. carborundum wheel, a speed of about 4,000 r.p.m. is suitable, but this may need to be varied to some extent to suit the grade of wheels employed.

The mean speed for a 3-speed $\frac{1}{4}$-in. bench drill should be about 2,000 r.p.m. This will give a range of speed suitable for drills from abut $\frac{1}{16}$ in. to $\frac{1}{4}$ in., but lower speeds are desirable for counterboring and countersinking.

Who's Who IN MODEL ENGINEERING

G. W. ALLINSON

As the indefatigable hon. secretary of the Newbury Model Engineering Society, G. W. Allinson is known to many model engineers in the southern counties; he is, however, known to a wider public by virtue of his profession as an artist. One of his pictures was in the Royal Academy exhibition in 1936, and his work in oils and water-colours is admirable in every way. His sketches in black and white are usually humorous and have been published in nearly all the journals that accept such work; *Punch* has published some of his work.

While he possesses a very well-equipped workshop, in addition to his studio, at his home, he devotes a great deal of his time in it to indulging his hobby of woodwork; but he says: "Although I do not make the intricate mechanical wonders that I admire, I do make my lathes turn out mundane things like tailstock dial-holders, and I find great satisfaction in making and repairing equipment used in a neighbouring turnery. It is satisfying to make something that will probably be used for several generations, like a draughtsman's stool made to measure for someone like our J.N.M. . . . It is pleasant to dabble in metal and to work in wood; it is all grist to the lively experiences that make life so good. To fashion one's life with the ruthless and loving care of a craftsman; *that* is, or should be, the great aim of all those who dive into sheds and muck about with wayward materials."

This is typical of G.W.A., who saw service in France in the 1914-18 war and emerged, badly wounded and only just alive, from the battle of the Somme. A very serious operation saved his life, and he is very much alive now. Our illustration is taken from a recent, beautifully executed, but entirely impromtu, self-portrait in water-colour.

A Showman's Engine and a Roller

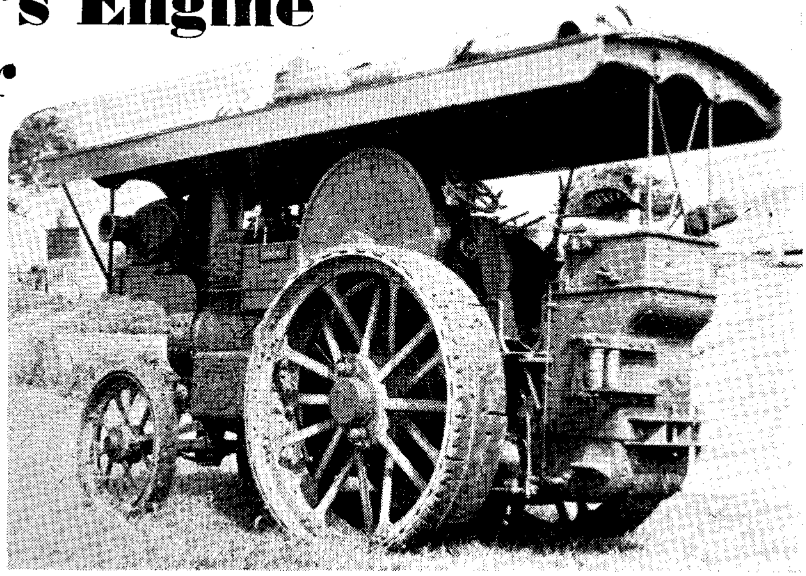
By Arnold Throp

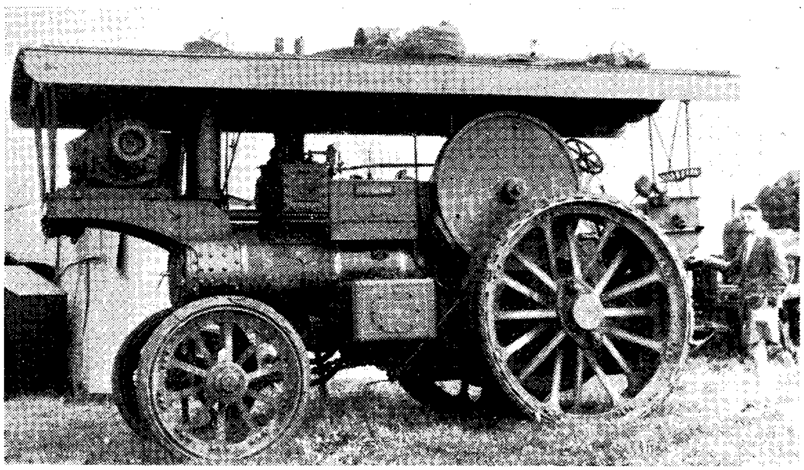
MANY examples of steam road locomotives of one type and another still in service have been recorded in THE MODEL ENGINEER, in recent times; but I have noticed no mention of an engine that was seen at the village of Winster, in Derbyshire, with the usual fair accessories, on Sunday June 29th, 1952, when it was photographed by me. The fire was out but the engine had apparently been in steam the previous day. There was no one about to discuss the engine. No owner's name could be found on the engine, but the Burrell nameplate showed the maker's number 3473, though no date of construction appeared. There was also a nameplate *Sarah*, and the weight was given as 11 tons 17½ cwt. The size of the engine can be judged by the boy in one of the photographs; he was six feet tall.

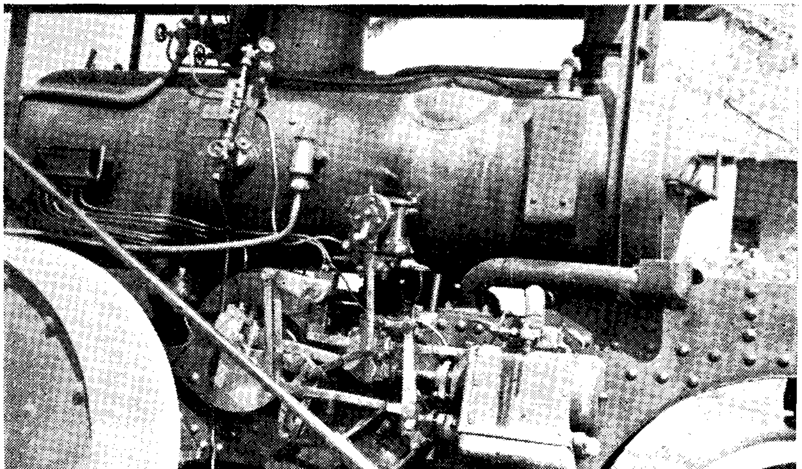
The engine seemed in very good condition so far as paintwork was concerned, but did not possess the amount of showy brasswork which many of these engines had. Exactly a year later, I happened to pass through Winster again and the engine was standing in the same spot. The paint had suffered in the intervening time by weathering and wear and tear.

The other photograph may also be of interest. It was taken in Switzerland in June, 1949, when visiting a new housing estate of the famous engineering firm Brown, Boveri. This road roller was levelling the roads of the estate. As it was necessary for me to keep up with the rest of the party, I had to take a very hurried snap and rush on without obtaining the details which a few minutes stay could have allowed. There were some rather unusual features of this machine, evidently of Continental make.

First, the cylinders are not mounted on top of the boiler, but below it, and had flat valves underneath the cylinders. The valve gear was of the Walschaerts pattern, but whether the engine was compound or had two single cylinders I did not have time to find out. The water gauge for the boiler is in an unusual position, well along the barrel, and is of the reflex type and not the ordinary glass tube. It shows up in the photograph just below the dome with which the boiler is fitted, another unusual feature. I cannot say what was the purpose of the large pipe coming out to the front over the cylinder, but it may be a filling pipe for a water tank between the frames.







READERS' LETTERS

Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

SILENCING MODEL POWER BOATS

DEAR SIR,—At the regatta to be held at St. Albans on June 5th, rule 14 of the M.P.B.A.: "All racing craft, petrol and steam, shall be fitted with efficient silencers, and other boats where necessary" will be strictly observed.

The "St. Albans Speed Trophy" kindly presented to the society by Mr. and Mrs. F. Hyder will be contested for the first time at this regatta. It will be awarded to the competitor whose boat puts up the fastest speed of the day irrespective of class; winner receives Trophy and replica, Trophy being held for a year.

Yours faithfully,

Redbaurn. P. LAMBERT.

HOT AIR ENGINES

DEAR SIR,—My attention has been drawn to the first two paragraphs entitled "Hot Air Engines" under the heading "Smoke Rings," on page 405 of THE MODEL ENGINEER for April 14th, 1955. The publicity about this museum, which you give from time to time, is appreciated but you will agree, I am sure, that for the benefit of all interested persons, the information published by your journal should be accurate.

Your paragraphs were no doubt, based on a letter written to you by Dr. C. St. C. Davison, an assistant keeper in my department, who stated that the seven hot-air engines and one drawing are represented in the National Collections. They are not all on view at the museum as stated in your paragraph. It is not possible under present conditions to exhibit the models of the Cayley type and of Rider's hot air engines and the Lowne's atmospheric engine, owing to lack of space in the appropriate gallery, so they are preserved in store.

The model of Bailey's hot air engine is based on LAUBEREAU'S patent, not as spelt in your paragraph. In your list you have omitted Robinson's hot air engine, which is included in Dr. Davison's letter and is on exhibiton here.

You also refer to this institution as the South Kensington Museum in spite of the fact that it became the Science Museum as far back as 1909 when the science collections and art collections were divided, the latter being transferred to the Victoria and Albert Museum. As there are five National Museums in South Kensington, you will agree, I am sure, that this institution should be specified as the Science Museum, and for the benefit of your readers who live abroad or in remote parts of this country, it would assist them when visiting London if you quoted Exhibition Road, S.W.7.

Yours faithfully,

A. STOWERS,

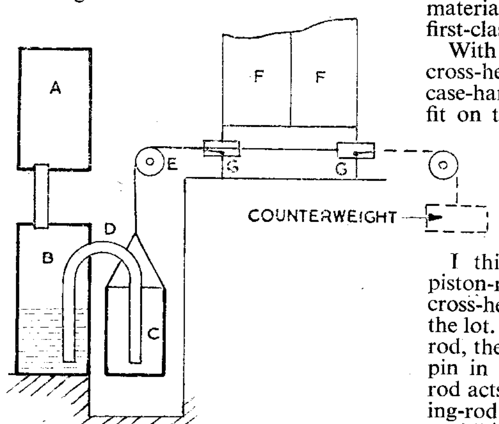
Keeper, Department of Motive Power and Industries, Science Museum.

DEAR SIR,—I have seen in a recent issue of THE MODEL ENGINEER that the Science Museum Authorities are seeking information on hot-air engines, and that you have undertaken to pass on to them any information that may be useful in this connection.

I cannot remember having seen at any time at the museum any reference to the hot air engines of Hero of Alexandria, who is chiefly remembered for his steam turbine.

Hero describes two forms of a hot air engine to work on a closed cycle, which was intended to open the doors of a temple after a fire had been kindled on an altar.

A rough sketch of one type of the engine is reproduced herewith. A is a closed vessel, the altar, communicating with a second closed vessel B, which is partly filled with water. A bent syphon D leads from B into a bucket C, which is suspended by a chain running over a pulley E and joined to two chains which are taken to the door pivots, wound round them in opposite directions and fastened at their ends to the pivots in such a way that when the main chain is pulled the two valves of the door will swing open. A similar gear but acting in the opposite direction, and controlled by a counterweight, keeps the doors closed when the engine is not working.



The fire having been started on the altar A, the air within A is heated and expands, raising the pressure in B (which I think corresponds to the working cylinder of the usual type of engine), and so driving out some of the water in B through the syphon D into the bucket C, till the bucket becomes heavy enough to overcome the counterweight and pull down the chain. When the bucket touches the ground the doors will be fully open. When the altar fire is extinguished the air will cool and contract so that the water which has passed into the bucket C will be passed back into B through the syphon D. The counterweight will then draw up the lightened bucket and close the doors.

The Greek text of Hero's "Pneumatica" is in "Veteres Mathematici" (Thevenot, Paris, 1693). No doubt there is a copy of this work in the Science Library. The hot air engines are described on page 191 line 19 to page 193 line 16. I have a copy of this book and have worked on translating the "Pneumatica." There is, however, a translation which was made for Bennet Woodcraft (London, 1851).

It seems to me that this engine is of interest, as it is so much older than Amonton's wheel (the oldest item in the museum in this class of machine). Hero's date is, I believe, somewhat uncertain but he may be placed roughly in the first century, so that hot air engines are of respectable antiquity. Hero was well acquainted with cylinders and pistons, but did not employ them in his steam or air engines.

Yours faithfully,

London, S.W.1. JOHN M. DIMOND.

CROSS-HEAD FIXINGS

DEAR SIR,—I have followed the recent correspondence on the above subject, and all the locomotives built by my father and me have this cross-pin method of fixing, and we have had no trouble yet; the first locomotive built by my father was made in the 1920s.

Speaking from my experience of 25 years in engineering, many of them in the toolroom, I think it is just a matter of the correct proportions, materials and, most important of all, first-class workmanship.

With an accurately bored or reamed cross-head of mild-steel, and preferably case-hardened, too, a good "knock-on" fit on to the piston-rod with the shaft end of a hammer, or a brass drift, and secured with a pin made of silver-steel or high tensile steel, accurately fitted, there should be no trouble at all.

I think the trouble arises when a piston-rod becomes a little bit loose in a cross-head and relies on the pin to do the lot. If there is any play in the piston rod, the cross-pin works like a gudgeon-pin in a petrol engine, and the piston rod acts like the small end of a connecting-rod; then, of course, the looseness rapidly gets worse.

However, I think the whole subject has been very much exaggerated and I will explain why I think so.

My father and I have a portable track which we take to various local functions; it is raised on trestles, and according to the lie of the land it is laid on, it is usually very "up and down," sometimes a matter of quite a few inches. Also, in the manner of such tracks, it is grossly neglected, distorted with age, and ill-treatment, and mostly rusty as well. The locomotive we use as a rule is a 6-in. gauge "Ivatt" G.N.R. Atlantic, built by a model engineer in Lincolnshire. It has built-up cross-heads; the portion the piston-rod fits into is gunmetal which, in my opinion, is too soft. With having the pistons out for packing at regular periods, there is an easy fit between the piston-rod and the cross-head, the pin is a taper pin of about $\frac{1}{8}$ in. dia. When we arrived at the last outing of last season, we were horrified to find no pin in one of the cross-heads; it must have dropped off on the way for it was most certainly in the last time we used the engine. As we were several miles from home, something had to be done in a hurry. Our kit comprised a pair of pliers, a few spanners, a file without a handle and the coal hammer, but, of course, no spare pin!

However, Mr. Kirk of the Leicester S.M.E. came to the rescue. He found an old nail, it was too small for the hole and "dropped" in it, so he hammered it roughly square on the rail track with the coal hammer, so that when fitted to the cross-head it touched in four places, and just held. Half an inch or so was left sticking out so that we could see it when running, and we felt it every trip to see if it still held tight. With 90-95 lb. "on the clock" the engine ran for some hours on a very rough and "hilly" track, pulling the usual loads.

If a badly fitting wire nail will stand up to this sort of work on an engine weighing the best part of 2 cwt., I think that the possibility of cross-head pins shearing has been overestimated.

Yours faithfully,

Leicester. R. TAYLOR.

"IN PRAISE OF STEAM"

DEAR SIR,—I should like to add a few words to the letter published in THE MODEL ENGINEER of April 21st from "Semper Fidelis." No one could be a more ardent admirer and lover of the steam locomotive than myself, but nothing is more certain than that this form of motive power will, in due course, become obsolete. I think it unlikely, however, that this will take place within the 15 years suggested by the "Powers that be."

What does seem alarming is that we should be told that we are going to have electrification in certain areas, diesel services in other sections, and possibly gas-turbines will not be ruled out. I should have thought that with the approaching atomic age and the construction of power stations envisaged, total electrification should be considered.

All systems should be operated by the same voltage so that all motive power units are interchangeable. We should not fall deeper into the trap which already exists, whereby several different systems, a.c., d.c., high voltage and low voltage are used, which is the very pitfall which occurred in the electrical industry in the early days, and is a parallel to the "battle of the gauges."

Extensive building of diesel power units is being put in hand for main work to replace steam locomotives (each costing $2\frac{1}{2}$ to 3 times the amount required for a steam locomotive) and these units will be diverted to other sections as and when electrification takes place in the region concerned.

Surely, is not the practical and economic solution to retain the steam locomotives until the changeover takes place, when we can use energy derived from nuclear power stations? This, in my opinion, is in the foreseeable future.

As to the remarks about the Southern Region, regarding open circuiting due to ice on the third rail, this would be avoided with the high-voltage overhead system.

Yours faithfully,

London, N.W.11. G. M. CASHMORE.

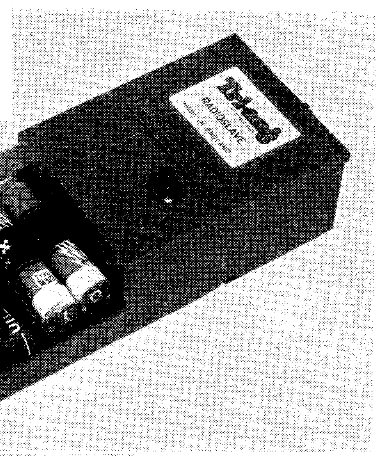
A NEW RADIO-CONTROLLED UNIT

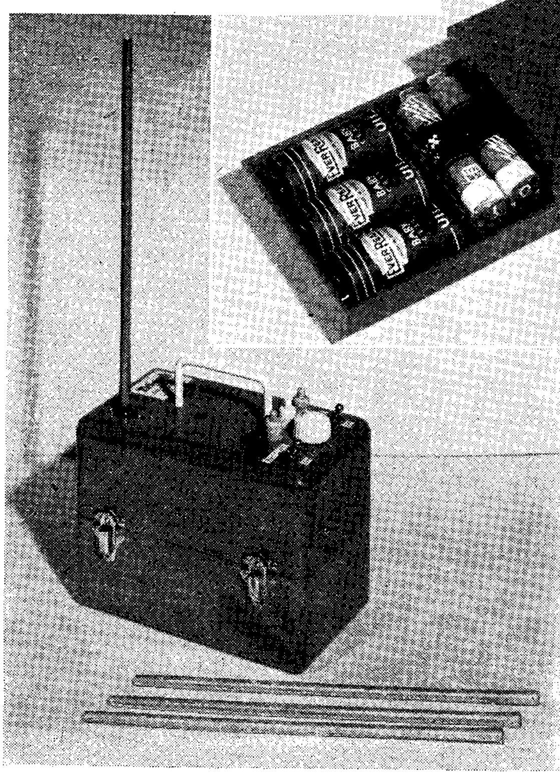
THE latest of the manufacturers to enter the radio-control field is Lines Bros. who are now marketing a complete ready-to-go model cargo boat (which includes transmitter, receiver unit and working model, complete), and intend supplying their standard individual radio components separately.

The transmitter operates on the standard 27 megacycle band and is designed to emit either an unmodulated carrier wave or a pulsed carrier wave in which both the mark-space ratio and the pulse rate can be varied. The unmodulated carrier can be used for operating normal sequence controls whilst the pulsed carrier signal is adaptable to "progressive" control systems.

The receiver incorporates a Mullard DL 68 sub-miniature "hard" valve and a double-pole twin-armature relay,

Right: The complete receiver, power pack and servo-motor unit. Below: The self-contained transmitter





the latter being adjustable for separate operation, if required. The complete receiver-servo mechanism unit, as installed in the cargo boat, is marketed as a unit, called the *Radioslave* and thus provides a "ready-made" installation for fitting into power boats, model cars, etc., using either sequence or progressive controls.